

Research Report Summary



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Analysis of Driver Behavior and Operations at Intersection Short Lanes

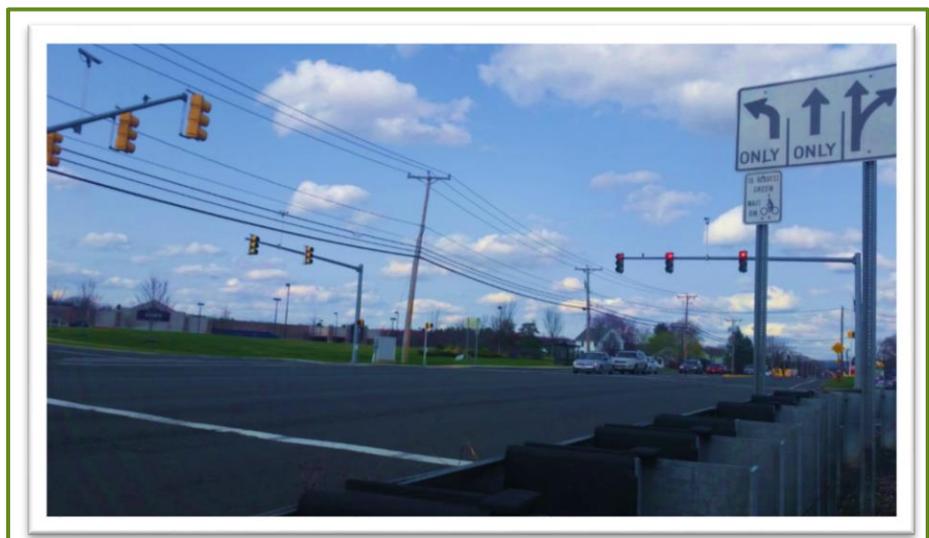
A Microsimulation and Driving Simulation Analysis of Auxiliary Through Lanes

With the ever-increasing demand to add roadway capacity in a safe and efficient manner, the application of auxiliary through lanes (ATLs) at intersections has increased in recent years. ATL intersections exist when there is an added through lane introduced upstream of a traffic signal and removed downstream of the intersection via a gradually tapered merge. In theory, these lanes increase the capacity of signalized intersections with minimal, if any, impact on safety; however, the intersection geometry presents several unique challenges for drivers. Furthermore, the benefits of increased capacity are only realized when drivers are making decisions that maximize the utilization of the introduced ATL and safety is not compromised.

The current research effort employed driving simulation, microsimulation, and field study to evaluate operational efficiency

of ATLs and driver performance elements related to their operation. The initial hypothesis evaluated the extent to which current field operations are reflective of modeled or predicted operations. This was evaluated in microsimulation and considers traditional intersection performance measures amongst others. Subsequent to that initial analysis, the remaining hypotheses evaluated were primarily related to auxiliary through lane utilization. More specifically, the focus was on

which factors contribute to drivers' decision making regarding use in these intersections. The driving simulation portion of this research investigates human decision making at ATL intersections. This behavioral data was evaluated against our previous findings in microsimulation and in the field. The results provide evidence to suggest optimal ATL design for maximizing driver performance and, subsequently, intersection capacity and safety.



Auxiliary through lanes were observed via field study, microsimulation, and driving simulation, emulating a rural signalized intersection. The field study verified the concern for underutilization of ATLs and analyzed the geometric design variance in causing this concern. A microsimulation model was utilized to further develop evidence for underutilized ATLs as well as provide evidence towards typical average queue lengths at ATL intersections. The driving simulation study developed a human behavioral perspective in understanding the reason behind this problem. The design of this study focused on combining the geometric design alternatives, as well as the queue variance, to determine whether they had a significant impact on the driver. While the strongest statistical significance lay with the basis of familiarity versus unfamiliarity with ATLs, the downstream merging design proved to affect the drivers significantly. Future research should target this downstream merge geometry to determine whether a joint-merge design would lead to better intersection performance. A modification in the downstream design of these intersections could lead to a more balanced utilization of ATLs and CTLs in the upstream and, therefore, higher performance of the intersection.

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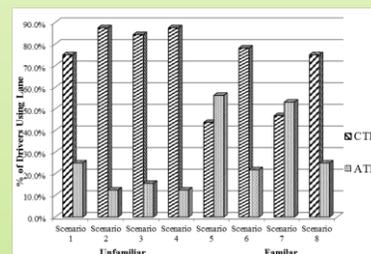
References

1. Bugg, Z., Nagui, R. M., & Schroeder, B. (2013). Lane choice model for signalized intersections with an auxiliary through lanes. *Journal of Transportation Engineering*, 139(4), 371-378.
2. Feldblum, E. G. (2005). *Alternative merge sign at signalized intersections* (Report No. CT-2233-F-05-4). Newington, CT: Connecticut Department of Transportation.
3. Nevers, B., Hermanus, S., Merezczak, Y., & Clark, Z. (2011). *Guidelines on the use of auxiliary through lanes at signalized intersections* (NCHRP Report No. 707). Washington, DC: National Cooperative Highway Research Program.
4. Ring, J. B., & Sadek, A. W. (2012). Predicting lane utilization and merge behavior at signalized intersections with auxiliary through lanes in Buffalo, New York. *Journal of Transportation Engineering*, 138(9), 1143-1150.

RTI Driving Simulator Results



Auxiliary through lane variations were analyzed through participant data collected on the ISA model developed within the simulator.



Binary results reveal that there is a significant impact on the familiarity of auxiliary through lanes, as opposed to unfamiliarity.

	P-Values from Paired t-tests				Total
	Scenario 1 & 2	Scenario 3 & 4	Scenario 5 & 6	Scenario 7 & 8	
Queue vs. No Queue	0.16	0.71	<0.01	<0.01	0.87
Familiar vs. Unfamiliar	<0.01	0.16	<0.01	0.16	<0.01
Long/Short vs. Short/Long Lane Length	0.18	1	0.66	1	0.44

† Statistical significance indicated by a P-value ≤ 0.05 and a shaded box

Familiarity yielded significant results along with variation of queue length altering the driver lane designation choice.



Example of alternative merge signs (3).