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LIMITATIONS OF COORDINATED SIGNAL TIMING PROGRAMS

A number of very sophisticated, relatively easy to use, and quite useful computer programs exist for developing and documenting coordinated signal timings (PASSER, TRANSYT, SYNCHRO, etc.). However, there is always a potential problem when computer programs become "too good" and "too easy to use". This is the tendency for users to blindly rely on program results and to fail to appreciate the limitations of the programs. What are these limitations?

1. **No information on when to run the various coordinated timing plans.** If you input weekday AM peak hour turning movement counts into the computer program (along with the other required data) the programs will produce a nice timing plan for the weekday AM peak hour. And if you input the weekday PM peak hour counts, it will produce a nice timing plan for the weekday PM peak hour. The same is true for the weekday mid-day peak hour and, if you collected weekend count information, for the Saturday peak hour and the Sunday peak hour.

   So you might end up with 5 timing plans that are based on 5 different hours of the week. But the week has a lot more hours in it than 5, so over what periods do you run the various plans? And how do you know that 5 plans is enough? Maybe you need a special plan on Friday afternoons, or on Saturday evenings, or on weekday evenings, or during the Christmas shopping season, or when school is out, or during the annual SPAM festival. The computer programs won't do you much good here. Making these types of plan-implementation decisions requires a long hard look at traffic volume graphs, a lot of engineering judgment, and some tinkering once the plans are implemented.

2. **No information on when to drop from coordinated operation to "free" operation.** As the evening goes on, traffic volumes along the corridor begin to drop and eventually main street platoons become small or non-existent. When this happens, it no longer makes sense to delay side street traffic by holding the green on the main street via coordinated operation. But when is this point reached? Do the computer programs tell you when to go into free operation at night? Do they tell you when to come out of free operation in the morning? Do they tell you if free operation makes sense on the weekends or on holidays? No.

3. **No information for identifying which signals to include in the coordinated system.** Let's say you have an arterial that goes between Downtown and the suburbs and it has 11 traffic signals located along it. The first 7 signals on the Downtown end of the arterial occur within the first two miles, and then there is a three-quarter of a mile stretch where there are no signals. This is followed by a one mile stretch that has 3 signals. The last signal is located another mile away. Should all of these signals be coordinated in one system having a common cycle length? Or should the first 7 signals form one sub-system and the last 4 signals another sub-system, each with its own individually tailored cycle length? Or should the first 7 signals form one sub-system and the next 3 signals another sub-system, with the last signal running "free"? Or maybe all 11 signals should be coordinated under one cycle length during weekday AM and PM peak periods, but then "broken-up" into smaller sub-systems during off-peak periods. These are important decisions but the computer programs offer little help in this area.

4. **No information on which signals to double cycle.** When an intersection is operated at half the cycle length of the other intersections in a coordinated system, it is said to be "double cycled". For example, a 75 second cycle is a double cycle in comparison to a 150 second cycle. (One might question why it is not called a "half cycle" since it is actually 1/2 of the system cycle, but that's just the way the terminology has evolved).

   Double cycling can be a very useful treatment for one or more lower-volume intersections located within a corridor, especially if these intersections are located at the ends of the corridor where platooning may be weak. Double cycling is also a nice option when cross-coordination is being used and the cycle length needed by signals along the crossing arterial does not need to be as high as for intersections located along the major arterial.

   Although the computer programs can accommodate double cycles in their analysis, they rely on the user to decide at which intersections double cycling is appropriate. The analyst has to be smart enough to recognize a double-cycling opportunity or the potential benefit will be lost.

5. **No information on how to accommodate long pedestrian crossing times.** Wide intersections, and intersections where the frail elderly or small children cross, can have very long pedestrian crossing times. If the corresponding vehicle phase time selected by the computer program is not long enough to "cover" the pedestrian time then problems can occur when the timings are implemented. Depending on the type of controller, not covering the peds usually causes one of the following to occur:

   1.) When the pedestrian phase becomes active the main street green band is reduced.

   2.) When the pedestrian phase becomes active the controller is forced into "free" operation and progression is compromised until the intersection can transition back into coordination.

   3.) Coordinated operation cannot be achieved at the intersection in question.

   If you want to avoid this you may need to reduce your pedestrian crossing times, or increase your minimum allowable cycle length, or both. The computer programs will not solve this problem for you.

6. **No information on ...**
   Should we activate simultaneous gap for any phases? What should our permissive periods be? Do we need to hold any minor phases during certain coordinated timing plans to avoid queue spillback problems? Should we provide cross-coordination anywhere? Should we omit any phases during certain periods? What happens to coordination during railroad preemption? Fire preemption? Transit preemption? Should we use force-offs or splits? Do we need to inhibit max? What kind of offset seeking should we use? (I could keep going and going, but I think you get the picture.)

Finally, it should be recognized that the above items are not trivial, they are extremely important in the ultimate success of any signal timing project. No matter how well you run the computer programs, if you ignore these items or if you make bad judgments concerning them you will not have a successful project.

On more than one occasion a bright young engineer has come out of college with an excellent understanding of how to run the computer programs but little or no understanding of the program limitations or the complex nature of real-world coordinated signal timing. This eager engineer is instructed to "solve" the timing problems on a difficult urban corridor (nobody wants the easy corridors retimed, they're usually working fine). He or she collects the necessary data, runs the programs, puts the timings in the controller, and all seems wonderful until the telephone starts ringing off the hook with citizen and law enforcement complaints. Where did junior go wrong? He or she probably screwed-up in one or more of the areas just discussed.

One might ask, with all of these limitations to coordinated signal timing programs, why should we use them at all? The answer is obvious if you have ever tried to optimize cycle lengths, offsets, splits (and maybe even main street lead-lag phasing) by hand. This is a very time consuming task, even for a system with just a few signals. So you definitely want to use the programs, just be careful that they don't use you.