Improving Intersection Behavior through Delay-Based Left Turn Phase Initiation

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Abstract

Serving protected left turn phases for one or two vehicles can often be an inefficient use of cycle green time when the opposing through movements are over capacity. This paper assesses the performance of an intersection based on the application of controller logic that delays the call for a protected left turn phase based on vehicle wait times. Four weeks of evaluation were carried out where the delay on left turn phase calls was varied in 25 second increments, from 0 to 75 seconds. The results indicate that delaying left turn phase initiation substantially increases the amount of green time for saturated through movements, while minimally increasing the travel delay for left-turning drivers. The paper concludes by recommending agencies consider using a delay in the range of 25 to 50 seconds for calling protected phases at intersections where the opposing through movement is oversaturated and could benefit from additional green time.

JUNE 2013						
SUN	MON	TUE	WED	THU	FRI	SAT
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

0s Delay Parameter

JUNE 2013						
SUN	MON	TUE	WED	THU	FRI	SAT
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

25s Delay Parameter

JUNE 2013						
SUN	MON	TUE	WED	THU	FRI	SAT
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

50s Delay Parameter

JUNE 2013						
SUN	MON	TUE	WED	THU	FRI	SAT
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

75s Delay Parameter

Can Eliminating the Protected Left Improve the Saturated Through Movement?

Phase 1 Not Called

Phase 1 Called

Phase 1 Called – 0s Delay Parameter

Phase 1 Not Called – 25s Delay Parameter

Study Location & Intersection Layout

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Impact on Cumulative Green Time & Capacity

Cumulative green times for Phase 1 and Phase 2 (average cumulative time for each delay setting highlighted)

Additional green time and capacity served on the Phase 2 through movement

Impact on Cumulative Green Time & Phasing

Comparison of Phase 1 and Phase 2 cumulative green time

Phase 1 left turn calls

Conclusions

- Detector delay for protected/permmissive left turns can be effective where a lightly traveled left turn has a saturated opposing through movement.
- Increasing detector delay does not significantly increase left turn wait times; most drivers were able to complete turns on the permmissive phase
- Increasing detector delay on the Phase 1 approach resulted in capacity increase of 235, 415, and 580 vehicles on the Phase 2 through movement for delay values of 25s, 50s, and 75s, respectively.
- Groundtruthing tools, including time lapse photography and high resolution controller data can be used to verify intersection performance.

Wait Times & Queuing for Left Turning Vehicles

Cumulative distribution (top) and histogram (bottom) of Phase 1 left turn queue lengths

Front detector presence times on Phase 1 for 0s, 25s, 50s, and 75s detector delay values