CE361 Homework 8 **Solutions**
Traffic Control Devices **Due: Wed. 5 April 2000**

1. (10 points) **Critique of Lesson 4 in Course Notes Chapter 6.** Again, thanks for giving the authors your constructive comments.

2. (15 points) **Warrants for Traffic Signals.** All three approaches have one lane. The Volume Warrant in CNotes Table 6.4.1 calls for at least 500 vph (total of both approaches) on N. 9th St. and at least 150 vph on the only Duncan Rd. approach. These approach flows are exceeded every hour from 7:00 AM until the hour beginning 19:00 – a total of 13 hours. The Volume Warrant is met.

3. **Critical Approach Speed.**
   A. (15 points) Find major street (8th Ave.) approach speed, so that a stop sign is needed.
      - CNotes p. 6.4.12: CAS = 10 mph or less dictates use of stop sign. Find 10 mph on B scale in Figure 6.4.10.
      - Dimensions a, b, c, and d don't change, so draw lines from 10 mph on B scale through the solid and hollow dots in Figure 6.4.10 to the A scale.
      - The line through the solid dot reaches the A scale at 50 mph. The line through the hollow dot never crosses the A scale.
      - A 50 mph approach speed on 8th Ave. leads to a stop sign on Edgemont.
   B. (10 points) If parking is prohibited on the minor street (Edgemont), is a Yield Sign still appropriate?
      - Parking (or not) on the minor street affects only the c' value: c' = 6 ft; c = c' + c" = 6 + 28 = 34 ft.
      - In Figure 6.4.10, the c,d coordinates move from the hollow dot to the "X".
      - The new B scale speed is 18 mph. The 13 mph speed from the a,b solid dot still governs.
      - The Yield Sign is still the result of the CAS analysis.

4. (15 points) **Phases and Intervals in Traffic Signal Timing.** Using the data in CNotes Tables 6.4.4 to 6.4.6, Y=4 seconds and All-Red=1 second, we can create a Traffic Signal Timing Form for the intersection of First and Acorn. The best starting point is when the Green phase on Acorn begins. Note in the form below that Intervals 3 and 6 are the All-Red Clearance Intervals.

Interval	Acorn Street		First Street	
	EB LT	WB Vehs	NB Vehs	SB Vehs
1	G=25	G=25	R=30	R=30
2	Y=4	Y=4		
3	R=31	R=31		
4			G=25	G=25
5			Y=4	Y=4
6			R=1	R=1

5. **Time Space Diagrams.**
   A. (15 points) Redraw the Time Space Diagram in CNotes Figure 6.4.14, such that WB traffic on Acorn Street can also have a "green wave" without exceeding the speed limit. Do this by "sliding" the red bars for one or (only if necessary) two intersections along Acorn. What is the new offset for each intersection after your change(s)?
      - Try sliding the 2nd Street red bar so that it ends at the same time as the red bar at 1st Street, i.e., at t = 60 seconds.
      - A straight line can now be drawn WB through green phases at all three signalized intersections.
      - Because the Red phases on Acorn at 1st and 2nd Street signals end at the same time, their Green phases start at the same time. This means that the offset at 2nd Street = 0 seconds.

   B. (10 points) What is the range of "green wave" speeds available to drivers in each direction (EB and WB) after your improvements?
      - Shifting the red bar at 2nd Street does not affect the range of green wave speeds on EB Acorn Street found in Example 6.6.4B: 14.3 mph to 35 mph.
      - The event coordinates that define WB Acorn's slowest green wave trajectory are (t=27.5 sec, d=1370 ft) at 5th Street and (t=89 sec, d=50 ft) at 1st Street. The corresponding speed is
      $$\frac{(1370-50)\,\text{feet}}{(89-27.5)\,\text{sec.}} = 14.6\ \text{mph.}$$
      - For the steepest (fastest) trajectory, the coordinates are (t=offset+G+Y=27.5+25=52.5 sec, d=1370 ft) at 5th Street and (t=60 sec, d=380 ft) at 2nd Street. This translates to a speed of
      $$\frac{(1370-380)\,\text{feet}}{(60-52.5)\,\text{sec.}} = 90.0\ \text{mph.}$$
      - The range of green wave speeds for WB Acorn traffic is 14.6 to 35 mph (the speed limit).

Figure 6.4.14 (Original) Time Space Diagram for Acorn Street