Improvement of Traffic Flow on Arterials In Mansor City, Baghdad In Iraq By Using Microsimulation Model

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Abstract— **The rapid rise of population in Al-Mansour's as well as the increasing number of vehicles and retail malls, results in an increase in the number of daily trips, which affects traffic flow and leads to traffic congestion, particularly in the downtown region. As a result, the goal of this study is to evaluate traffic performance in a city by proposing well intersections performance. Because ideal saturation flow is the most important element influencing driver behavior, it has been changed to be the average of saturation flow measurements taken in the field (2200 vphgpl). Following that, some improvement suggestions are made, ranging from modifying time signals to changing intersection geometrics. Manual calculation is used to determine the traffic parameters. Field survey is used to determine geometric data. The traffic data measured in the field (1.27 (v/c) degree of saturation, 154 second latency, and L.O.S is F) was compared to the improvement generated by SIDRA INTERSECTION. When geometric data was changed (0.98 (v/c) degree of saturation, 46 seconds delay, and L.O.S equals D), there was a significant improvement in traffic for the intersection. This disparity could be explained by the ineffectiveness of leveraging the geometric features of this pirtucular intersection to alleviate traffic congestion.**

Keywords— **Intersection; Level of Service; Traffic delay; SIDRA; Geometric Data.**

I. Introduction

In developed areas, controlling the ever-increasing demand on the traffic network necessitates the development of enhanced ways for closely monitoring the operational conditions of current transportation facilities without the need for additional infrastructure [1]. Over the years, the quality and accuracy of simulation models have improved, while new concepts and technologies have been introduced to the sector. Static or dynamic simulation models, deterministic or stochastic simulation models, microscopic or macroscopic simulation models, and so on [2]. Each simulation model's development will be defined by diverse backgrounds and algorithms. Every model is suitable for its circumstance and has its own set of strengths and weaknesses; as a result, the chosen program should meet the analyst's aims and replicate the research area's elements [3-4].

Some research has focused on estimating delays at signalized junctions. The authors of a study [5] looked at the control delay at signalized crossings in a developing country for mixed traffic situations (India). They used a theoretical delay model to estimate control delay and compared it to control delay measured in the field using HCM 2000 recommendations. The findings revealed that the observed delay in the field and the expected delay from the theoretical model are not well correlated. As a result, the field-measured control delay was used to determine LOS. At four 3-legged signalized crossroads in Ankara, reference [6] measured the control latency and LOS at signalized intersections using HCM. The findings revealed that intersections on the south corridor had lower LOS levels ranging from C to F, whereas the north route currently has less traffic, resulting in LOS levels ranging from C to E at peak hours. The performance level of signalized crossings was measured in reference [7] based on traffic and geometric features. On weekdays, the requisite field data was collected at the Retteri signalized intersection in Chennai, India for 12 hours. The volume of traffic was analyzed, and morning and evening peak hours volumes were estimated. IRC 106-1990 was used to calculate the Volume/Capacity (V/C) ratio. The time it took for a vehicle to arrive was calculated using the traditional Webster's method and the quality of service (LOS). The study found that describing the current performance circumstances of specific signalized crossings is simple, and it is likely to aid traffic engineers, planners, and policymakers in comprehending the evaluation of specific signalized intersections under mixed traffic situations.

In terms of industrial development and technological improvement, Baghdad, Iraq's capital, is remarkably similar to any other country's capital city. These rapid shifts are accompanied by even more rapid changes in traffic conditions. As existing approaches become outmoded, new and novel methods for assessing and managing intelligent transportation systems must be proposed [8].

The city's recent growth in traffic congestion has been identified as a severe concern that affects the economy, travel time, driver behavior, and driver comfort. The number of cars in Baghdad is fast increasing without a corresponding increase in road network capacity, resulting in increased delays and a decreased level of service (LOS) [9].

II. Aim and Objectives of the Study

The overall goal of this research is to improve traffic signal performance in congested locations by analyzing data from a critical crossroads in Baghdad's downtown area utilizing micro-simulation software packages. The following are the study's goals:

i) To collect traffic and geometry data at the present level of service for the selected intersection.
ii) Using Sidra Intersection software, evaluate the capacity, performance, and level of service for roads and intersections.
iii) To offer ways to improve the junction by optimizing the cycle duration and, if necessary, improving the geometry.

III. Data Collection Method

A. Study Area Description

Within Baghdad's Central Business District (CBD), there are two multi-lane divided urban streets in the study area. Because of the abundance of activity hubs like as schools, government offices, and commercial stores, the Al-Liqaa 4-leg crossroads was chosen as the study location. The selected junction is depicted in Figure 1 with four approaches.

Fig. 1 Google image for selected intersection in Al-Mansour city, Iraq (Al-Liqaa Intersection).

B. Geometric Data

To collect reliable and adequate data that meets the requirements of statistical calculations and representations, it was required to choose sites with substantial traffic flow that produced realistic findings that could be statistically evaluated to predict the delay. With a flyover bridge connecting the north and south approaches, the crossroads has a significant traffic demand. The dimensions of the intersection geometry were hand measured on site. The geometric data layout for the junction is shown in Figure 2.

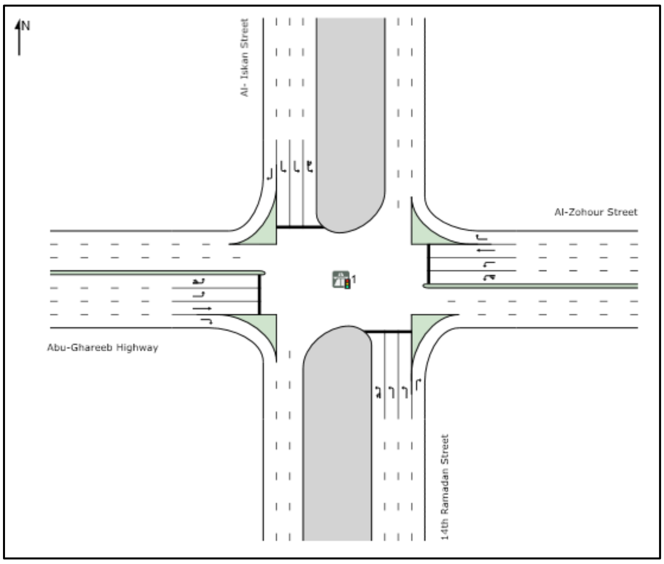


Fig. 2 Geometric layout of the intersection via SIDRA INTERSECTION

The basic geometric aspects of the intersection have been measured to be regarded some variables information for evaluation, such as (number of lanes, lane width, median width, lane type, and giveaway lane type). Table 1 shows the main geometric properties of the chosen intersection.

TABLE I
Main geometric features of the selected intersection

Approach	No. of lane	Lane width (m)	Median width (m)	Giveaway lane type
North	3	3.5	18	Low-Angle
South	3	3.5	18	Low-Angle
East	3	3.5	1	Low-Angle
West	3	3.5	1	Low-Angle

C. Traffic Volume Data

This information comprises traffic quantities abstracted from manual recording for each approach at the chosen intersection, as well as traffic composition and the volume of turning motions during peak hours. Table 2 shows the average network traffic volumes (veh/hr) for the intersection. While the percentage of heavy vehicles has been set at 8% for all intersection legs.

TABLE III
Traffic volume data for the selected intersection

Approach	Left Turn	Through	Right Turn	U-Turn
North	450	-	60	60
South	420	-	120	60
East	240	690	90	35
West	600	420	180	90

IV. Traffic Analysis and Evaluation

A. Calibration of SIDRA for Signalized Intersections

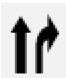
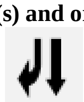
The abstracted and processed traffic and geometric data obtained on site were used as input parameters into SIDRA software for study and evaluation of traffic performance at the designated road network. The software functions are listed below [10]:

- It's used to design and evaluate signalized junctions, pedestrian crossings, single point interchanges, roundabouts, roundabout metering, and give-way/yield sign control.
- It can be adjusted to suit your specific needs. For signalized intersections, saturation flow rate and lane usage factor are utilized for calibration, while for roundabouts, environment factor and entry/circulating flow are used.
- Analyze a variety of design options to optimize intersection geometry, signal phasing, and timings, and specify different optimization algorithms.
- Conduct a design life study to determine the impact of increased traffic.
- For calibration, optimization, assessment, and geometric design reasons, conduct a parameter sensitivity analysis.
- Use the time-dependent delay, queue length, and stop rate models to analyze oversaturated conditions.
- At a signalized intersection, the saturation headway is the most important parameter that is influenced by motorist behavior. The saturation flow rate is mostly affected by this parameter. The greatest departure (queue discharge) flow rate obtained during the green period at traffic lights is known as saturation flow rate [11].

B. Traffic Network Data

To look into the current state of traffic operation techniques and geometry and how they affect traffic flow performance. In Table 3, the phase order for signalized intersections is shown.

TABLE IIIII
Phase length, order and cycle length

Phase length (s) and order				
				**Cycle length (s)**
60	**60**	**60**	**60**	**240**

The output results of simulation runs, which include the degree of saturation, total delay, and level of service for the intersection in the research region, are shown in Table 4 and Figure 3. Because all of the output results have large total delays, the level of service for the intersections is (F) according to the software's LOS categories, which are based on the HCM approach.

TABLE IVV
Lane summary for the current intersection

Demand flows (veh./hr)	**Degree of Saturation (v/c)**	**Average Delay (seconds)**	**Level of Service**
5180	1.27	154	F

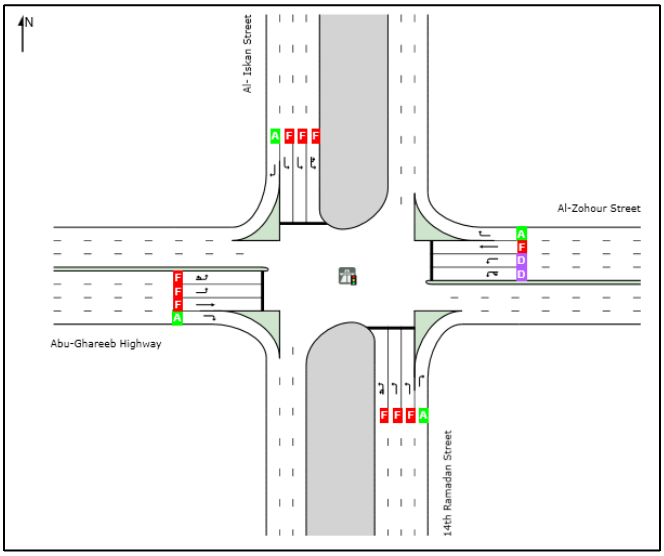


Fig. 3 L.O.S summary for the selected intersection via SIDRA INTERSECTION for the current situation

V. RESULTTS AND IMPROVEMENTS

This section presents the improvement strategies applied to the traffic flow in the study area, through the application of SIDRA INTERSECTION

A. Signal Timing Optimization and Coordination

The coordination of traffic lights is one of the most frequent strategies for boosting the efficiency of traffic operations. This is because an increase in traffic demand will result in an increase in the need for coordination. In many regions, traffic signal synchronization can help to alleviate traffic congestion. Coordination could result in significant improvements in traffic flow as well as a reduction in delays and stops.

The delay times in the network were reduced by 37.7% after the coordination procedure for signalized intersections. Despite the fact that the optimization and coordination runs increase the network MOE, the degree of saturation does not drop below 0.9.

Table 5 and Figure 4 also show that using optimization methods like split and offset for isolated signalized junctions has no influence on the MOE. Even though the cycle time has been optimized, the isolated intersections continue to perform under oversaturated conditions, necessitating the use of geometric features to improve performance. This study's findings have been confirmed by a number of other research [12-15].

TABLE V
Measure of Effectiveness for the improved intersection by SIDRA

Improvement Type	**Cycle Length (sec.)**	**Degree of Saturation (v/c)**	**Average Delay (v. /sec.)**	**L.O.S**
Base Condition	240	1.27	154	F
Cycle length Optimization and Coordination	120	1.03	56	E

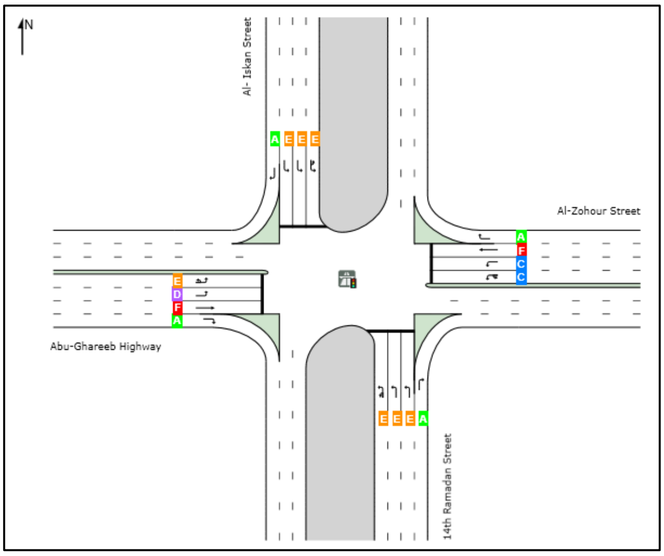


Fig. 4 L.O.S summary for the selected intersection via SIDRA INTERSECTION after cycle length optimization and coordination

B. Geometric Improvement

Each approach to the Al-Liqaa Intersection is being annotated and new lanes are being added while the width of all lanes are decreased to 3.0 m. The MOE was improved by this procedure, but not to the desired degree. This could be due to platoon movements being present. The performance of an intersection is improved by at least 70% when the pavement is remarked and lanes are designated. The outcomes of geometric improvement are shown in Table 6 and Figure 5.

TABLE VI
Measure of Effectiveness for the geometric improvement by SIDRA

Improvement Type	**Cycle Length (sec.)**	**Degree of Saturation (v/c)**	**Average Delay (v. /sec.)**	**L.O.S**
Base Condition	240	1.27	154	F
Cycle length Optimization and Coordination	120	1.03	56	E
Geometric improvment	60	0.98	46	D

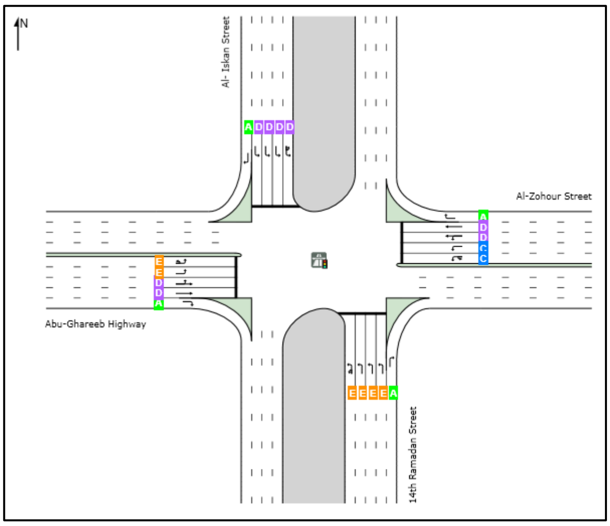


Fig. 5 L.O.S summary for the selected intersection via SIDRA INTERSECTION after geometric improvement

VI. Conclusions

The key findings that can be made from the main objectives are summarized as follows, within the restrictions of the traffic and geometric aspects of the study area:

i) The average basic saturation flow rate for Baghdad city is 2200 pcuphgl, this is higher than the value recommended by SIDRA of 1950 pcuphgl.

ii) The current traffic level of service in the intersection is F with 1.27 degree of saturation and 154 seconds delay.

iii) Cycle length optimization process slightly improve the selected network by changing the level of service to E with 56 seconds delay.

iv) Geometric improvment process generally improved the selected network by decreasing the delay from 154 seconds to 46 seconds. While L.O.S improved also from F to D.

Nomenclature

L.O.S Level of Service
MOE Measure of Effectiveness
HCM Highway Capacity Manual
CBD Central Business District

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