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TYPICAL BACKGROUND CYCLE LENGTHS

The old saying goes in real estate that three things are important: location, location, and location. The same is true in coordinated signal timing, only the three important things are: cycle length, cycle length, and cycle length. If you select the proper cycle length for a given period then workable solutions will be obtainable along the corridor. But if the wrong cycle length is chosen then you will have considerable difficulty in achieving suitable traffic operation, regardless of how well your green splits and offsets are chosen. Selection of a cycle length that is too short for a given time period will result in cycle failures and poor progression while the selection of too long of a cycle length will result in queue blockage problems and "running of the red" (or subsequent irate phone calls) by impatient side street motorists.

My experience has shown that the computer optimization programs commonly used for arterial signal timing are not very good at picking the best cycle length. I have discovered that, in general, PASSER will recommend a cycle length that is too long whereas TRANSYT will recommend a cycle length that is too short. This is not surprising given the nature of their respective optimization algorithms. Therefore, it becomes necessary for the analyst to severely constrain the range of cycle lengths over which these programs can search in order to produce usable results. Determining this "feasible" range of cycle lengths for a given design period (such as the PM peak hour) is best done as follows:

STEP 1: Pick out the busiest intersection in the corridor. This can usually be done by simple observation. If you are unsure which is the "busiest" or want a more objective tool for making this decision, then perform an isolated intersection capacity analysis. This can be done by hand using the old 1985 Highway Capacity Manual planning level analysis (my personal favorite) or by one of many available software programs (HCM95, SIDRA, TRANSYT, TEAPAC, etc.)

NOTE: One advantage of performing a formal capacity analysis is that you can determine in advance if the intersection is "hopeless". If the analysis shows that the intersection will operate at a volume-to-capacity ratio of greater than 1.2 (or a sum of the critical lane volumes of greater than 1700), you're sunk. The niftiest timing in the world won't help you here - you either need more lanes or some form of grade separation.

STEP 2: Observe the busiest intersection during the busiest portion of the design period (such as the peak 15 minutes). Take along a stopwatch and measure the existing cycle length. If the intersection is already in coordination you will only need to do this once since it will be running a fixed value every cycle. If it is not in coordination, take the median of three consecutive cycles. For example, if cycle lengths of 121 seconds, 132 seconds and 134 seconds are recorded; the resulting median cycle length would be 132 seconds.

STEP 3: Complete the following steps for each critical movement.

NOTE: A "critical movement" is one that is associated with the heaviest combination of conflicting movements for a given street.

For our example let's assume that, during the PM peak hour, the heaviest combination of movements on the side street is associated with the southbound thru movement and the northbound left turn (not the northbound thru movement and the southbound left turn). For the main street, we will assume that the eastbound left turn and the westbound thru movement are critical (not the westbound left turn and the eastbound thru movement).

STEP 4: For each critical movement, note if phase failures are occurring.

NOTE: A "phase failure" occurs whenever vehicles that were waiting in line when the signal turned green for a particular movement do not make it through the intersection. Being "caught" by a phase failure is very frustrating to motorists.

For this example, let's assume that an average of about 8 vehicles are being caught in each of the two southbound thru lanes every cycle and about 2 vehicle are being caught in the northbound left turn lane.

STEP 5: Add 2 seconds to the existing cycle length for every vehicle (per lane) that is "caught" by a cycle failure. Continuing our example: 10 times 2 equals 20 seconds and 20 seconds plus 132 seconds equals 152 seconds.

STEP 6: Subtract from the existing cycle length any wasted green time that occurs. If a movement is getting green time even though there is only sporadic demand, then the green time can be considered "wasted". This is a judgment call, but anyone accustomed to watching traffic flow knows when green time is being inefficiently used. Estimate the amount of wasted green time and subtract it from the value obtained in STEP 5. For our example, let's assume that about 12 seconds of green time is being wasted by the westbound thru movement. The resulting cycle length is 152 seconds minus 12 seconds, which equals 140 seconds.

The resulting cycle length (140 seconds) should be the minimum value used in subsequent computer analyses. Add about 30 seconds to this value to establish a reasonable "feasible" range of cycle lengths over which to search (140 to 170 seconds). Then let the computer program pick-out the best coordination plan that falls within this range.

My experience has shown that this sort of empirical approach is the best method for determining a suitable range of cycle lengths. You can go to all kinds of trouble trying to calculate the best cycle length, using any number of available computer programs, however, it is my experience that the simplest and most accurate way is to just follow these 6 steps.

One last item regarding cycle length. In many areas of the country, including Florida, the nature of the urban arterial has changed dramatically over the years. With increasing growth and suburbanization has come wider arterials with more lanes, more traffic, longer pedestrian crossings, and more phases.

In the past we might have been dealing with four lane arterials having single left turn lanes on the main street, two phase signals, and carrying 40,000 vehicles per day. But these days it is not uncommon to have a six lane arterial with dual left turn lanes and exclusive left turn phasing on all four approaches - an arterial which may carry more than 60,000 vehicles per day. My experience has clearly shown that this type of an arterial cannot accommodate rush hour traffic without using cycle lengths of between 150 and 200 seconds. The old 120 second cycle length ceiling, which many engineers continue to cling to like it was handed down by Moses, no longer applies for many arterials.

I've done a lot of coordinated signal timing and the technicians I work with often ask me: "Do you like long cycle lengths or short cycle lengths?" They ask it with a certain gleam in their eye, hoping to place me into one camp or the other.

I always respond with the same answer: "I like the right cycle length."