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Evaluation and Improvement of Three-Leg Intersections: A Case Study in Amman City

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COMMITTEE DECISION

This Thesis (**Evaluation and Improvement of Three-Leg Intersections: A Case Study in Amman City**) was successfully defended and approved on 11/08/2020.

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DEDICATION

This humble effort is dedicated to my esteemed parents for their love, care for me, and sacrifices for my education and preparing me for my future.

To my wife, who was a continuous source of support and encouragement during the challenges of this study.

To all my dear brothers and sisters.

To the soul of my dear uncle, who wished me success always and forever.

To everyone who wishes good to me.

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- ATM Active Traffic Management
- AWSC All-Way Stop Control
- BRT Bus Rapid Transit
- EB Eastbound
- GAM Greater Amman Municipality
- HCM Highway Capacity Manual
- HCS Highway Capacity Software
- LOS Level of Service
- MOEs Measures of Effectiveness
- MUTCD Manual on Uniform Traffic Control Devices
- NB Northbound
- PHF Peak Hour Factor
- PHV Peak Hour Volume
- SB Southbound
- TDM Transportation Demand Management
- TSM Transportation System Management
- TWSC Two-Way Stop Control
- V/C Volume to Capacity ratio (Degree of Saturation)
- VMS Variable Message Sign
- WB Westbound

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ABSTRACT

The rise in car ownership in the last decades in Jordan caused high traffic demand in most of the urban roadway network in Amman City, especially in the peak periods. The growth in traffic demand results in congestion on the urban network, high delay, low Level of Service (LOS), and more fuel consumption and air pollution. Intersections are considered as the most critical elements in the urban roadway network, therefore, the evaluation of intersections within the network helps the decision-makers to improve the traffic operation performance, in short, medium, and long-term periods of time. Based on these facts, this study involves evaluating and improving six 3-leg signalized intersections and four 3-leg unsignalized intersections at different locations in Amman City using HCS-2010 and Synchro-10 computer software and validated by VISSIM-11 simulation tool and manual calculation. The evaluation and improvement for each intersection are conducted for the existing and short-term traffic conditions (Year 2019 and Year 2024, respectively). The results of the evaluation revealed that all intersections operate at LOS-E or breakdown condition (LOS-F) during peak hour period. Many low-cost solutions such as prohibiting on-street parking, prohibiting U-turn, adding additional lanes for minor-street and major-street, redirection of flow, and optimization of the cycle length were suggested on the existing and short term period assuming growth rate of 5.5% combined with strict law enforcement. The output results of the used software showed significant improvements such as a reduction in delay, number of stopped vehicles, and fuel consumption. The operational performance was also improved to LOS-C or LOS-D at all six selected signalized intersections.

For unsignalized intersections, the evaluation process showed that the current left-turn from the minor-street faces high delay and operates with LOS-F. To prioritize traffic movements at these four intersections, the installation of traffic signals was suggested and justified according to warrant 3; Peak Hour Volume only. The results

showed that three intersections are warranted for signalization under the existing conditions while the fourth is warranted for signalization only in the short-term period. Also, the optimum cycle time was selected for each intersection with two operation modes for left-turn from the major street; Protected and Protected-Permitted. Accordingly, the LOS of the minor approach improved to LOS-C or D as well as the LOS of the entire intersection to LOS-C or D.

Finally, flow management diagrams with bar charts were prepared for decision-makers to show and summarize the improvements results in the existing and short-term condition based on the output resulted from HCS-2010 and Synchro-10 software and validated by VISSIM-11 simulation tool.

Further medium- and long-term improvements of the urban road network in Amman require costly infrastructures such as overpass interchanges or underpass tunnels. Therefore, it is recommended to apply transportation demand strategies to reduce travel demand besides applying useful sustainable transportation that is based on the five pillars; public transportation, electrical vehicles or hybrid, carpooling, bicycle, and walking.

Keywords: Three-Leg intersection, Signalized Intersection, Unsignalized Intersection, Synchro Software, VISSIM Software, Traffic Signal Warrants, Project Management, Transportation System Management (TSM).