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Evaluation Of On-Street Parking At Congested Segments Within Hilla City(Case Study: Al-Takaud Region)

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ABSTRACT

Altakaud region in Hilla city has a high trip generation rate because there are important government institutions. Privately owned vehicles have increased due to population and economic growth, but inadequate parking and traffic management strategies have stopped the road network and parking facilities from upgrading. Street parking unpredictability requires aimless driving. Cruisers, parkers, and unparkers generate traffic jams, especially during rush hours. This also causes traffic jams. Assessing traffic congestion, identifying causes, and proposing solutions were urgent. Traffic counts and parking surveys followed. VISSIM was used to simulate and evaluate the research are[1]a and mitigation approach, and on-street parking impact on through traffic was examined. A statistical test (paired t-test) of VISSIM results revealed clear insights to help resolve the crisis and persuade city management to amend its parking and traffic management policies. After VISSIM removed on-street parking, traffic volume increased from 183 to 300, and speed increased from 3 km/h to 31.32 km/h for the first 50 meters of the first segment. The remaining seven segments also improved their speed, and the level of service improved from F, E, and C to A.

KEYWORDS

Simulation, Optimization, validation, on-street parking, software.

1. INTRODUCTION

As the number of people who own cars rises, parking management has emerged as a pressing issue in cities all over the globe. The quantity of parking spaces is an essential indicator of the quality of a transportation infrastructure facility. It is crucial to carefully plan parking areas along roads to reduce the potential for delays in moving traffic caused by parking maneuvers. Reduced link capacity and slower operational speeds are two of the biggest issues caused by parking on the side of the road (Patel and Joshi, 2015). Both the parking procedures (m erging and diverging) and the resulting narrowing

Congestion issues, especially along urban arterial corridors, are a current problem in the city of Hilla. Constant traffic jams can be traced back to two factors: increased vehicle volume and reduction in the capacity of the road during peak hours. Problems like increased pollution, higher fuel consumption, and defeat drivers due to gridlock are all exacerbated when such places are located along major arterial and disrupt the traffic flow. parking lots hasn't caught up with.

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Since cars spend 95% of their time parked and only 5% in motion, having a streamlined parking system is crucial (Shoup, 2006). Traffic and parking in CBDs can be made more manageable with the help of data from a VISSIM simulation study (Lin et al., 2013).

This study aims to examine the current state of on-street parking on Altakaud Street and provide solutions to reduce parking demand and traffic congestion during rush hours.

This research aims to determine how on-street parallel parking in approved parking bays affects stream speed and traffic volume.

2.LITERATURE REVIEW

For quite some time, researchers have been interested in parking, and the topic has been studied in books and articles. In the beginning, researchers focused on correct on-street parking principles; later, they conducted empirical research on the factors that influence the selection of a parking space (Christiansen et al., 2017); in today's overcrowded cities, it might be difficult for drivers to get a parking space on the street, especially near high-trip-generation destinations like malls (Wang et al., 2013)

Several studies (Marshall and Garrick 2011; Kraus et al. 1996) suggest that on-street parking is a key contributor to traffic hazards and risks. Eliminating on-street parking is the simplest and least expensive way to improve city road capacity and security. (Biswas, Chandra, & Ghosh, 2017). Moreover, there are more pedestrian-related incidents overall because of poor visibility caused by parked cars.

Parking on main streets was found to be unsafe and should be limited (Biswas et al., 2017).

When parking is nearly full (occupancy rate is above 85 percent), the International Handbook for On-Street Parking Management notes, drivers have a harder time finding a parking space, adding to the congestion in the area.

Parking on the street or curb is done along the edge of the roadway, either perpendicular or parallel to the curb. Many factors should be considered when deciding between parallel and angle parking. Lack of parking and inadequate management cause traffic flow obstruction, increase the search for vacant spaces, and cause negative effects and damage.

The most important effects, like time and obstruction of traffic flow, are caused by the lack of parking spaces and the inadequate management of many existing waiting facilities, which in turn increases the search for vacant spaces and leads to many of the negative effects and damage that are exacerbated day after day. The effect on traffic flow impediment could be summed up as follows:

A-Recent research found that the search for places to halt cars accounts for roughly two-thirds of the traffic on city streets.White 2007)

B- Double parking: Lack of parking spaces in front of or near public facilities (such as ministries and banks) leads to prohibited parking, and street deductions are part of the street. Thus, it reduces street capacity by 70- 40%, causing traffic congestion(Mohamed and Riad 2005)

3.RESEARCH METHODOLOGY

The study methodology is as follows:

- Choose the case study where the Altakaud area was chosen as the focus of the research. After that, we gathered geometric data on the study area in its current state and an inventory of parking facilities there.
- The peak hours of parking demand and traffic were calculated.
- Field survey to collect flow, speed, parking movements, and parking duration in the peak hours afterward
- Development of VISSIM microsimulation model based on collected information
- Calibration of microsimulation model.
- Validation of the VISSIM microsimulation model
- Analyzed the model and simulated suggested scenarios for the study area.
- Lastly, conclusions were presented.

3.1 STUDY SITE SELECTION

Altakaud region in Hilla city was selected as the study area for this research. Vehicles on this street come from three main streets: Street 40, and the second is Al-Taqa Street and Nader Street. There are several important governmental institutions: the Supreme Authority for Hajj and Umrah, the Babel branch, the institution of the martyrs of Babylon, the Babylon Retirement and Al-Rafidain Bank, and the Babylon branch located in this region, as shown in Figure 1. This street has problems with its parking in a way that has an adverse effect on the thought flow. These establishments are distinguished by the density of visitors, which creates a demand for car parks. The intensity of traffic that occurs from the beginning of the official working hours of this governmental institution to the end of them creates traffic congestion due to the process of entering and then leaving this institution, which creates confusion in the flow of vehicles in the main street in this region. Because of the demand for car parks in the study area and the lack of the availability of parking lots near it, vehicle owners resort to parking their cars in the side streets perpendicular to the main street Al-takaud region, as well as on the sidewalks of these institutions.

Figure1: Altakaud region location, the government institution, and its on-street parking

3.2 PARKING INVENTORY

Inventory of on-street parking was made using the license plate method for three peak hours on Monday. Fining that is parking rate in Segment 1 is 0.41 from the traffic flow,0.58 from the traffic flow in Segment 2,0.45from the traffic flow in Segment 3, and 0.38 from the traffic flow in Segment 4. also finding the average parking duration in on-street parking in segment one is20 min/veh, the average parking time in segment 2 is 28 min/veh, the average parking time in segment 3 is 32 min/veh and the average parking time in segment 4 is 22 min/veh. The parking rate and average parking time are primary inputs in PTV VISSIM, the segment's location is illustrated in Figure 2.

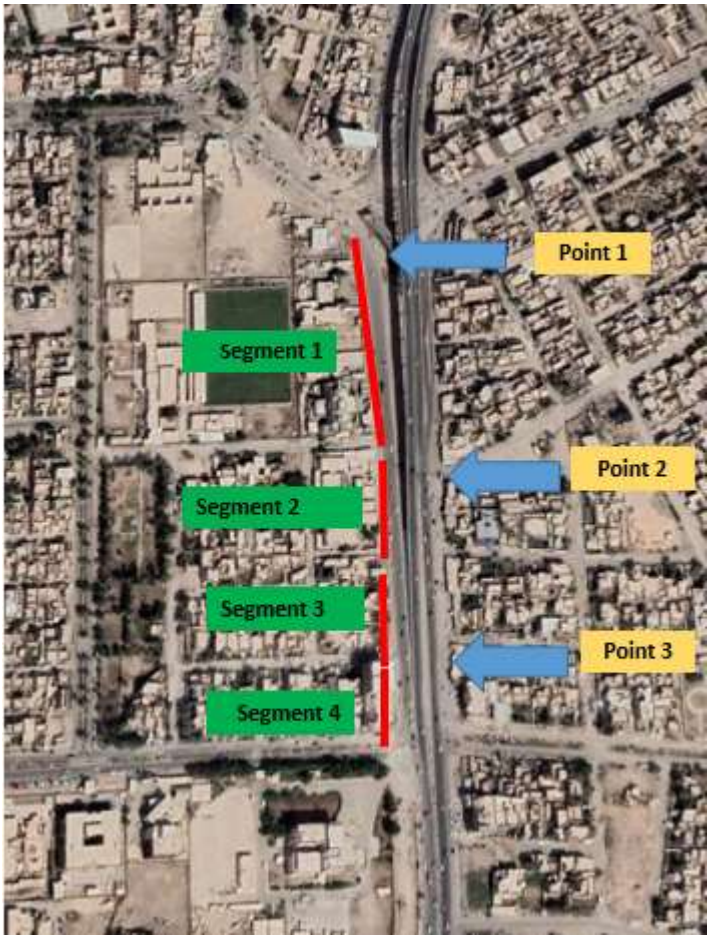

Figure 2:The segment of the study area and the location of the point of cameras

3.3 GEOMETRIC DATA

VISSIM modeling requires geometric information. As a precaution for surveyors and to avoid potential traffic jams, geometric data was gathered on a Friday morning.

3.4 TRAFFIC DATA COLLECTION

The following describes the method utilized to acquire traffic data for this study.

3.4.1 VIDEOS WITH HAND-WRITTEN SUBTITLES

Video is captured in the field using cameras. Then the data is extracted using slow-motion playback and the Smart Traffic Analyzer STA software, powerful software with very useful capacities for road traffic management. This method takes some time but is not very tedious, and the results are reliable. It is possible to obtain accurate data on trip duration and speed with only a camera and a computer. This is why the method employed here is standard practice in both developing and wealthy nations.

3.4.2 TRAFFIC VOLUME DATA

In the initial survey, points were selected to collect traffic volume data. These points are the location of the cameras, as shown in Figure 6. From the reconnaissance survey, Altakaud region has a severe problem of parking. On these links in the study area, data was collected with high-quality video cameras over five days through three peak hours, morning and three hours afternoon, covering the morning, afternoon, and evening peak hours.

Traffic volume data was extracted from the video footage, and the peak hours were determined afterward.

Finally, after finding the peak hours, data was collected on all points of the study street on Monday in the morning and afternoon peak hours. The peak hour volumes of all the study streets were then computed and further used in modeling in VISSIM. Morning peak hour from 9:30 A.M to 10:30 A.M were found to be severe for the study street. Figure 3 illustrates the traffic movement from the video at Al-takaud region.

Figure 3: Video screenshot of traffic movements Al-takaud region

3.4.3 THE SPEED CALCULATION

Another important and fundamental parameter of traffic is the speed which is the basic measure in the evaluation and development of roads. The speed was calculated for 100 vehicles for each class vehicle. Speed data were computed for the concerned segments. Then the speed data was examined to ensure that the data were subject to a normal distribution, and after ensuring that they were subject to a normal distribution, the rate of speed was taken for each category. This data was then used as input in VISSIM for further evaluation.

3.4.4 TRAFFIC VOLUME AND VEHICLE COMPOSITION

The video graphic method was used to collect data on traffic volume by vehicle class. The traffic data was mined for information on the classes of vehicles on the road. At the end of the traffic data gathering period, we tallied up the number of vehicles in each classification during peak hour so that we could determine the proportion of each class. The sum of all classes during peak hour provided us with the entire volume of traffic, as shown in Figure 4. VISSIM requires the vehicle's composition to be used as a modeling parameter.

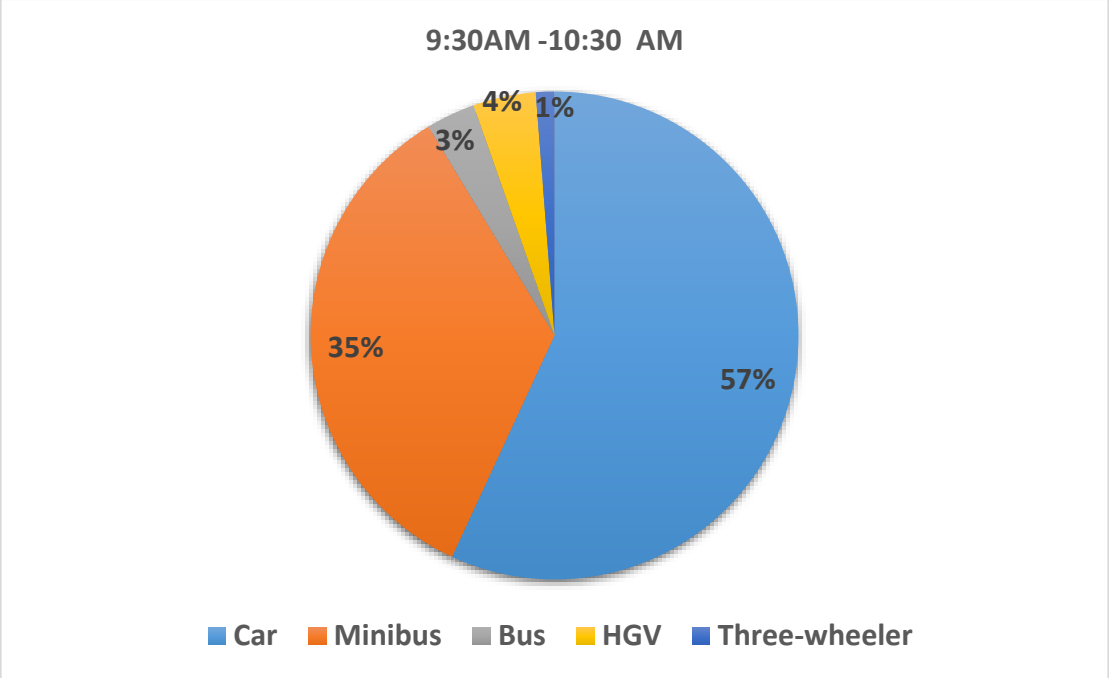

Figure 4: Vehicle compositions recorded in the peak hour in Al-takaud region

3.5DEVELOPMENT PARKING LOTS IN THE STUDY AREA AS A PROPOSED SCENARIO

The scenario is summarized in the exploitation of the empty spaces under the bridge of the Al-um in the study area, as shown in Figures 5 and 6, where this space can be exploited to make car parks for the benefit of those who intend to park their cars on the side of the street, and to get rid of the negative impact of maneuvering vehicles while stopping on the street and leaving them to merge with the front traffic. The spacious spaces were found to be sufficient for 127 parking spaces in two parts, one for 72 parking spaces, as shown in Figure 7, and the other for 55 parking spaces, as shown in Figure 8. The length of each parking lot is 5.5 meters, and its width is 3 meters. The design relied on the standard determinants in the subject of off-street parking in terms of parking space for one vehicle, parking angle, and lanes, lanes required for serving the existing area, in addition to the entrances and exits. Then the process of linking them to the adjacent main street to ensure the required speed, and thus affects the delay. In Figures 7 and 8, instead of the traffic being two lanes for traffic and one for parking, there are now three lanes for traffic, and the fourth lane is for vehicles that intend to enter or exit the parking lot, where the width of the street has been increased by a lane in order to make the entry and exit lane of the parking separate from the front traffic, in figure 7 and 8 The green color is the places of the Al-um Bridge columns.

Figure 5: The empty spaces under the bridge of the Al-um(part1)

Figure 6: The empty spaces under the bridge of the Al-um(part 2)

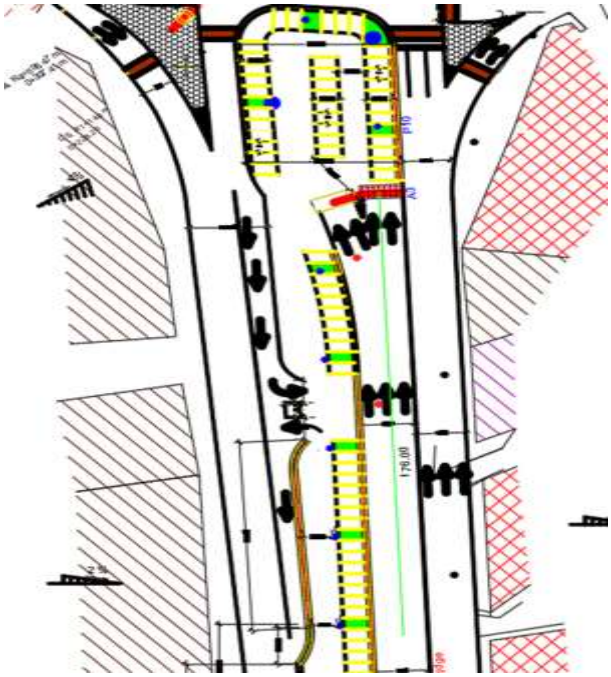

Figure7: illustrate the first part of the proposed scenario

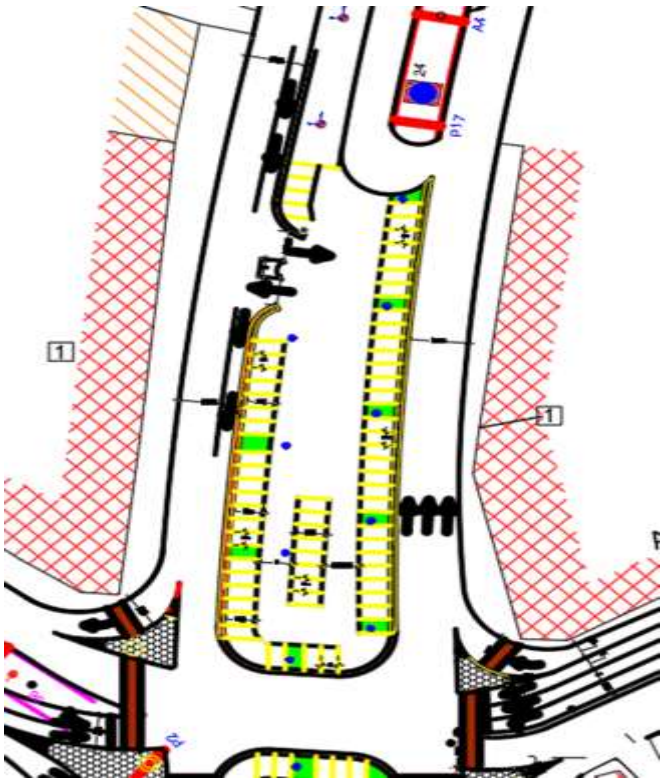

Figure8: illustrate the second part of the proposed scenario

3.6 VISSIM MODEL BUILDING

For this purpose, we utilized the traffic simulation software VISSIM (v22). VISSIM requires initial data input before it can generate a network for the project site. After the initial data model has been constructed, the gathered parameters are entered into VISSIM. When developing a new model, it is common practice to utilize default parameters that must be modified afterward. Inputs from the data-gathering procedure should be used to model the study region as closely as possible. The base data must be established before the network can be constructed. Users can change a wide variety of parameters, including Network Settings, 2D/3D models, vehicle types and classes, and more, all from the Base Data menu.

3.6.1 D/3D MODELS

The Base Data drop-down menu provides access to a variety of 2D and 3D models. VISSIM comes with its own 2D/3D vehicle models, but users can change the default dimensions of the models or define their own. Based on the vehicle specification data gathered, this study modified existing models and defined new models. That thrilling Cars, trucks, buses, trams, bicycles, and other vehicle types are all considered basic vehicle Compositions in VISSIM (VISSIM 2021). The Minibus and Three-Wheeler vehicle classes were included in the research area model.

The following procedures are used to implement a traffic simulation model:

1.First, create a backdrop using a Google Maps image of the area.

2. Making link as it actually exists on the hand number of lanes,with each lane,the direction of flow and make the connection between the main road end miner roads as actually exists.

3. Built four groups of parallel parking along the right side of the main street in Al-takaud region, as shown in Figure 9.

4. Inputting the vehicle types on the vehicle input based on the category: car, minibus, bus, HGV, and three-wheeler.

5. Making the conflict area between the main street and the miner streets and between the existing and inter place of the suggested scenario as shown in Figure 10.

6. Inputting driver behavior.

7. Run the simulation.

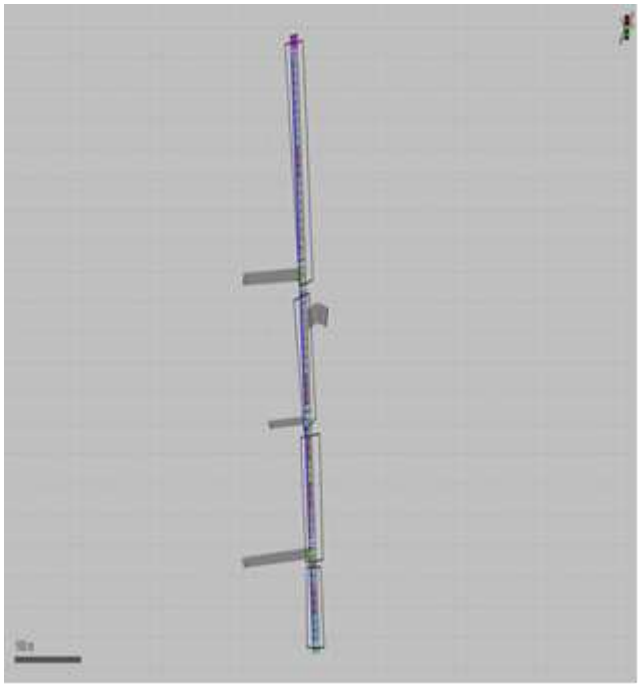

Figure 9: 2D snapshot for the VISSIM highlights the existing condition with on-street parking,

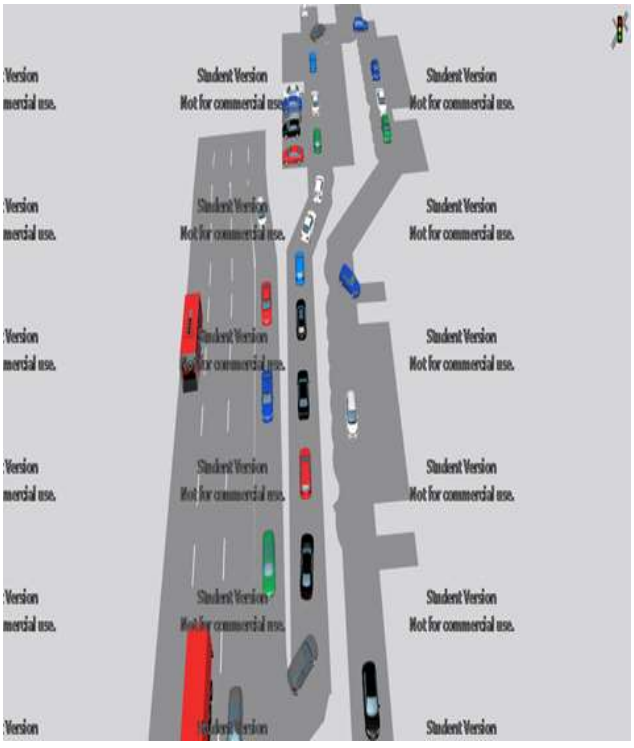

Figure 10: 3D snapshot for the VISSIM highlights the proposed scenario

3.6.2 CALIBRATION AND VALIDATION

By replicating the paths of individual vehicles in the network, micro-simulation models accurately reflect the behavior of real-world traffic systems. Model calibration is required

because the simulation software's default parameters infrequently reflect local traffic conditions and characteristics, leading to inaccurate results. VISSIM's results are questionable if they deviate significantly from actual field data. Our model calibration converged as expected since we used parameters measured in the field and collected data with a high degree of precision. There is a formula for calculating GEH, which is then used as a calibration indicator to validate the model's accuracy. According to the literature (Oketch and Carrick 2005), a GEH value below 5 indicates a satisfactory fitness level between observed and predicted hourly volumes. Based on the data shown in Table 1, the maximum values of GEH for segment three do not exceed 4.816, which is considered to be within safe parameters. As seen from the above, the produced models have the potential for additional applications in testing various scenarios, and the simulation model reasonably agrees with the data.

$$GEH=\sqrt{\frac{2*(m-c)^2}{(m+c)}}$$

Table1: GEH Statistics

Segments	Flow (field)	Flow(model)	GEH
1	250	183	4.553
2	292	236	3.446
3	280	205	4.816
4	304	262	2.301

4. DATA ANALYSIS

Traffic volume, speed, and level of service were derived from the VISSIM model after modeling and simulations were done according to the initial site circumstances. After removing all on-street parking spaces and applying the proposed scenario, new traffic flow measurements and level of service were taken. The number of vehicles was obtained from the data collection results object in the menu bar, The speed was obtained from the link segment result, and The level of service was obtained from node results, as shown in Figure 11. The data show a wide range of situations with and without on-street parking. The statistical significance of the differences between the on-street parking and proposed off-street parking in the study area scenarios was determined using the Paired t-test, and the corresponding p-values are shown graphically in the accompanying charts.

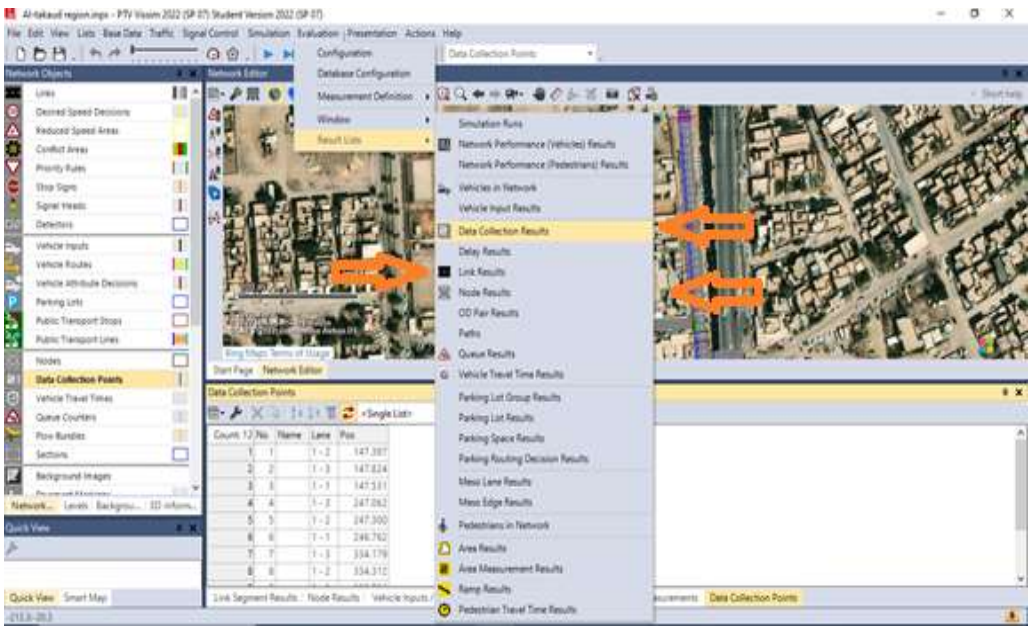

Figure 11: The result list object in PTV VISSIM software

4.1 TRAFFIC VOLUME

Volume results were taken from VISSIM on the Al-takaud region. Traffic volume results are summarized in Table 2 and depicted in Figure 12, showing the p-value of the t-test in the original state in the presence of on-street parking and after applying the proposed scenario where the on-street parking was removed. From the simulated model, it was observed that the number of vehicles would increase when removing the on-street parking and the proposed scenario applied.

Table 2:Number of Vehicle from the Simulation Run in PTV VISSIM Software

Segment	Number of vehicles with on-street parking	Number of vehicles with the proposed scenario
1	183	300
2	236	397
3	205	392
4	262	434

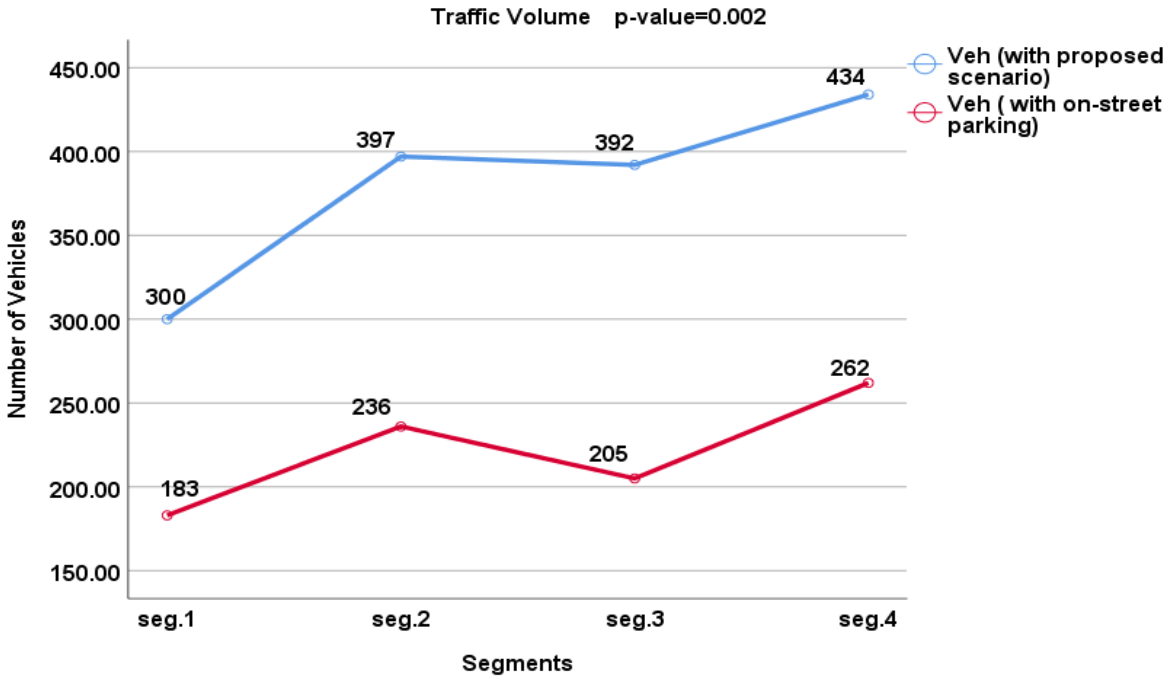

Figure 12: Traffic volumes with on-street parking and the proposed scenario on four segments in AL-takaud region(Significant difference between the means from paired t-test).

4.2 SPEED ANALYSIS

This study also found that removing on-street parking increased street speed since vehicles entering traffic from parking bays slowed the flow of traffic. Given these findings, it is recommended that on-street parking be eliminated to reduce the impact of parking maneuvers on through-traffic flow. Table 3 summarizes the results of the speed analysis, depicted in Figure 13, where this figure illustrates the t-test's significance level.

Table 3:Speed from the Simulation Run in PTV VISSIM jk h hi Software

Segment	The speed with on-street parking	Number of vehicles with the proposed scenario
1	3.18	31.32
2	4.11	27.55
3	4.92	16.36
4	5.68	12.66
5	9.37	17.27
6	7.97	18.87
7	23.08	21.78
8	8.24	29.75

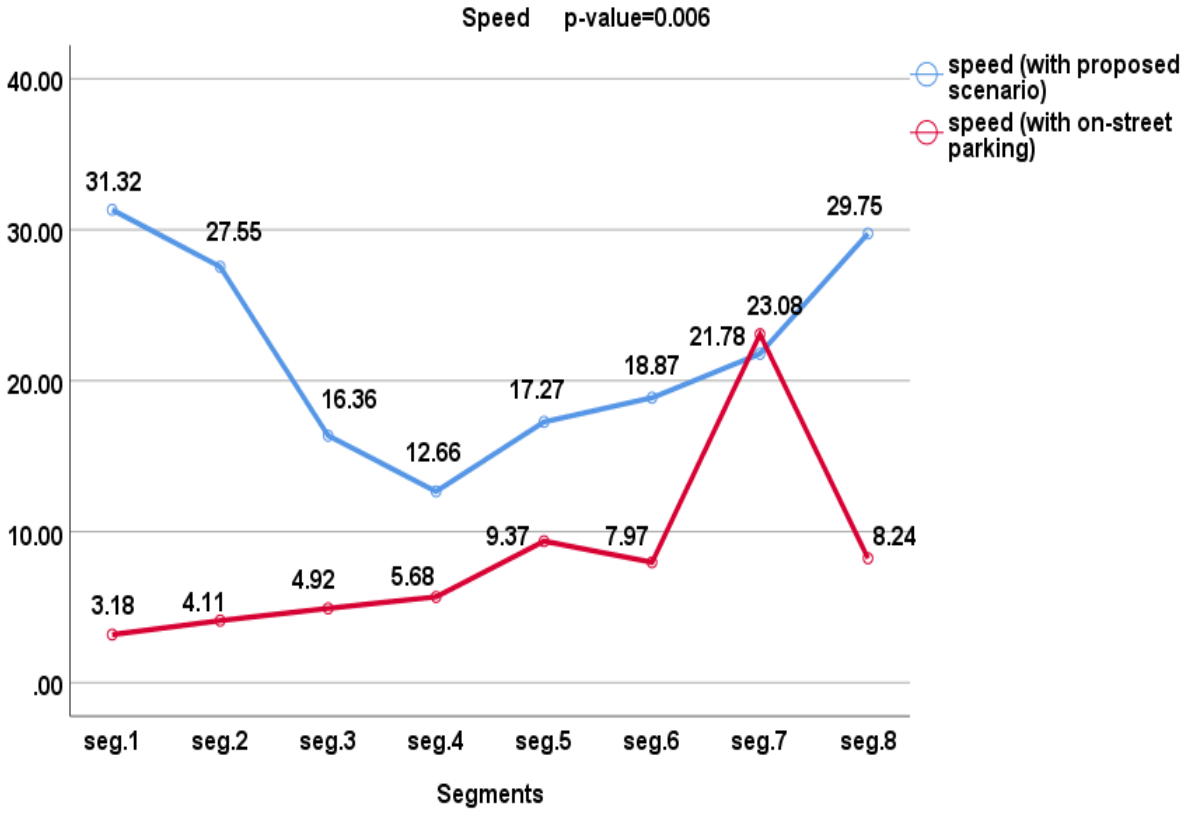

Figure 13: The speed with on-street parking and the proposed scenario on four segments in the Al-takaud region (Significant difference between the means).

4.3 LEVEL OF SERVICE ANALYSIS

LOS is F for most nodes in on-street parking, but after removing it, LOS is optimized for all nodes to A, as shown in Figure 14. level of service results are summarized in Table 4.

Table 4:level of Service from the Simulation run in PTV VISSIM Software

Nodes	LOS with on-street parking	LOS with the proposed scenario
1	F	A
2	F	A
3	F	A
4	E	A

5	C	A
6	A	A
7	A	A

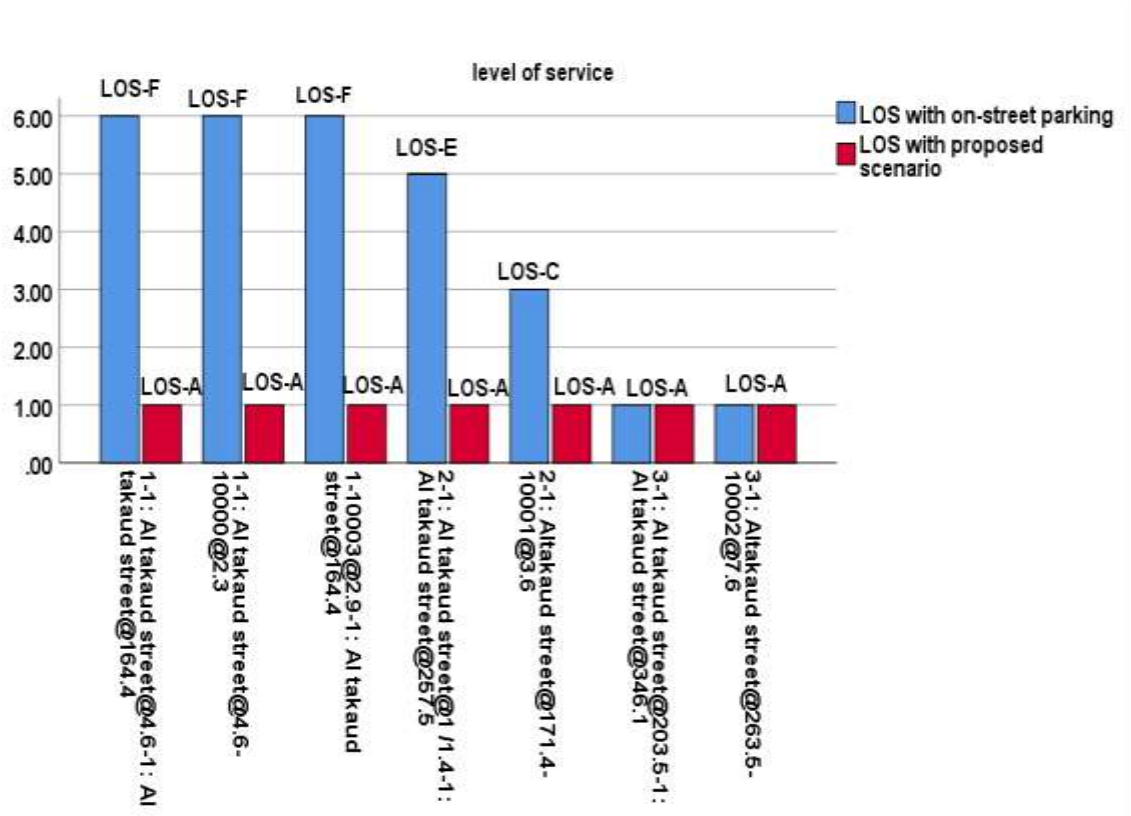

Figure14: Level of Service with and on-street parking And with the proposed scenario in the Al-takaud region

4.CONCLUSION

The study area is essential because it contains many institutions and auditors, so this crowded area must be evaluated and the necessary solutions should be put in place for parking vehicles. This research aimed to assess how maneuvers to park on the side of the road affect the pace and volume of traffic. When analyzing traffic flow, speed, and service level for the effect of vehicle parking on street flow in the Al-takaud region in the center of Hilla City, the level of service is F for all segments. There were empty spaces under the Al-um Bridge, which were used, and parking spaces were made. The level of service was raised to reach A. Also, the number of vehicles and speeds increased. According to the analysis, with this achievement, solving the problem of the crowded area was completed, especially during official working hours and peak times.

FUTURE WORK

Conducting a study of areas with similar conditions regarding vehicle congestion due to stopping problems to evaluate them and suggest solutions for those areas.

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