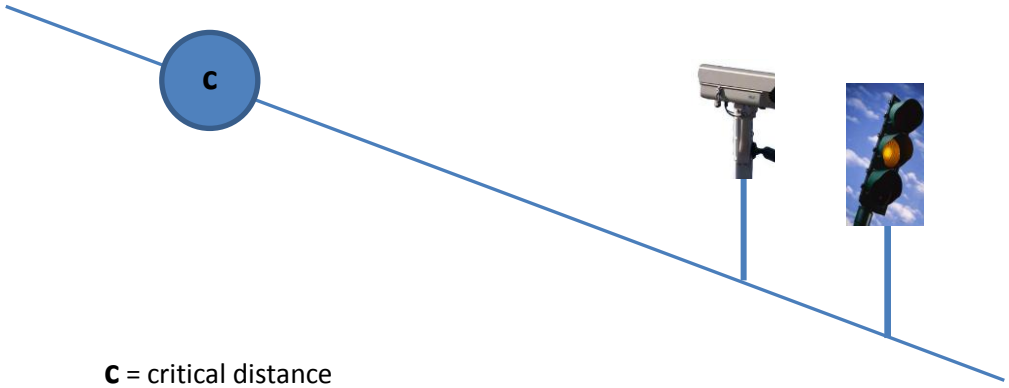
INTERSECTION ANALYSIS

Intersection

New Hope Church (EB) at Brentwood
Raleigh, North Carolina

Google Street View

Illustration



C = critical distance

Test Time

August 25, 2012 11:40 AM

Approach Speed & Grade

mph	Actual[1]	Signal Plan[2]
Speed	~43	35

degrees	Actual[3]	Signal Plan
Grade	-4%	-4%

Yellow Change Interval

seconds	Actual[4]	Signal Plan	ACS[5]	NCDOT Min Requirement	Physics[6]
Straight		4.1	4.27	4.7	7.9
Left Turn		3.0		3.0	7.9

Signal Plan

August 2007, Zachary M. Little

Red Light Camera

Straight-thru and left turning traffic

Description

The intersection is on a continuous downhill slope. It is a narrow 4-lane road with a center turning lane. The cameras face downhill waiting to catch drivers proceeding downhill or turning left on Brentwood.

Conclusion

The intersection is a typical red light camera trap. The engineer did not compute the approach speed and the approach speed is greater than the posted speed limit. The

	uncomputed approach speed makes this intersection out of compliance with the NCDOT spec. This intersection falls into the 20 – 30 mph left turn assumption. There is a lot of left turning traffic with a camera facing in that direction. This intersection has the 3.0 second left turn yellow which for -4^{o} grade means that only 20 mph cars at point C will get a chance to stop safely. The left turn yellow will force left turning vehicles legally travelling at the speed limit to run red lights. Applying the ITE Yellow Change Formula is particularly bad at this intersection as well. There are lots of drivers which have to tap their brakes to avoid hitting turning cars. The Formula will force many of these drivers to run red lights.
Failures	1. The yellow light duration does not take into approach speed due to the hill. The critical distance[7] for a 35 mph level road is 195 feet. 195 feet back from the intersection stop line places the point of measurement of v_0 and g on the hill. The previous intersection is Atlantic Ave. The distance between Atlantic Ave. and Brentwood is long enough for cars to accelerate past the posted speed limit 35 mph. The only freely-flowing cars, however, were those cars in front of the pack. These cars had an approach speed is 41 mph. About half of the cars in the middle of the pack turned and forced the surrounding drivers to tap their brakes. One should measure freely flowing traffic at night. At the Test Time, the previous traffic light at Atlantic Ave was out of sync with the light at Brentwood. When Atlantic is red, Brentwood is green. When Brentwood is red, Atlantic is green. At the Test Time, traffic never got the chance to flow freely. When these two intersections are in sync and drivers are just going straight, my best lowball estimate would be that the approach speed would be 43 mph. 2. ITE Yellow Change Interval Formula fails to provide fair warning for drivers who tap their brakes while inside the critical distance. The Formula always induces a type 1 dilemma zone for any act of deceleration with intent to enter the intersection. Drivers within the dilemma zone on the onset of yellow will have to run a red light. a. There is a lot of eastbound traffic turning left and right into the Brentwood neighborhood causing a great percentage of drivers to tap their brakes. b. There is a lot of opposing westbound traffic turning left onto Brentwood. This traffic cuts across the path of eastbound drivers. This causes a lot of the eastbound drivers to tap their brakes. c. There is a very popular gas station on the north side of New Hope Church Rd. It is more than a gas station. It is a hang-out. This gas station's entrance is within the critical distance of the signalized intersection. Drivers entering and egressing from the gas station cause many other drivers to tap their brakes.

NCDOT Requirement	The approach speed is about 43 mph. Using the AASHTO values, the ITE Formula yields the yellow change interval = 4.7 s.

Footnotes

For definitions of approach speed, critical distance the yellow change interval formula and for an explanation of the various types of problems, refer to *Misapplied Physics in the International Standards that Set Yellow Light Durations Forces Drivers to Run Red Lights*.

1. I measured the approach speed of vehicles at the critical distance using a Bushnell Speedster III Radar Gun. The accuracy of this model is +/- 1 mph. I did not take into account the cosine law, so the actual approach speed is greater than that shown here. The difference is insignificant.

2. The approach speed in the signal plan is that the traffic engineer plugged into the yellow change interval formula.

3. I measured the grade of the road using an iPad clinometer app.

4. I measured the yellow time using a Dakota Compass Stop watch. I take several measurements and then average them. So far my measurements have matched the signal plan by +/- 0.10 seconds.

5. Affiliated Computer Services (ACS) stamps a red light camera citation with the camera system's measured yellow time. The system measures the yellow time using passive magnetic inductance. The system senses a change in the intersection's yellow light circuit by sensing a magnetic field induced by its initiating electric current. It may take several tenths of a second before the yellow circuit completely closes and the yellow light bulbs illuminate. The ACS yellow interval is usually longer than the yellow duration the driver actually sees.

6. Any duration less than the laws of physics forces certain drivers to run red lights. Physics dictates the necessary yellow change interval such that both drivers progressing at a constant approach speed and drivers progressing but decelerating toward the intersection can stop or go safely without running a red light.

7. I computed the critical distance, **C**, by plugging the signal plan's speed limit and grade into the critical distance formula. I located the critical distance point using a Rolatape measuring wheel, measuring out the critical distance from the intersection's stop line.