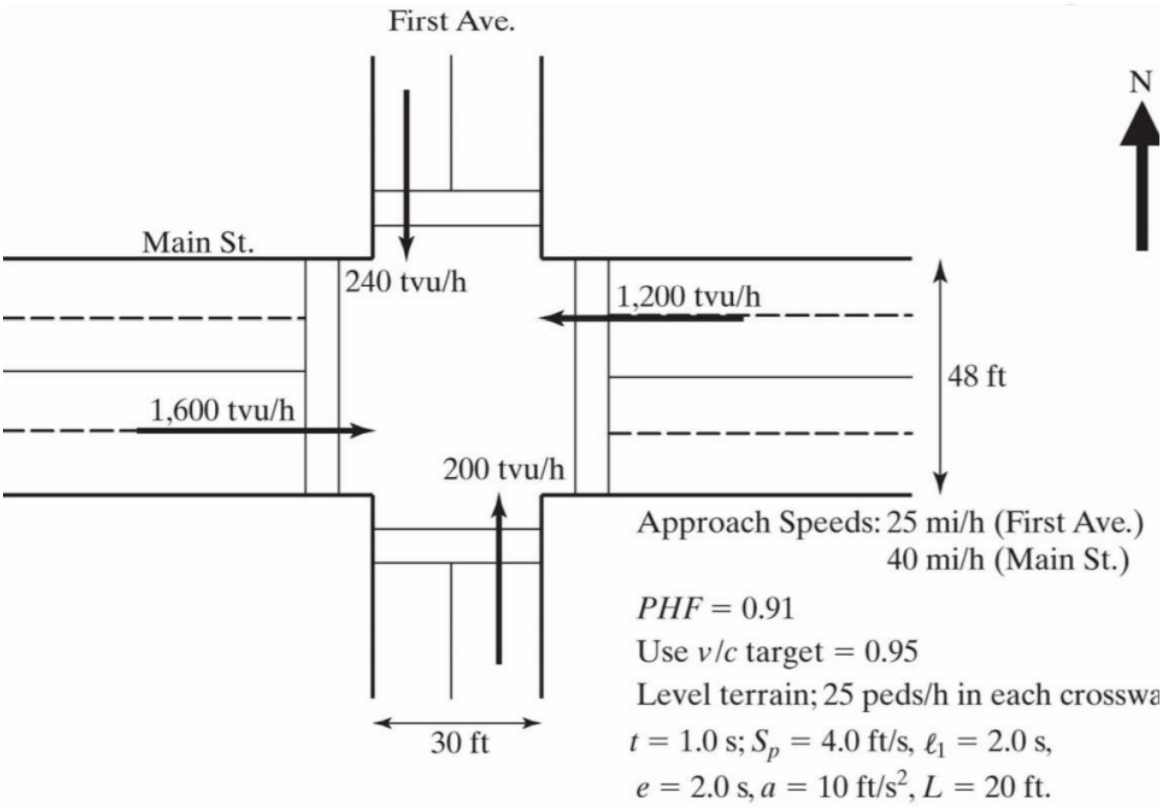
Example



Solution:

Step 1: Develop a phase plan, because this is a semi- actuated signal there are two phases, as follows:

Phase 1 – All First Avenue movement (Minor Street)

Phase 2 – All First Main Street movements (Major Street)

Step 2: Minimum Green Time and Detector Location, for a semi actuated signal, only the side-street phase is actuated and only side-street approaches have detectors. Point detectors will be used. For semi-actuated signals, the objective is generally to provide only the amount of green time necessary to clear side – street vehicles, with as little unused green time as possible. Therefore, the minimum green time for First

Avenue should be as low as possible. Using a start-up lost time of 3 sec., the minimum green time that could be allocated would be 5 sec. If G_{min1} is set at 5 sec, then the detector placement is determined by solving for d in equation:

G_{min1}=5=3+2 Int (d\25)

Int(d\25) = (5-3)\2=1.0

The detector would be placed anywhere between 0.1 and 25ft from STOP line. It must be placed such that no vehicle can enter the approach without traversing the detector.

Step 3: Passage Time for Point detectors.

For point detectors, the passage time is equal to be the maximum allowable headway (HAM). The recommended value is 3 sec. This must be greater than the passage time from the detector to the STOP line, assuming the maximum setback of 25ft.or:

PT_{min}= d\(1.47*S15)= 15\(1.47*(25-5))= 0.85 sec. < 3 sec. OK

The 3 sec. unit extension is safe and will be implemented.

Step 4: Sum of Critical –Lane Volumes

All of the demand volumes have already been converted into through vehicle equivalents (tvu). The SB movement has a higher volume than the NB movement (both approaches have one lane)> thus the critical-lane volume for Phase 1 is 240 tvu/hr. The EB volume of 1600 tvu\hr is critical for phase 2 but is divided into two lanes. Thus the critical-lane volumes,

V_c is 240+800= 1400 tvu\hr

Step 5: Yellow and All-Red Times

Lost time per cycle, to determine other signal timing parameters, an initial cycle length must be selected. This requires, however, that all lost times within the cycle be known, which requires that the yellow and all-red intervals be established. Yellow intervals and all –red intervals for each phase are estimated using equations below:

$$y = t + \frac{1.47\ S_{85}}{2a + 64.4(0.01\ G)}$$

$$y_1 = t + \frac{1.47\ (25 + 5)}{2 * 10 + 64.4(0.01 * 0)}$$

= 3.2 sec.

$$y_2 = t + \frac{1.47\ (40 + 5)}{2 * 10 + 64.4(0.01 * 0)}$$

= 4.3 sec.

$$ar = \frac{w + L}{1.47 S_{15}}$$

$$ar_1 = \frac{48 + 20}{1.47(25 - 5)}$$

= 2.3 sec.

$$ar_2 = \frac{30 + 20}{1.47(40 - 5)}$$

= 1.0 sec.

With default values of 2.0 sec. used for both l_1 and e the lost time per cycle is equal to the sum of the yellow and all-red times in the cycle, or:

L=3.2+2.3+4.3+ 1.0= 10.8 sec.\cycles

Step 8: Maximum Green (Pahse1) and Minimum Green (Phase 2)

As semi- actuated signal, the critical cycle is composed of maximum green for the side street (First Avenue Phase 1), the minimum green for the major street (Main

Street Phase 2), and the yellow and all-red intervals from each. The initial cycle length is estimated using Equation below:

$$C_i = \frac{L}{1 - [\frac{V_c}{1615 * PHF * (\frac{v}{c})}]}$$

$$C_i = \frac{10.8}{1 - [\frac{1040}{1615 * 0.92 * 0.95}]}$$

= 41.1 sec.

For a semi actuated signal, this value does not have to be rounded, green split based on cycle length are determined using Equation below:

$$g_i = (C - L) * (\frac{V_{ci}}{V_c})$$

$$g_1 = (41.1 - 10.8) * (\frac{240}{1040})$$

= 7 sec.

$$g_2 = (41.1 - 10.8) * (\frac{800}{1040})$$

= 23.3 sec.

Effective green times and actual green times are equal, given the default values of 2.0sec. For both l_1 and e. Standard practice establishes the maximum green for major as 1.5 times the above values,

G_{max1}= 1.5 *7.0= 10.5 sec.

G_{min2}= 1.5*23.3 = 35 sec.

The G_{max1} of 10.5 sec. compares favorably with the G_{max1} of 5 seconds established earlier, so no adjustment of this timing is necessary. The critical cycle length is the sum of:

$C_c = 10.5 + 35.0 + 3.2 + 2.3 + 4.3 + 1.0 = 56.3sec.$

Step 7: pedestrian Requirement

Pedestrian cross the minor street during Phase 2. Thus the pedestrian crossing requirement must be compared to the minimum green phase plus yellow and all-red provided in Phase2. For the purposes of this composition, N_{peds} which is the same for all crosswalks, will be based on the critical cycle length of 56.3 seconds.

Then:

$$N_{peds} = \frac{25}{(3600/56.3)} = 0.39\ peds/cycle$$

$$G_{p2} = 3.2 + \frac{30}{4.0} + 0.27 * 0.39 = \ 10.8\ sec.$$

G_{p2}=10.8≤ G_{min2} +Y_2

= 35.0+4.3+1.0 = 40.3 sec.

The minimum green times provides more than enough time for safe crossings of the minor street during Phase 2. No pedestrian pushbutton is needed, pedestrian signals are optional.

Pedestrians cross the major street during Phase 1, which has a minimum green time of 5.0 seconds. Checking for pedestrian's safety:

G_{p1}= 3.2+ (48\4.0) + 0.27*0.39=15.3 sec.

G_{p1}= 15.3≤ G_{min1}+Y_1

= 4.0+3.2+2.3= 9.5 sec.

Pedestrians are not safely accommodated by G_{min1}. Thus, for pedestrians crossing the major street, a pedestrian pushbutton must be provided, and pedestrian signal are mandatory. When pushed, the next green phase will provide a minimum green time of:

$G_{min1,ped}$= 15.3-3.2-2.3=9.8sec.

The pedestrian walk and clearance intervals would be as follows:

$WALK_1$= 3.2+0.27*0.38 = 3.3 sec.

Up-raised $Hand_{flashing1}$= 48/4.0=12.0 sec.