Module 4-2 tutorial
Solutions

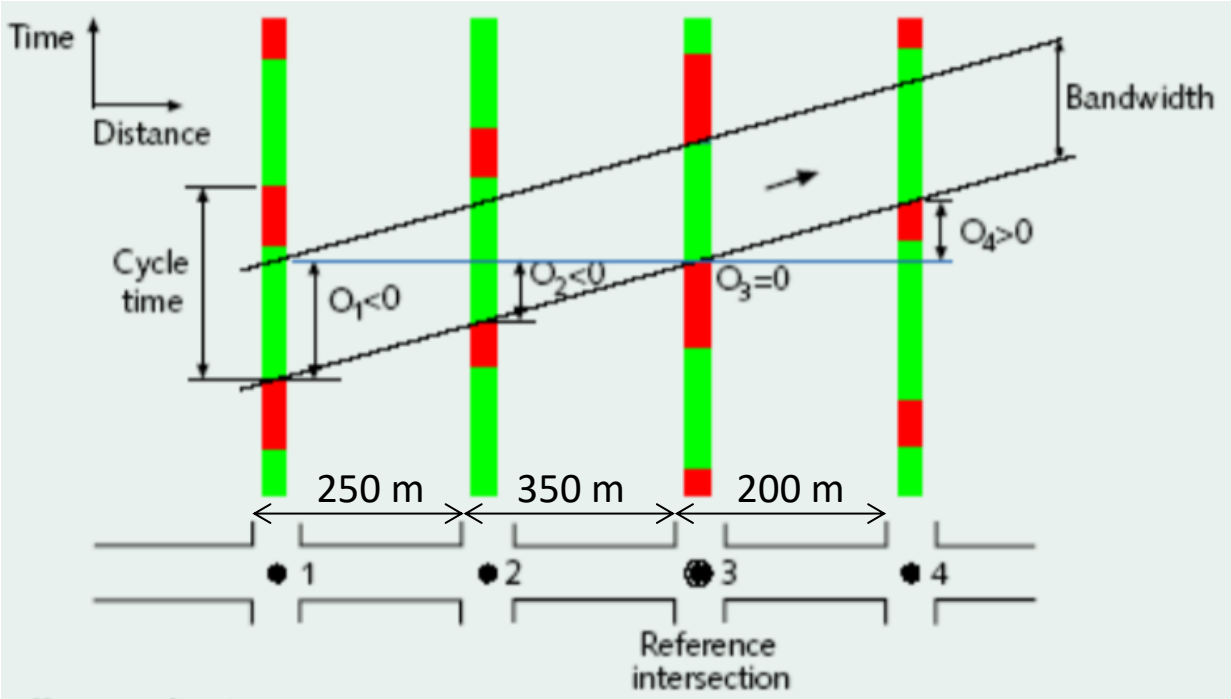
Austroads

Signalised intersections – operations and control strategies

Question 1. Consider the signal operations of four successive intersections as in the figure below. The distances between the intersections are shown in the figure. If free flow speed is 60 km/h determine

a) The offset O_1, O_2, and O_4.

b) The bandwidth.



Solution to Question 1.

a) The offsets should be determined such that the vehicles assuming travelling by the free flow speed reach to the immediate downstream intersection at the start of the green time. Simply put, in an ideal scenario with zero residual queue, the offset can be determined using O=L/v. Accordingly using free flow speed as 16.67 m/s,

O_1=(250+350)/16.67=36 s; O_2=350/16.67=21 s; O_4=200/16.67=12 s.

Note that O_1 and O_2 are negative that is these cycles should start earlier than the reference intersection 3 and O_4 is positive that means the cycle of intersection 4 to start later than the reference intersection. See the figure.

b) By having a careful look at the figure, we can determine that the bandwidth in this case is the minimum of the green time of the four intersections which is in this example is the green time of intersection 3.

Question 2. A common traffic signal practice in the city of Sydney is to ban the right turns at the intersections or at least forbid them during the peak traffic intervals. The signalized streets in those areas are mostly bi-directional with 2 lanes per direction. What are the advantages and disadvantages of this policy on the operations of traffic?

Solution to Question 2.

This practice, forbidden right turn, has several advantages especially in areas with high demand, and short block distance between signalized intersections. By banning the right turns, the number of possible movements decreases from 12 to a smaller number, perhaps 10 or even 8. This results in a smaller number of phases usually from 4 to 2. And consequently, cycle time will be significantly shorter. These are the direct effect of restricted right turns. Less phase means less loss time (which is a fraction of yellow times and all-red times) so higher capacity is expected on average. Less cycle time means on average shorter queue length (also shorter maximum queue length) that is a crucial measure in short links to avoid spillback (aka spillover). Moreover, if the links have 2 lanes the lane allocation to movements will be more straightforward, i.e. dedicated LT + dedicated Through or mixed LT and Through + dedicated Through).

The disadvantage would be a portion of vehicles need to travel more. That means average travel distance increases. Note that this increase does not necessarily lead to higher travel times as well. In nutshell, this seems a policy that deserves detailed analysis and might be beneficial.

Question 3. Assume the green times of a 3-phase traffic signal are 25, 40 and 20 seconds. What is the cycle time? Note to consider the yellow and all-red times. Check Table 6.8 of Guide to Traffic Management Part 9: Transport Control Systems – Strategies and Operations, Austroads (2020).

Solution to Question 3.

Using Table 6.8, we assume 5 seconds for each yellow time and 3 seconds for each all-red time. Also, each phase includes one yellow time and one all-red time. So, the cycle time would be 25+5+3+40+5+3+20+5+3=109 seconds. Note that for a detailed design of traffic signal timing to determine the yellow and all-red times of each phase, one should consult Appendix G4.6 of Guide to Traffic Management Part 9: Transport Control Systems – Strategies and Operations, Austroads (2020).