Network Signal Coordination

CIVL 4162/6162

Learning Objectives

- Define progression of signalized intersections
- Quantify offset, bandwidth, bandwidth capacity
- Compute progression of one-way streets, two-way streets, and networks
- Estimate progression by different types

Progression: Why Needed

- Where signals are close enough together
- Vehicles arrive in platoons
- It is necessary to coordinate their times so that vehicles may move efficiently through set of signals

Signal Spacing and Progression

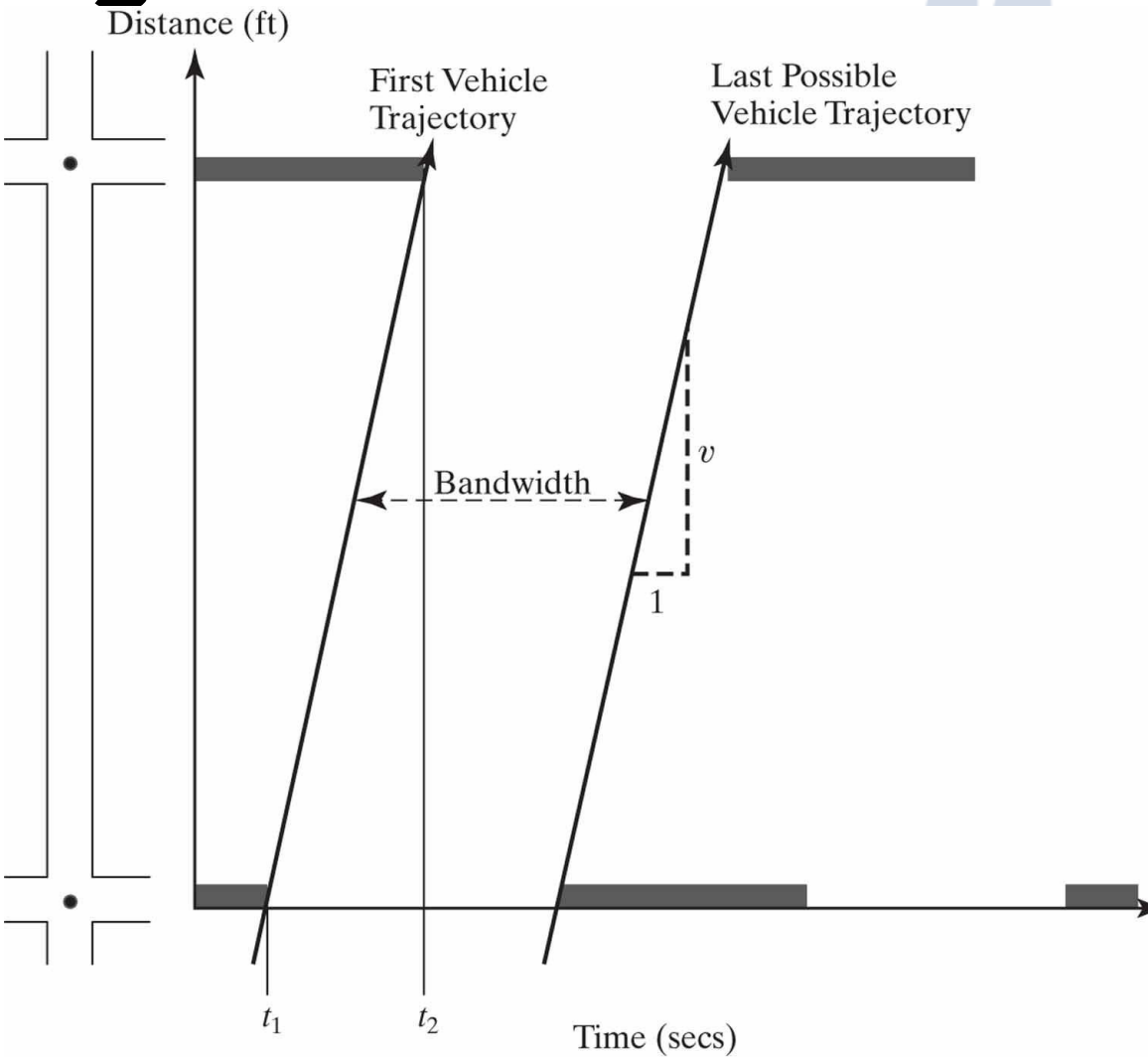
- In some cases signals are so closely spaced that they should be considered as one signal
- In other cases, signals are so far apart that they may be considered as isolated
- Common practice is to coordinate signals less than a mile apart on major streets and highways

Key Requirement

- All intersections in system are to have the *same cycle length or multiple of minimum cycle length*
  - **long enough to provide sufficient capacity at the busiest intersection**
- System cycle length is determined through a series of steps
  - **determine the minimum (optimum) cycle length at each intersection**
    - **as if they are isolated signals**

Time Space Diagram

- Path a vehicles takes as time passes
- $t=t_1$
  - first signal turns green
- $t=t_2$
  - vehicle reaches second signal
- *Offset:* Difference between green initiation times (t_2-t_1)



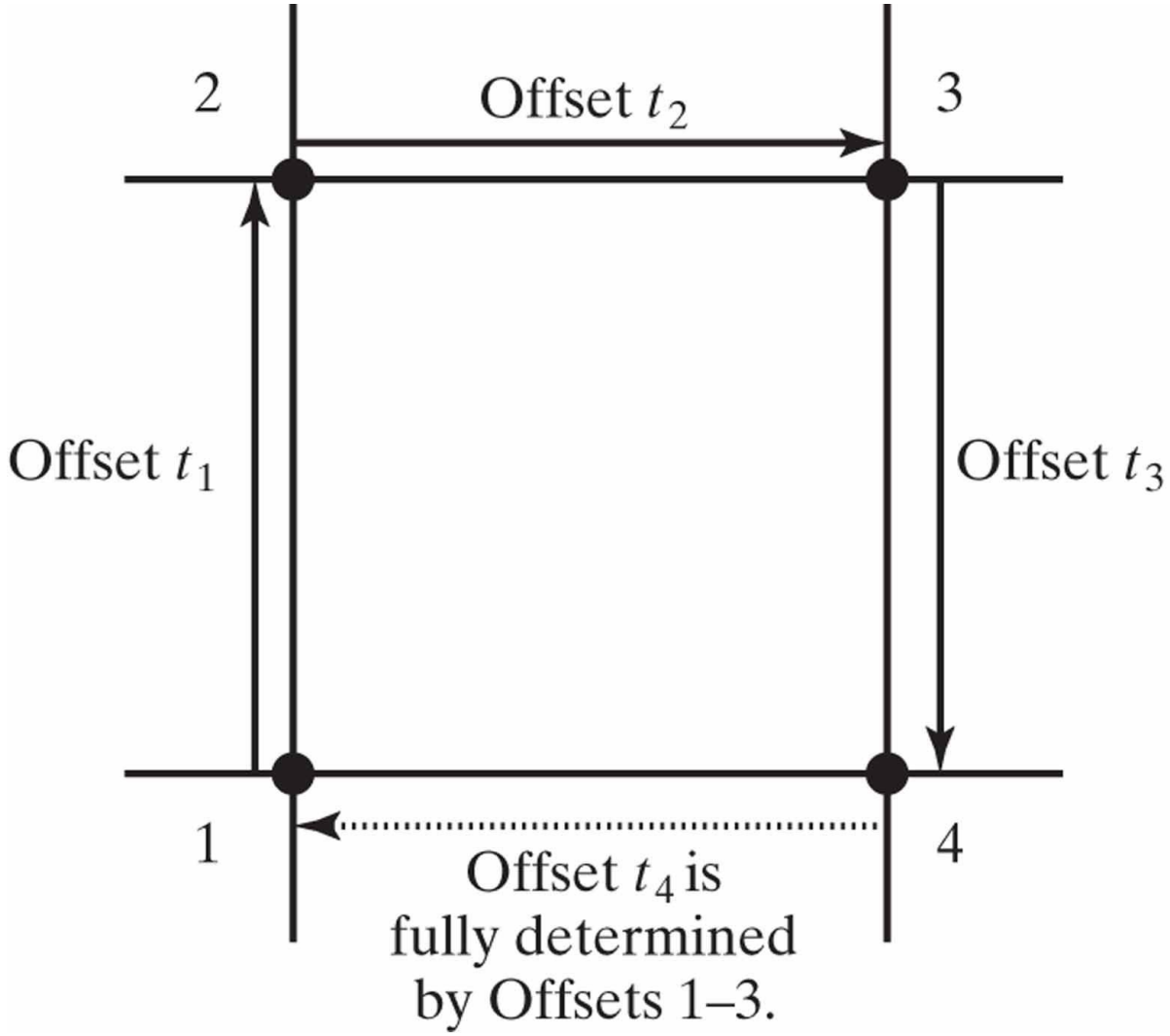
Offset

- Ideal offset is defined as time needed for the first vehicle of the platoon just arrives at the downstream signal when its green

$$t_{ideal} = \frac{L}{S}$$

  - t_{ideal}: ideal offset, sec
  - L: Distance between signalized intersections, ft
  - S: Vehicle speed, ft/sec
- Offset is a positive number between zero and cycle length

Network Level Coordination

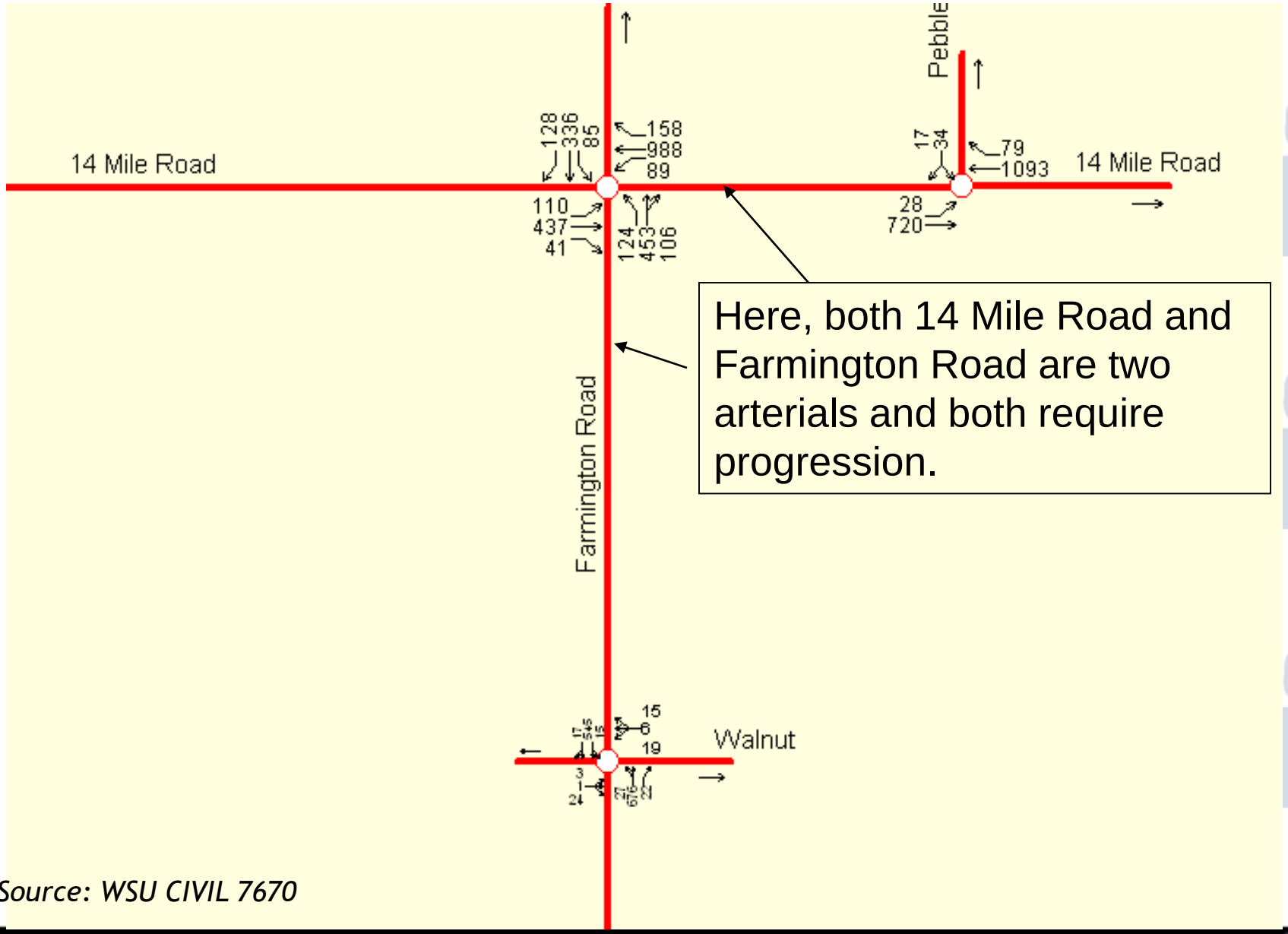


Optimization for Two or More Arterials

- When optimizing using Synchro's 'Network Cycle Length', many times it gives 'Mixed Cycle Length' (and not multiple of minimum cycle length)
- When you use mixed cycle length, the progression can not be achieved.
- In such situation, you have to analyze the arterials independently.

Optimization for Two or More Arterials

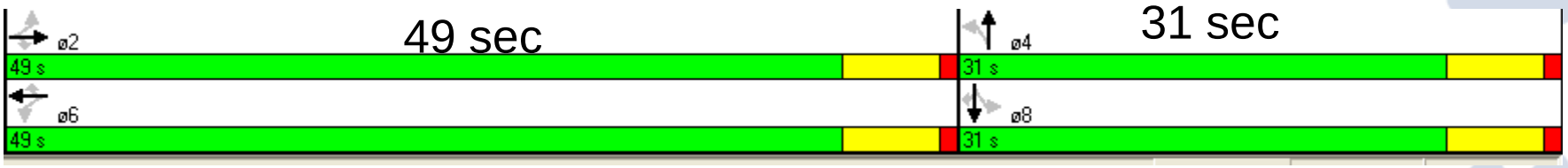
- When the arterials are separately (independently) analyzed, progression on both arterials can be achieved.
- However, the offset for both the arterials shall be adjusted such that both the arterials get the desired progression.
- Usually, offset of one of the arterial's is fixed (due to jurisdictional boundary, or other reason) and the offset for the other arterial is adjusted accordingly.



Source: WSU CIVIL 7670

Adjusting Offsets for Progression of Cross Arterials – A Practical Example -1

The timing plan for 14 Mile Road is as shown below.



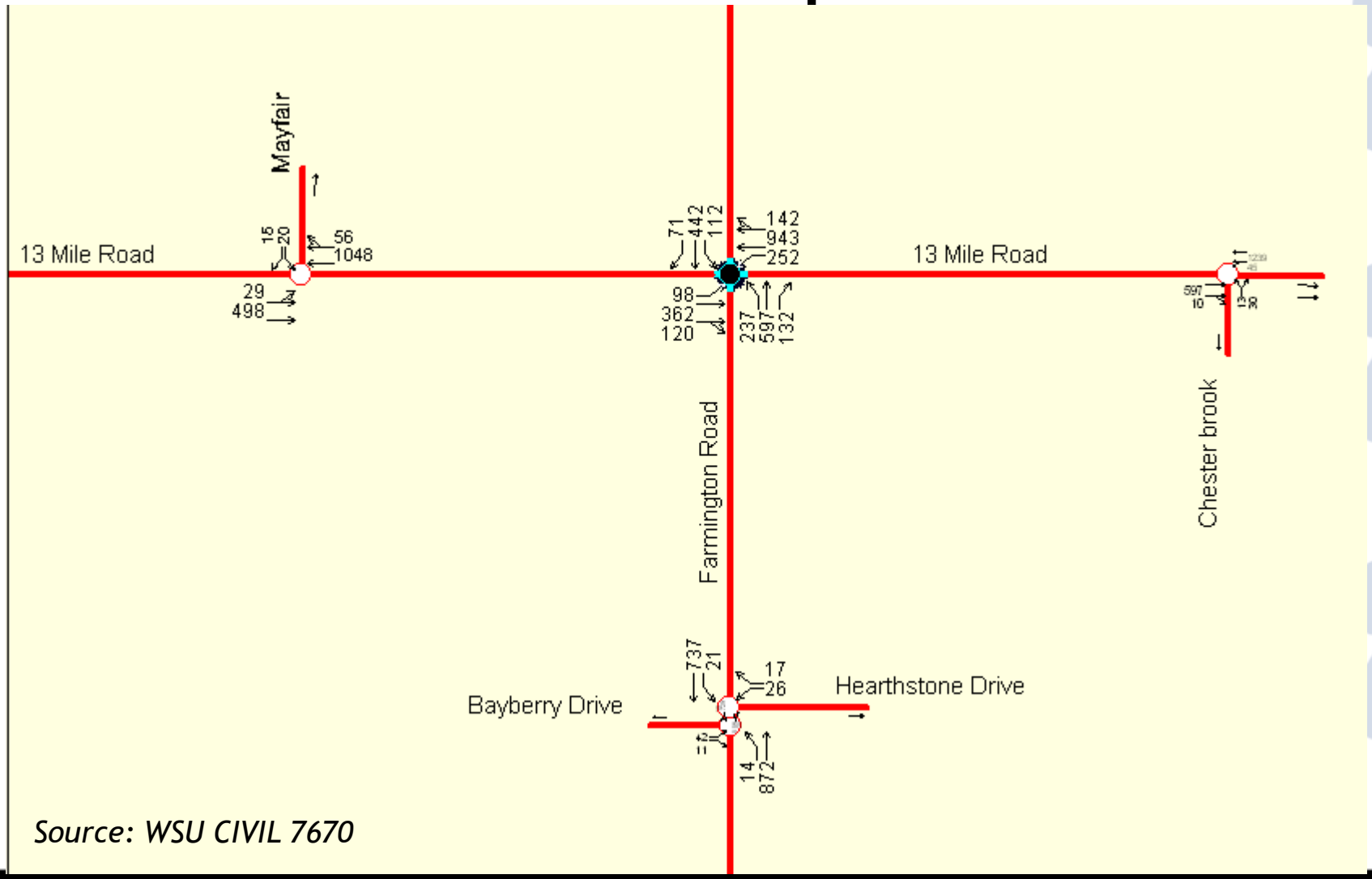
Cycle Length = 80 sec: Offset for 14 Mile Road (East-West) =29 sec)

The timing plan (splits, phasing patterns and cycle length) for Cross Arterials (Farmington Road) shall also be the same, except OFFSET for Cross Arterial (Farmington Road).

The offset for Farmington Road in this example = 29 sec+49 sec = 78 sec

Source: WSU CIVIL 7670

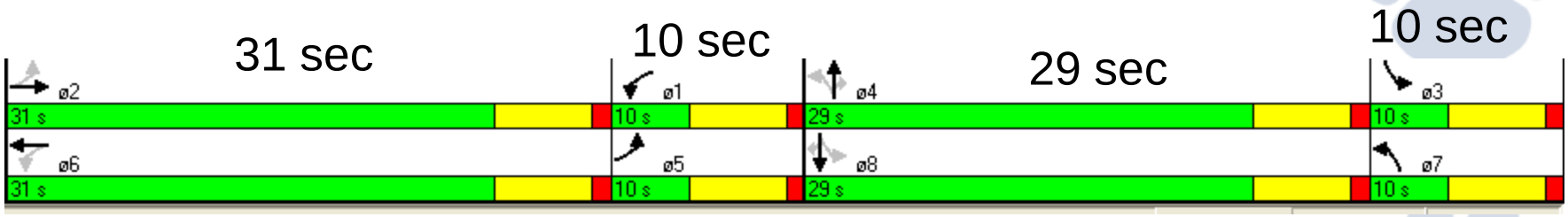
Adjusting Offsets for Progression of Cross Arterials – A Practical Example - 2



Source: WSU CIVIL 7670

Adjusting Offsets for Progression of Cross Arterials – A Practical Example - 2

The timing plan for 13 Mile Road is as shown below.



Cycle Length = 80 sec: Offset for 13 Mile Road (East-West) =76 sec)

The timing plan (splits, phasing patterns and cycle length) for Cross Arterials (Farmington Road) shall also be the same, except OFFSET for Cross Arterial (Farmington Road).

The offset for Farmington Road in this example = 76 sec+(31sec+10 sec) – (80 sec) = 37 sec

Source: WSU CIVIL 7670