

Evaluation and Improvement of Traffic Operation for Al-Zeoat Intersection in Al-Ramadi City

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Abstract.

The increase in traffic volumes at intersections is one of the important problems that makes difficulties in the traffic movement then leads to traffic congestion in these facilities. The objective of the present study is improvement the traffic operation of the selected intersection (Al-Zeoat intersection) in Al-Ramadi city by analysis and evaluation this intersection and using accepted solutions to improve the traffic operation of Al-Zeoat intersection under local exist conditions and present a best proposal to enhance the performance at the intersection.

To achieve these objectives, the traffic volumes data collection and geometric layout for Al-Zeoat intersection that required for the traffic and geometrical analysis were gathered manually, while SIDRA traffic program is used for the requirements of traffic analysis process.

Keywords: Traffic Operation, Capacity, Level of Service (LOS), Delay, Signalized intersection.

1. Introduction.

Traffic congestion is a major problem in cities of all sizes. It's a condition on any intersection as use increases and is characterized by slower speeds, longer trip times, and increased queuing [1].

Intersection is one of the most complex locations in a traffic system; intersection analysis must consider a wide variety of prevailing conditions, including the amount and distribution of traffic movement, traffic composition, geometric characteristics and the details of intersection [2].

The concept of capacity, level of service and delay are central to the analysis of intersections, as they are for all types of facilities, therefore that both capacity and level of service must be fully considered to evaluate the overall traffic operation of the intersections [3] . While The delay is one of problems that occur in any facility of traffic.

Al-Zeoat intersection in AL-Ramadi city is an important congested intersection due to its critical location on major streets. This intersection has the following characteristics

1. It has a very high traffic volume in two approaches.
2. It is located on Major Street which intersect with two minor streets.
3. Many activities are located around this intersection.

Form Existing condition, it is obvious that this intersection work under or close to saturated condition. To solve the problem at Al-Zeoat intersection, a flyover must be adopted to reduce the number of vehicles at ground level and increase the capacity of intersection.

2. Study Area.

Al-Zeoat intersection is a congested intersection located in the centre of Al-Ramadi city. Al-Zeoat intersection is consist from four major street:

1. Al-Mohafadha Street.
2. Al-Mahkama Street.
3. 17-July Street.
4. Al-Mearadh Street.

Al-Zeoat intersection is a significant locations and highly traffic volume can be related to:

1. Al-Zeoat intersection located in an important location. It connects between main directions from Al-Mohafadha Street toward Al-Mahkama Street.

2. The existing of different public activities near Al-Zeoat intersection. These activities results a high traffic volume and lead to create a high delay especially at peak hour.

For this study, the area of improvement includes the intersection with its approaches. **Fig. (1)** shows a satellite image for Al-Zeoat intersection and the boundary of the study area (Google Earth 19 April 2004).

3. Objectives Of The Study.

The main objectives of this study are:

1. Specify the peak hour volume at Al-Zeoat intersection and the distribution of traffic volume at peak hour.
2. Calculate the peak hour factor (PHF) for all approaches at Al-Zeoat intersection.
3. Evaluate the existing level of service (LOS) at the intersection under study.
4. Evaluate all proposals, which can be solved the problem of congestion at Al-Zeoat intersection and calculated the level of service for each proposal.
5. Select the best proposal that solving the congestion problem and providing a good performance within the design period.

4. Data Collection.

4.1 Traffic volume.

Estimate the traffic volume at the intersection, by counting the hourly traffic volume at Al-Zeoat intersection from (7:30 a.m up to 5:00 p.m) the workday of the week from (10 April to 20 April) 2008. This survey aims to find the peak hour volume, which represent the design hourly volume.

The type of vehicles are classified into two types, they are:

- Passenger car: all vehicles, which have four tires only.
- Heavy vehicles: all vehicles, which have more than four tires.

The heavy vehicles were converted to passenger car by using a passenger car factor equal to (2.0).

The volume for peak hour represents the design hour volume, which will be used in the analysis of this study. **table (1)** shows the traffic account at Al-Zeoat intersection for (15) min period form 7:30 a.m up to 5:00 p.m while **table (2)** shows the total volume for all approaches each (15) min.

4.2 Saturation flow.

To calculate the saturation flow at stop line for Al-Zeoat intersection, Webster method was used for this purpose because there are many problems in site which has an effect on saturation flow. **table (3)** shows the calculated saturation flow at stop line for all approaches at Al-Zeoat intersection.

4.3 Existing geometric design.

The evaluating of existing level of service needs to specify the number of lanes in addition to the direction of each movement. **Fig. (2)** shows Existing geometric layout for Al-Zeoat intersection.

5. Analysis And Results.

5.1 Peak hour volume.

By using Excel program, the traffic account shown in **table (1)** was analyzed to specify the peak hour. Form site investigation and traffic account, the following conclusions were observed:

- a. It was found that the peak hour is limited between 3:00 PM and 4:00 PM. The total volume during this hour is (4665) pc/h.
- b. The maximum traffic volume is concentrated in the approach coming from the Al-MohafadhaSt.; this volume is (1406) pc/h. while the lowest volume is (928) pc/h which coming from Al-Maeradh St..
- c. The percentage of heavy vehicles is concentrated in two approaches as shown in **table(4)**.
- d. **Fig. (3)** shows all turning movements for all approaches.
- e. The variation of traffic volume for each approach is shown in **Fig. (4)** for 15 min interval while **Fig. (5)** shows the total volume at intersection for each (15) min.

5.2 Peak hour factor.

The peak hour factor gives an indication about the variation of traffic volume during peak hour. From **table (1)**, the PHF was calculated according to American Highway Specifications. **table (5)** shows PHF values for all approaches.

5.3 Existing los at al-zeoat intersection.

Before study any proposal at Al-Zeoat intersection, it is very important to specify the existing level of service (LOS) at base year. By using SIDRA program, it was found that the existing level of service Al-Zeoat intersection is LOS (F) as shown in Table (6), while **table(7)** shows some significant indicators about level of service at Al-Zeoat intersection.

6. Design Proposal.

From traffic volume shown in **table (1)**, it seems that the major flow concentrated along the (Al-MohafadhaSt.— Al-Mahkama St.) approach. In addition to that, the other approach (17-July St.— Al-Maeradh St.) approaches is not along a straight line. For these reasons, there is only one proposal. This proposal include executing flyover along (Al-MohafadhaSt.— Al-Mahkama St.) approach. By adopting this proposal, the expected traffic volume at peak hour which will use the flyover will be as follows:

- About 900 pc/h from Al-MohafadhaSt. toward Al-Mahkama St.
- About 1000 pc/h from Al-Mahkama St. toward Al-MohafadhaSt.

With existing of a flyover along (Al-MohafadhaSt.— Al-Mahkama St.), the expected traffic volume at ground level will be as shown in **Fig. (6)**. By adopting this proposal, the expected average delay at base year is (34.1) sec/veh. This delay will make the intersection work under level of service (C). **tables (8 and 9)** show the level of service and some significant indicators about the efficiency of this proposal.

The expected average delay will be (59.40) sec/veh. The level of service will be LOS (E) as shown in **table (10)**. While **table (11)** shows some significant indicators about the efficiency of proposal (1).

7. Design Of Flyover At Target Year.

- Direction from Al-MohafadhaSt. toward Al-Mahkama St.

$$SF = 1000 * 1.8 = 1800 \text{ pc/h}$$

Assume LOS (D)

$$v/c = 0.80$$

$$f_{HV} = 1.0$$

$$f_w = 0.93 \text{ (use standard lane with 1 ft obstruction on both sides)}$$

$$N = (1800 / (1900 * 0.8 * 0.93 * 1.0 * 1.0)) = 1.27 \text{ lanes}$$

So use two lanes with standing lane.

- Direction from Al-Mahkama St. toward Al-MohafadhaSt.

$$SF = 900 * 1.8 = 1620 \text{ pc/h}$$

Assume LOS (D)

$$v/c = 0.80$$

$$f_{HV} = 1.0$$

$$f_w = 0.93$$

$$N = (1620 / (1900 * 0.8 * 0.93 * 1.0 * 1.0)) = 1.14 \text{ lanes}$$

So use two lanes with standing lane

8. Conclusions.

It has been concluded that, fly over at the main path of traffic movement at Al-Zeoat intersection (Al-Mohafadha St. –Al-Mahkama St.) is the best proposal to improve the capacity and traffic operation in Al-Zeoat intersection.

By considering the previous mentioned results, it is concluded that proposed geometric shown in **Fig. (6)** reflects the accepted solution on the target year from the capacity and the performance operation point of view at Al- Zeoat intersection.

References.

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- [4]. Akcelik R.(1986). " SIDRA version 2.2 input and out put" Austrian road research board . Technical manual ,ATM No. 19.
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Table (1): Traffic volume at Al-Zeoat intersection form 7:30 a.m to 5:00 p.m for all approaches in pcu

| Direction Time | From Al-MohafadhaSt. | | | From Al-Mahkama St. | | | From 17-July St. | | | From Al-Maeradh St. | | |
|-------------------|----------------------|------|-----|---------------------|------|-----|------------------|------|-----|---------------------|-------|------|
| | R 1 | TH 2 | L 3 | R 4 | TH 5 | L 6 | R 7 | TH 8 | L 9 | R 10 | TH 11 | L 12 |
| 7:30 - 7:45 | 14 | 100 | 44 | 7 | 104 | 31 | 5 | 93 | 16 | 13 | 47 | 24 |
| 7:45 - 8:00 | 15 | 109 | 49 | 8 | 113 | 33 | 6 | 107 | 18 | 16 | 55 | 29 |
| 8:00 - 8:15 | 16 | 117 | 54 | 11 | 128 | 36 | 6 | 118 | 23 | 20 | 62 | 31 |
| 8:15 - 8:30 | 14 | 124 | 52 | 10 | 125 | 38 | 7 | 126 | 20 | 23 | 65 | 38 |
| 8:30 - 8:45 | 17 | 133 | 55 | 13 | 142 | 35 | 8 | 131 | 22 | 19 | 72 | 34 |
| 8:45 - 9:00 | 18 | 125 | 53 | 9 | 151 | 38 | 8 | 125 | 24 | 20 | 74 | 41 |
| 9:00 - 9:15 | 20 | 149 | 57 | 11 | 162 | 43 | 7 | 144 | 28 | 23 | 82 | 45 |
| 9:15 - 9:30 | 19 | 136 | 52 | 10 | 158 | 42 | 9 | 143 | 27 | 22 | 81 | 44 |
| 9:30 - 9:45 | 23 | 147 | 57 | 10 | 163 | 44 | 99 | 157 | 29 | 24 | 87 | 48 |
| 9:45 - 10:00 | 27 | 149 | 55 | 12 | 180 | 48 | 10 | 163 | 30 | 25 | 91 | 50 |
| 10:00-10:15 | 25 | 150 | 49 | 10 | 173 | 45 | 6 | 160 | 26 | 22 | 96 | 46 |
| 10:15-10:30 | 20 | 148 | 61 | 13 | 187 | 43 | 8 | 155 | 23 | 27 | 92 | 44 |
| 10:30-10:45 | 19 | 155 | 55 | 13 | 175 | 47 | 8 | 164 | 29 | 25 | 97 | 41 |
| 10:45-11:00 | 20 | 157 | 56 | 12 | 179 | 50 | 9 | 153 | 31 | 28 | 94 | 49 |
| 11:00-11:15 | 16 | 152 | 49 | 16 | 184 | 51 | 11 | 148 | 29 | 24 | 97 | 48 |
| 11:15-11:30 | 17 | 160 | 52 | 13 | 187 | 47 | 13 | 143 | 25 | 23 | 104 | 47 |
| 11:30-11:45 | 20 | 150 | 59 | 12 | 183 | 48 | 12 | 145 | 32 | 29 | 100 | 52 |
| 11:45-12:00 | 21 | 155 | 56 | 12 | 192 | 47 | 12 | 139 | 24 | 25 | 102 | 56 |
| 12:00-12:15 | 25 | 168 | 65 | 14 | 193 | 52 | 11 | 141 | 27 | 28 | 99 | 54 |
| 12:15-12:30 | 29 | 160 | 61 | 14 | 189 | 51 | 12 | 145 | 28 | 29 | 107 | 58 |
| 12:30-12:45 | 27 | 180 | 69 | 15 | 212 | 56 | 13 | 134 | 26 | 31 | 114 | 62 |
| 12:45- 1:00 | 28 | 185 | 71 | 17 | 205 | 55 | 13 | 140 | 27 | 29 | 106 | 57 |
| 1:00 - 1:15 | 22 | 188 | 74 | 11 | 192 | 47 | 9 | 186 | 29 | 28 | 108 | 56 |
| 1:15 - 1:30 | 20 | 209 | 73 | 14 | 208 | 49 | 10 | 179 | 30 | 26 | 107 | 51 |
| 1:30 - 1:45 | 23 | 202 | 77 | 13 | 203 | 44 | 9 | 173 | 31 | 31 | 106 | 53 |
| 1:45 - 2:00 | 25 | 208 | 79 | 14 | 195 | 46 | 8 | 184 | 28 | 32 | 110 | 60 |
| 2:00 - 2:15 | 24 | 210 | 83 | 12 | 217 | 49 | 11 | 189 | 33 | 34 | 116 | 59 |
| 2:15 - 2:30 | 21 | 217 | 77 | 14 | 212 | 52 | 12 | 179 | 29 | 30 | 112 | 56 |
| 2:30 - 2:45 | 25 | 221 | 82 | 13 | 222 | 49 | 14 | 183 | 26 | 29 | 120 | 62 |
| 2:45 - 3:00 | 22 | 212 | 79 | 13 | 227 | 53 | 12 | 190 | 28 | 31 | 115 | 68 |
| 3:00 - 3:15 | 34 | 221 | 85 | 15 | 244 | 62 | 11 | 197 | 37 | 34 | 126 | 69 |
| 3:15 - 3:30 | 38 | 233 | 90 | 17 | 254 | 68 | 12 | 210 | 40 | 36 | 132 | 73 |
| 3:30 - 3:45 | 35 | 229 | 88 | 18 | 261 | 73 | 11 | 201 | 38 | 34 | 124 | 68 |
| 3:45 - 4:00 | 34 | 230 | 89 | 17 | 246 | 65 | 10 | 189 | 35 | 35 | 127 | 70 |
| 4:00 - 4:15 | 28 | 218 | 81 | 14 | 219 | 55 | 9 | 175 | 28 | 29 | 110 | 53 |
| 4:15 - 4:30 | 23 | 185 | 76 | 11 | 203 | 46 | 8 | 159 | 26 | 25 | 104 | 42 |
| 4:30 - 4:45 | 19 | 167 | 71 | 13 | 184 | 42 | 8 | 142 | 23 | 23 | 101 | 40 |
| 4:45 - 5:00 | 18 | 150 | 59 | 9 | 168 | 31 | 7 | 131 | 24 | 23 | 92 | 35 |

Table (2): Traffic volume at Al-Zeoat intersection form 7:30 a.m to 5:00 p.m for all approaches for each (15) min

| Time | Volume | Time | Volume |
|---------------|--------|---------------|--------|
| 7:30 – 7:45 | 498 | 12:15 – 12:30 | 878 |
| 7:45 – 8:00 | 558 | 12:30– 12:45 | 969 |
| 8:00 – 8:15 | 622 | 12:45 – 1:00 | 933 |
| 8:15 – 8:30 | 642 | 1:00 – 1:15 | 950 |
| 8:30 – 8:45 | 681 | 1:15 – 1:30 | 976 |
| 8:45 – 9:00 | 688 | 1:30 – 1:45 | 967 |
| 9:00 – 9:15 | 771 | 1:45 – 2:00 | 991 |
| 9:15– 9:30 | 743 | 2:00 – 2:15 | 1037 |
| 9:30 – 9:45 | 798 | 2:15 – 2:30 | 1011 |
| 9:45 – 10:00 | 840 | 2:30 – 2:45 | 1046 |
| 10:00 – 10:15 | 808 | 2:45 – 3:00 | 1050 |
| 10:15 – 10:30 | 821 | 3:00 – 3:15 | 1135 |
| 10:30 – 10:45 | 828 | 3:15 – 3:30 | 1203 |
| 10:45 – 11:00 | 838 | 3:30 – 3:45 | 1180 |
| 11:00 – 11:15 | 828 | 3:45 – 4:00 | 1147 |
| 11:15 – 11:30 | 831 | 4:00 – 4:15 | 1019 |
| 11:30 – 11:45 | 849 | 4:15 – 4:30 | 908 |
| 11:45 – 12:00 | 841 | 4:30 – 4:45 | 833 |
| 12:00 – 12:15 | 877 | 4:45 – 5:00 | 747 |

Table (3): Calculated saturation flow at Al-Zeoat intersection

| Direction | Saturation flow pc/h |
|----------------------|----------------------|
| From Al-MohafadhaSt. | 1700 |
| From 17-July St. | 1550 |
| From Al-Mahkama St. | 1675 |
| From Al-Maeradh St. | 1650 |

Table (4): Percentage of heavy vehicles for all approaches at Al-Zeoat intersection

| Approach | % heavy vehicles |
|----------------------|------------------|
| From Al-MohafadhaSt. | 10.7 |
| From 17-July St. | 3.2 |
| From Al-Mahkama St. | 9.6 |
| From Al-Maeradh St. | 4.5 |

Table (5): PHF values for Al-Zeoat approaches

| Approach | PHF |
|----------------------|------|
| From Al-MohafadhaSt. | 0.97 |
| From 17-July St. | 0.96 |
| From Al-Mahkama St. | 0.95 |
| From Al-Maeradh St. | 0.95 |

Table (6): Existing level of service at Al-Zeoat intersection

| Approach | Average delay sec/veh | Degree of saturation | Level of service |
|----------------------|-----------------------|----------------------|------------------|
| From Al-MohafadhaSt. | 84.70 | 0.932 | F |
| From 17-July St. | 94.20 | 0.939 | F |
| From Al-Mahkama St. | 85.60 | 0.930 | F |
| From Al-Maeradh St. | 75.80 | 0.909 | E |
| Average | 84.70 | | F |

Table (7): Some significant indicators about level of service at Al-Zeoat intersection

| Indicator | Value |
|--------------------------|--------|
| Average delay (sec/veh) | 84.70 |
| Total delay (veh.h/h) | 109.57 |
| Stop rate | 1.19 |
| Performance index | 424.12 |
| Practical spare capacity | -4% |

Table (8): Expected level of service (LOS) at Al-Zeoat intersection at base year with proposal (1)

| Approach | Average delay sec/veh | Degree of saturation | Level of service |
|----------------------|-----------------------|----------------------|------------------|
| From Al-MohafadhaSt. | 38.70 | 0.547 | D |
| From 17-July St. | 28.5 | 0.587 | C |
| From Al-Mahkama St. | 42.4 | 0.593 | D |
| From Al-Maeradh St. | 33.1 | 0.601 | C |
| Average | 34.1 | | C |

Table (9): Some significant indicators about the (LOS) at Al-Zeoat intersection at base year with proposal (1)

| Indicator | Value |
|--------------------------|-------|
| Average delay (sec/veh) | 34.1 |
| Total delay (veh.h/h) | 27.87 |
| Stop rate | 0.80 |
| Performance index | 162.2 |
| Practical spare capacity | 50% |

Table (10): Expected LOS Al-Zeoat intersection at target year with adopting proposal(1)

| Approach | Average delay sec/veh | Degree of saturation | Level of service |
|----------------------|-----------------------|----------------------|------------------|
| From Al-MohafadhaSt. | 71.0 | 0.872 | E |
| From 17-July St. | 53.4 | 0.87 | D |
| From Al-Mahkama St. | 68.9 | 0.83 | E |
| From Al-Maeradh St. | 54.1 | 0.876 | D |
| Average | 59.4 | | E |

Table (11): Some significant indicators about the (LOS) at Al-Zeoat intersection at target year with proposal (1)

| Indicator | Value |
|--------------------------|--------|
| Average delay (sec/veh) | 59.4 |
| Total delay (veh.h/h) | 87.54 |
| Stop rate | 1.0 |
| Performance index | 403.08 |
| Practical spare capacity | 3% |



Figure (1): Satellite Image for Al-Zeot Intersection in Al-Ramadi City (Google Earth 19 April 2004).

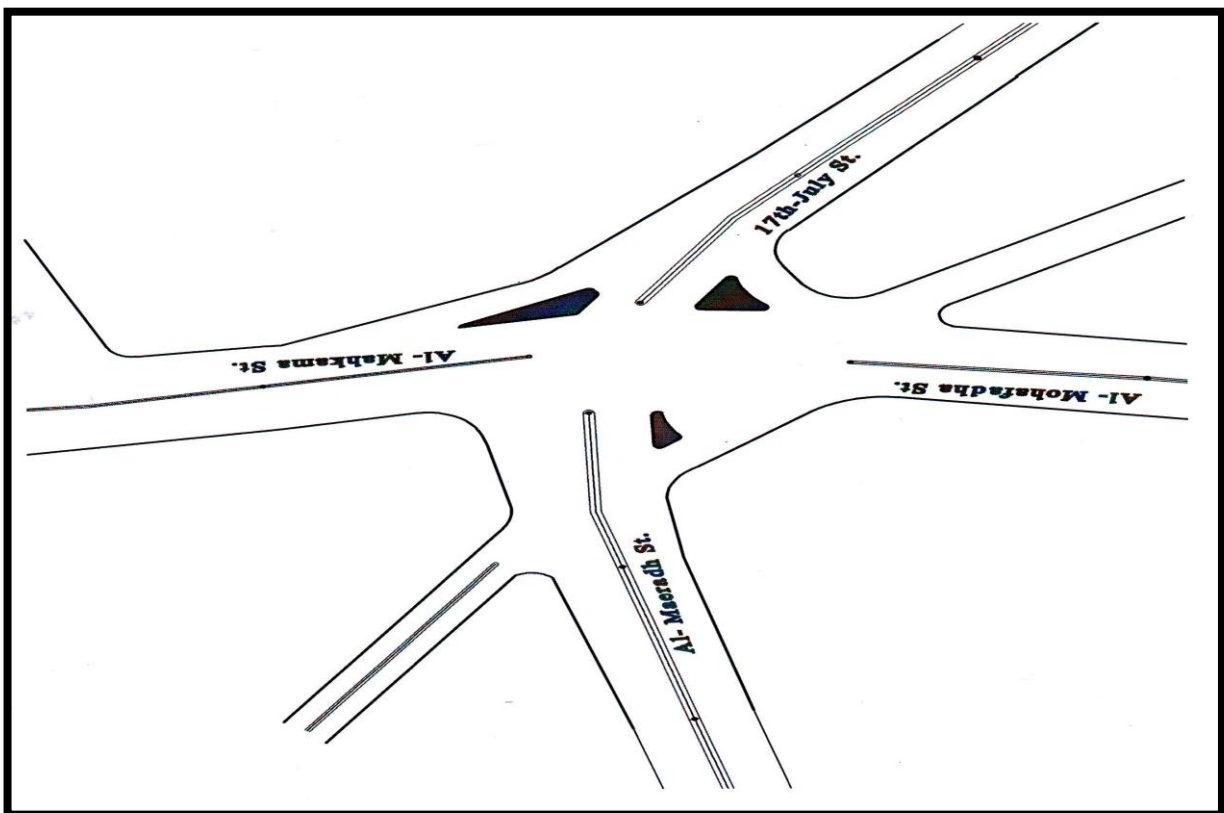


Figure (2): Existing geometric layout for Al-Zeot intersection.

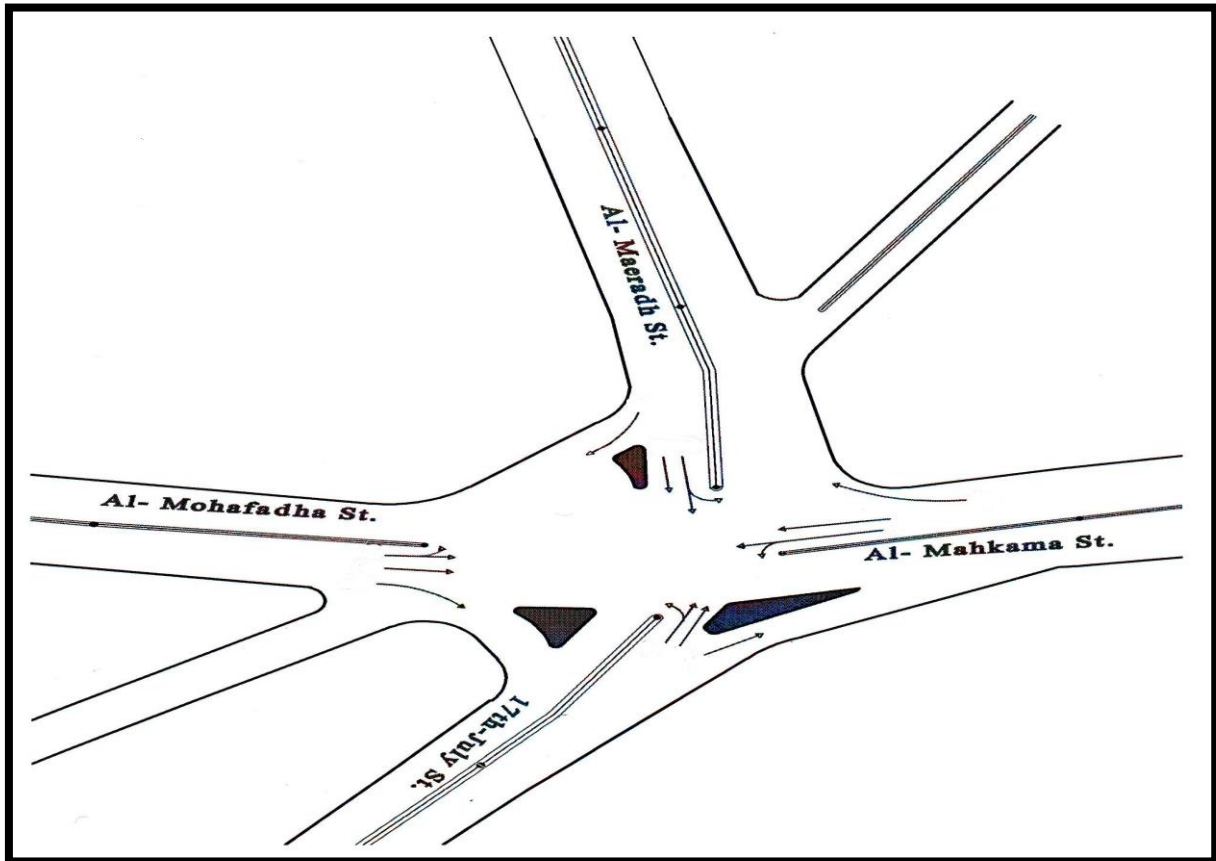


Figure (3): Turning movements for all approaches in Al-Zeoat intersection.

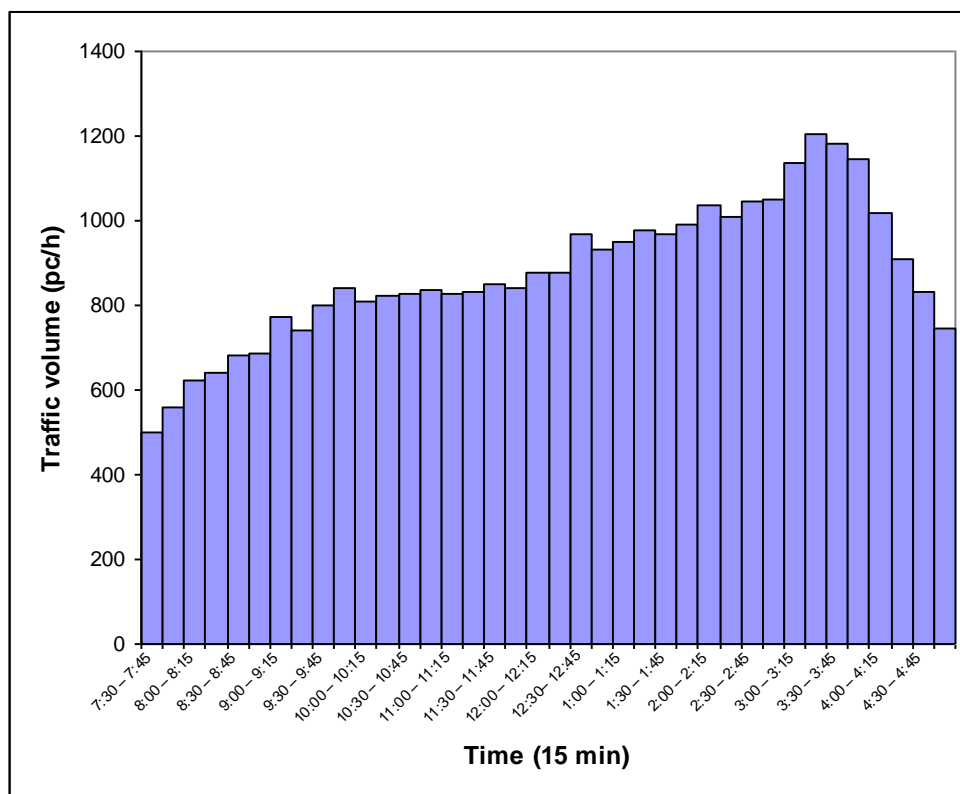


Figure (4): Variation of traffic volume for all approaches at Al-Zeoat intersection.

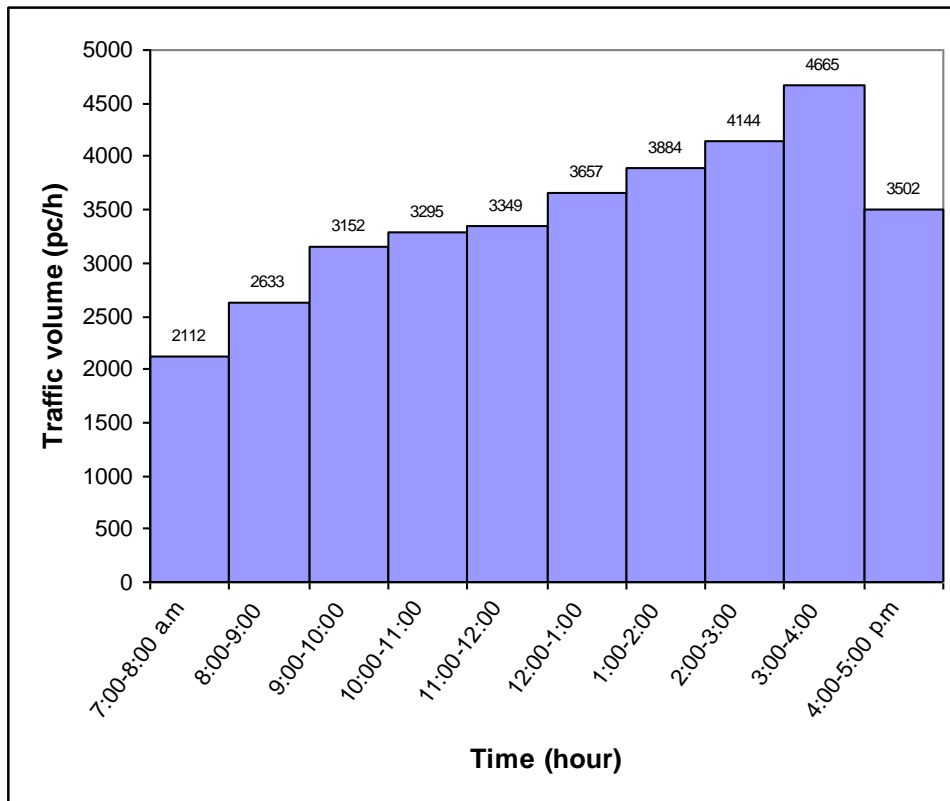


Figure (5): Total traffic volume at Al-Zeoat intersection for each (15) min.

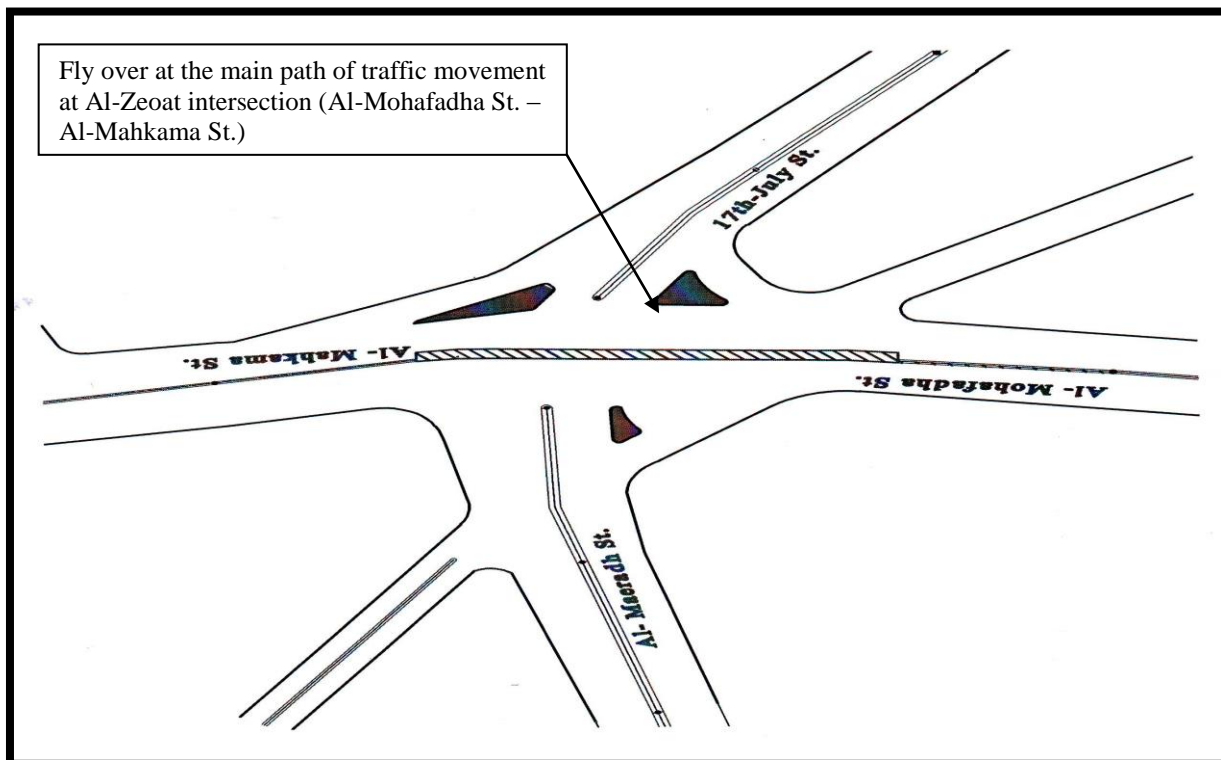


Figure (6): Proposal for Al-Zeoat intersection.

تقييم وتطوير الانسيابية المرورية لتقاطع الزيوت في مدينة الرمادي

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الخلاصة

تعد الزيادة في الحجم المرورية في التقاطعات إحدى المشاكل المهمة التي تجعل حركة المرور في هذه التقاطعات صعبة والتي تؤدي إلى الازدحام في هذه المناطق. إن هدف هذه الدراسة هو تحسين الخدمة المرورية في تقاطع مروري محدد (تقاطع الزيوت) في مدينة الرمادي و ذلك بواسطة تحليل وتقييم هذا التقاطع واستخدام الحلول المقبولة لتحسين الخدمة المرورية في تقاطع الزيوت تحت الظروف الحالية وتقييم أفضل مقترح لتعزيز الأداء في التقاطع. لإنجاز هذه الأهداف، جمع بيانات الحجم المرورية والتخطيط الهندسي لتقاطع الزيوت المطلوبة لغرض التحليل المروري والهندسي للتقاطع تم جمعها يدويا ، بينما برنامج المرور SIDRA استخدم لمتطلبات التحليل المروري.