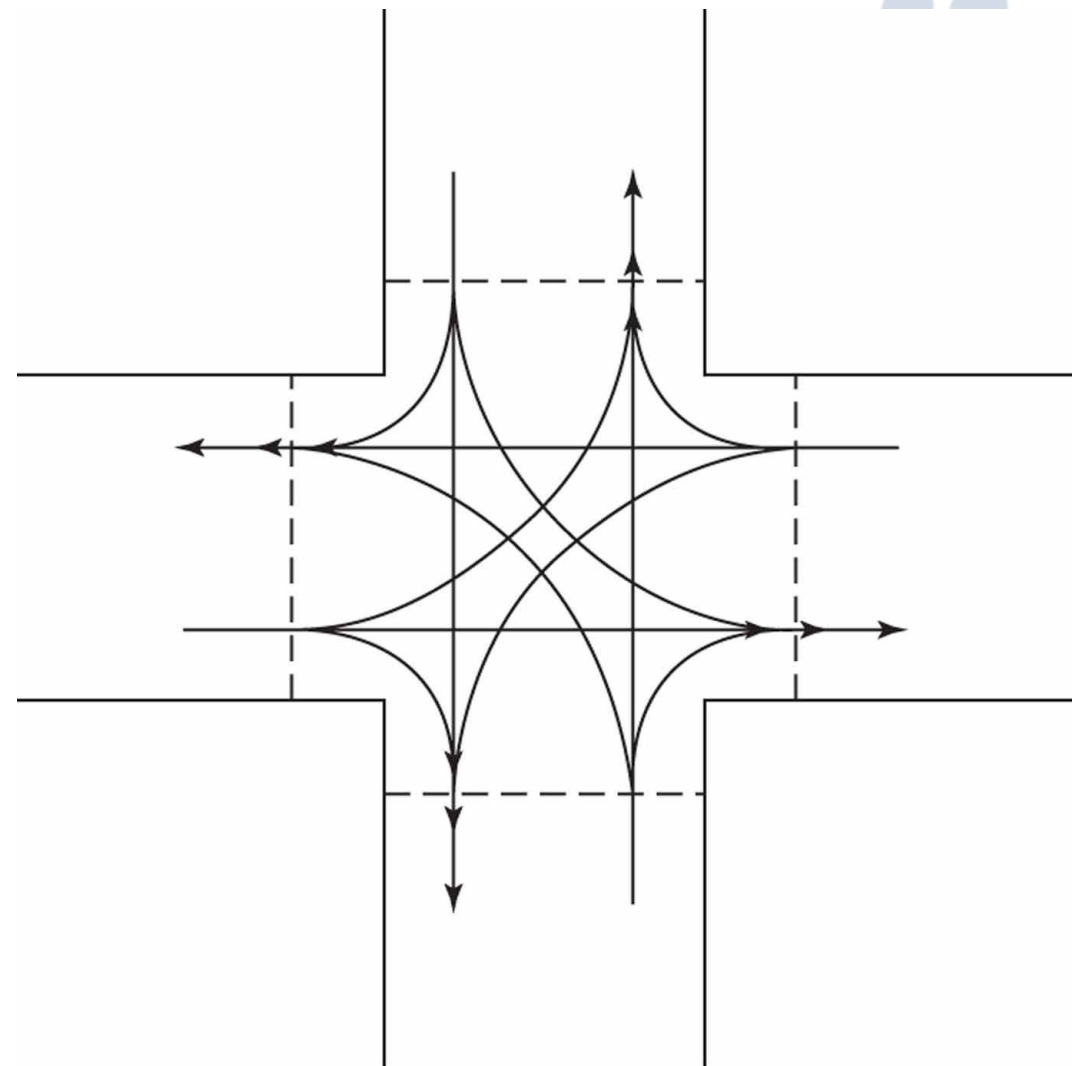


Introduction to Intersection Control

CIVL 4162/6162



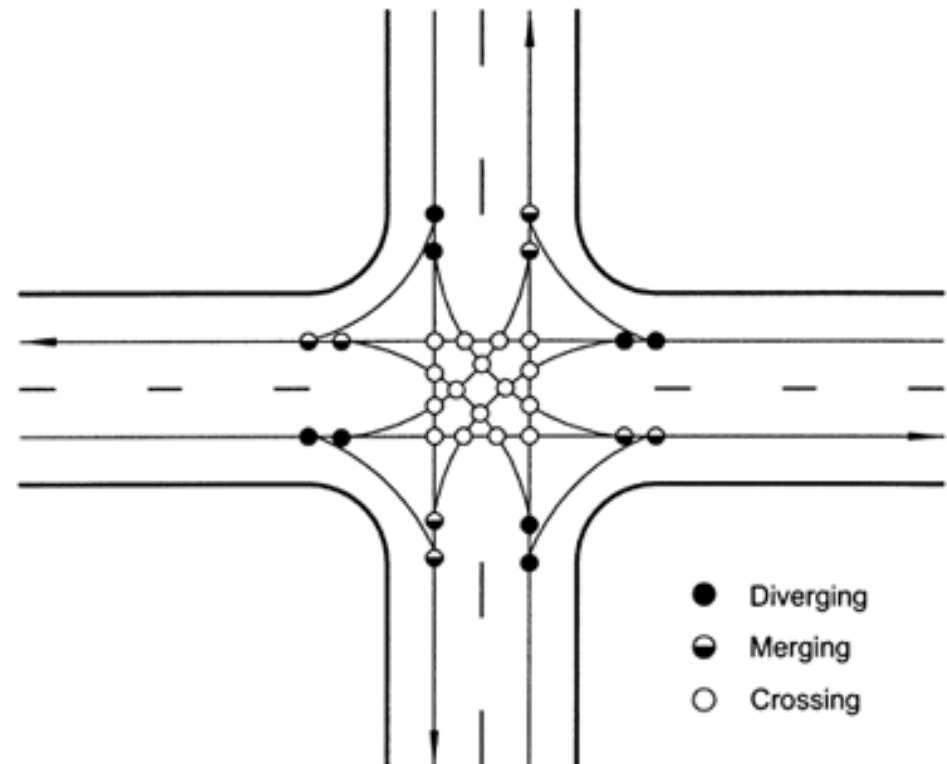
Intersection Control



Intersection Control



- # of conflicting points of conventional 4-legged intersection
 - 8 merge
 - 8 diverge
 - 16 crossing
 - 12 out of 16 from left turns

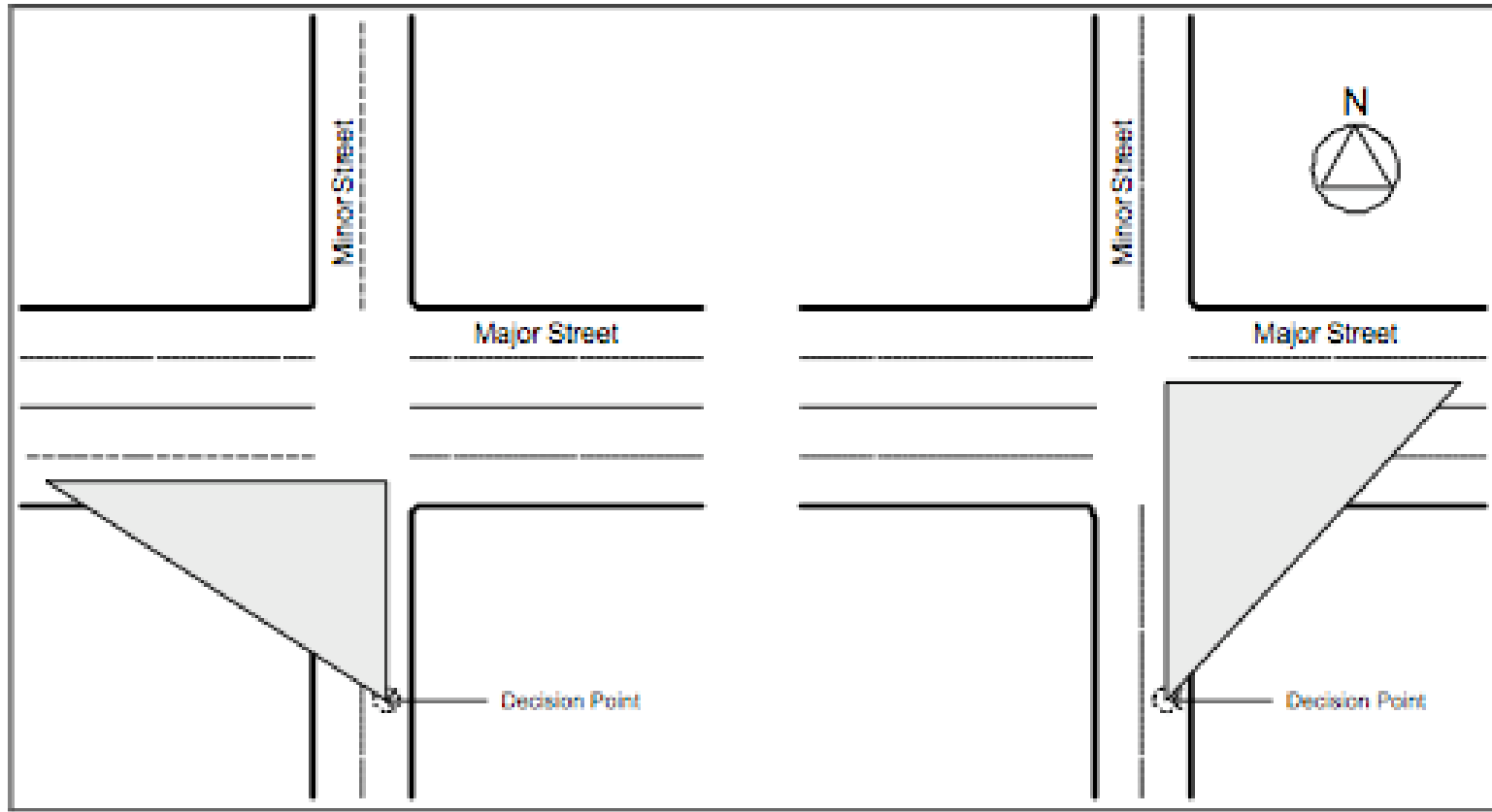


Levels of Control

- Level I - Basic rules of the road
-
- Level II - YIELD or STOP control
- Level III - signalization



Basic Rules of the Road



Stopping Sight Distance

- Stopping sight distance is composed of how many distances?
- What are they?
 - Distance traveled during perception/reaction time
 - Distance required to physically brake vehicle

Reaction time distance

Braking distance

$$SSD = 1.47Vt + \frac{V^2}{30(0.348 \pm G)}$$

V is in mph
t in sec
a in ft/sec²
G in %

Basic Rules of the Road

$$\frac{b}{d_B - a} = \frac{d_A - b}{a}$$

$$d_B = \frac{ad_A}{d_A - b}$$

Where:

d_A = distance from Vehicle A to the collision point, ft

d_B = distance from Vehicle B to the collision point, ft

a = distance from driver position in Vehicle A to the sight obstruction, measured parallel to the path of Vehicle B

b = distance from driver position in Vehicle B to the sight obstruction, measured parallel to the path of vehicle A, ft

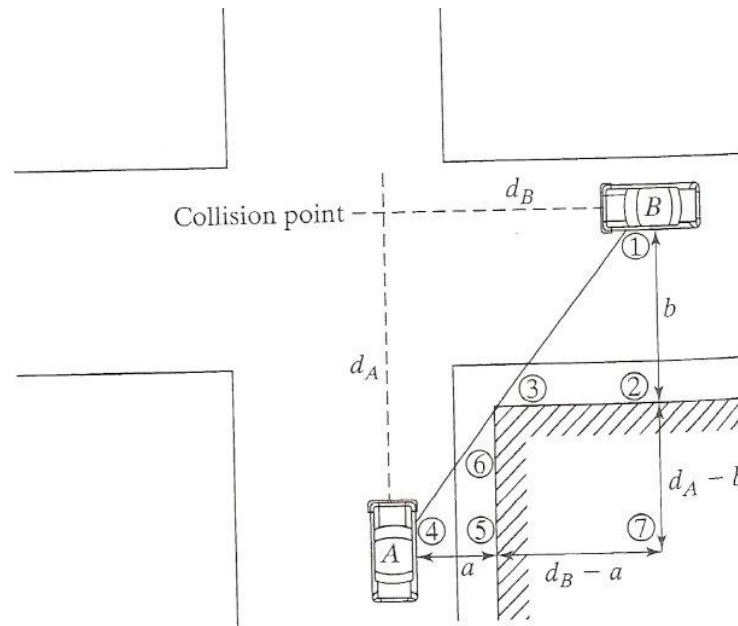


Figure 16.2: Sight Triangle at an Intersection

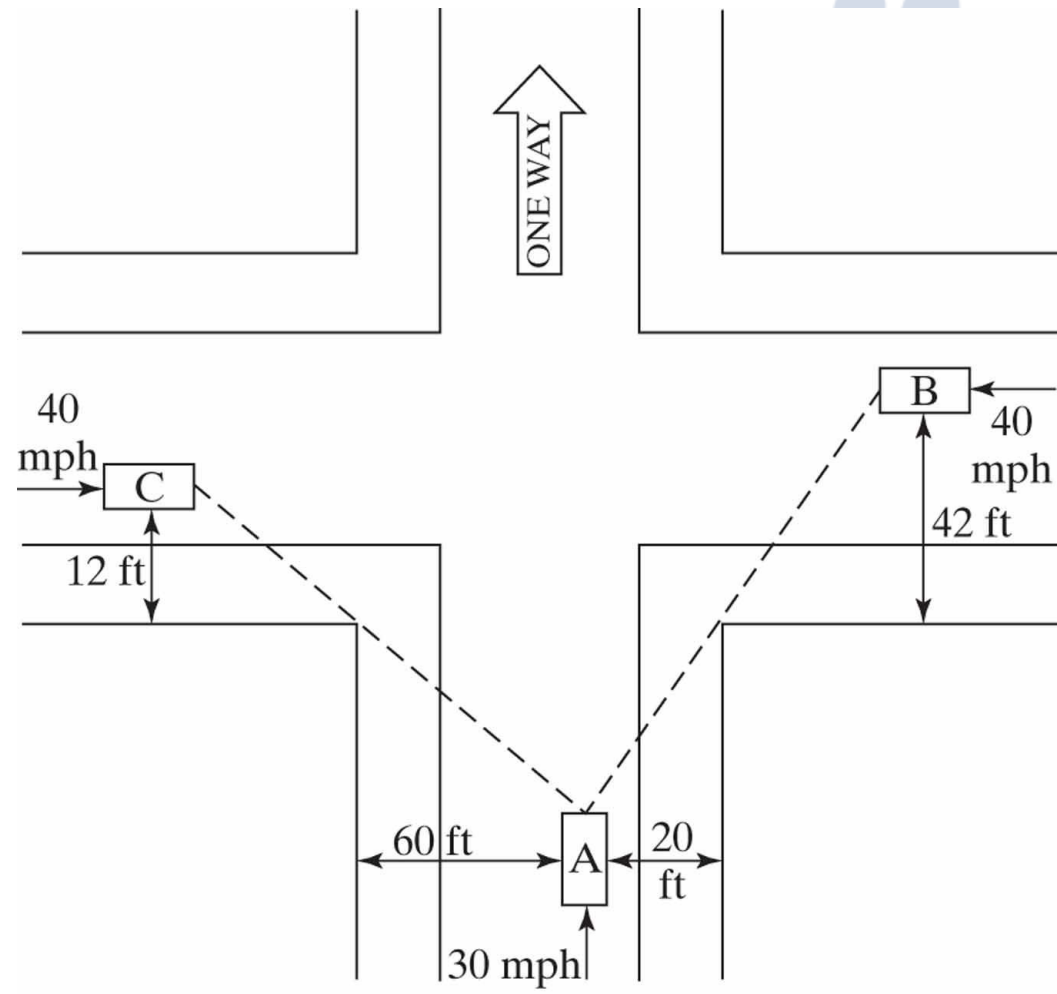


Basic Rules of the Road (2)



- 4 steps
 - Calculate d_A
 - Calculate d_{Bact}
 - Calculate minimum d_B
 - Check if $d_{Bact} < \text{minimum } d_B$, unsafe and move to Level II and III

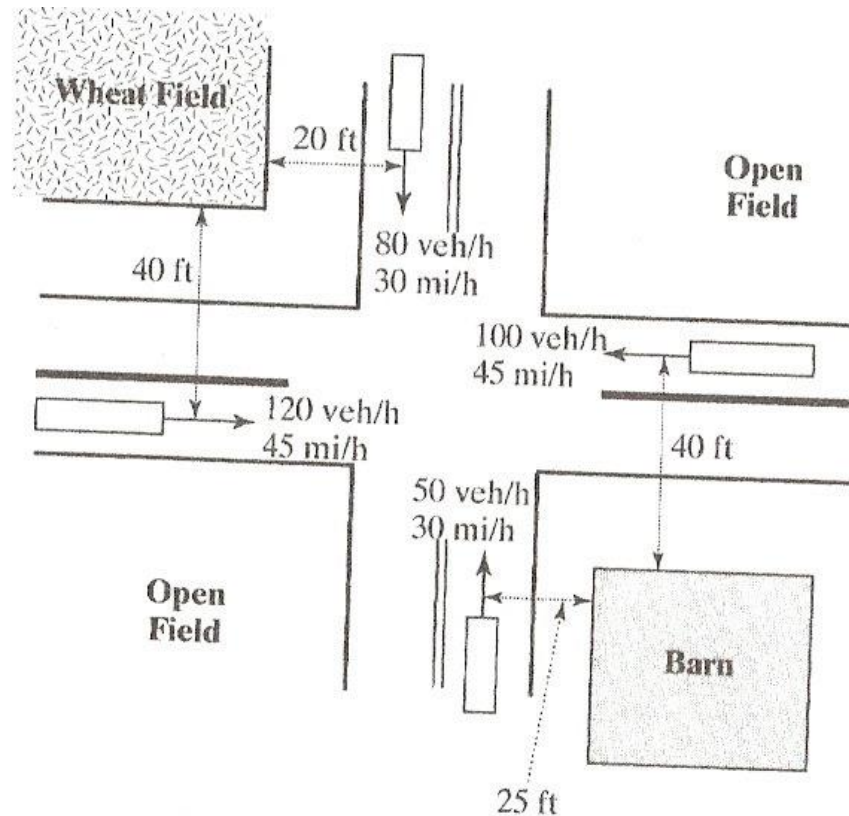
Example



(reaction time = 2.5 s, level grade)

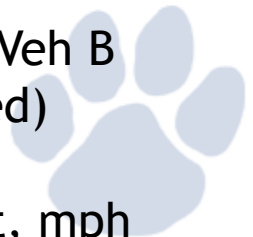
Example

- Determine if the operation will be safe or not
- If not what control would you recommend?



Reaction time, $t = 2.5$ s
 $F = 0.348$; $G = 0.0\%$

2-Way Stop Control



- MUTCD
 - [Section 2B.05 STOP Sign Applications](#)
- AASHTO guidelines based on gap acceptance

$$d_{A-STOP} = 18 + d_{cl}$$

$$d_{B\min} = 1.47 S_{maj} t_g$$

Where:

d_{A-STOP} = distance of veh A on a STOP-controlled approach from collision point, ft.

d_{cl} = distance from curb line to center of closest travel lane from the direction under consideration, ft.

Where:

$d_{B\min}$ = minimum sight distance for Veh B approaching on major (uncontrolled) street, ft.

S_{maj} = design speed of major street, mph
 t_g = average gap accepted by minor street driver

Table 18.1 Warrants for Using 2-Way STOP or YIELD Control at an Intersection

Table 18.1: Warrants for Using 2-Way STOP or YIELD Control at an Intersection

STOP or YIELD signs should be used at an intersection if one or more of the following conditions exist:

- A. An intersection of a less important road with a main road where application of the normal right-of-way rule would not be expected to provide reasonable compliance with the law;
 - B. A street entering a designated through highway; and/or
 - C. An unsignalized intersection within a signalized area.
-

(Source: Manual on Uniform Traffic Control Devices, Draft, Federal Highway Administration, Washington DC, December 2007, p. 70, available at www.fhwa.com.)

Table 18.2 Warrants for STOP Signs

Table 18.2: Warrants for STOP Signs

At intersections where a full stop is not necessary at all times, consideration should first be given to using less restrictive measures, such as YIELD signs.

The use of STOP signs on the minor street approaches should be considered if engineering judgment indicates that a stop is always required because of one or more of the following conditions:

- A. The vehicular traffic volumes on the through street or highway exceed 6,000 veh/day;
- B. A restricted view exists that requires road users on the minor street approach to stop in order to adequately observe conflicting traffic on the through street or highway.
- C. Crash records indicate that 3 or more crashes that are susceptible to correction by installation of a STOP sign have been reported within a 12-month period, or that 5 or more such crashes have been reported within a 2-year period. Such crashes include right-angle collisions involving road users on the minor street approach failing to yield the right-of-way to traffic on the through street or highway.

(Source: *Manual of Uniform Traffic Control Devices*, Draft, Federal Highway Administration, Washington DC, December 2007, p. 71, available at www.fhwa.com.)



YIELD Control and Multiway Stop



- MUTCD
 - [Section 2B.09 YIELD Sign Applications](#)
 - [Section 2B.07 Multiway Stop Applications](#)
- YIELD assigns right of way to major uncontrolled street
- Multiway may cause confusion



Yield Sign Warrant

Table 18.3: Warrants for YIELD Signs

A YIELD sign *shall* be used to assign right-of-way at the entrance to a roundabout. YIELD signs at roundabouts *shall* be used to control the approach roadways and *shall not* be used to control the circulatory roadway.

YIELD signs may be installed:

- A. On approaches to a through street or highway where conditions are such that a stop is not always required.
- B. At the second crossroad of a divided highway, where the median width at the intersection is 30 ft or greater. In this case, a STOP or YIELD sign may be installed at the entrance to the first roadway, and a YIELD sign may be installed at the entrance to the second roadway.
- C. On a channelized turn lane that is separated from the adjacent travel lane by an island, even if the adjacent lanes at the intersection are controlled by a highway traffic control signal or by a STOP sign.
- D. At an intersection where a special problem exists and where engineering judgment indicates the problem to be susceptible to correction by the use of YIELD signs.
- E. Facing the entering roadway for a merge-type movement if engineering judgment indicates that the control is needed because acceleration geometry and/or sign distance is not sufficient for merging traffic operation.

(Source: *Manual of Uniform Traffic Control Devices*, Draft, Federal Highway Administration, Washington DC, p. 73, available at www.fhwa.com.)

Table 18.4 Warrants for Multiway STOP Signs

Table 18.4: Warrants for Multiway STOP Signs

The following criteria should be considered in the engineering study for a multiway STOP sign:

- A. Where traffic control signals are justified, the multiway STOP is an interim measure that can be installed quickly to control traffic while arrangements are being made for the installation of the traffic control signal.
- B. Five or more reported crashes in a 12-month period that are susceptible to correction by a multiway STOP installation. Such crashes include right- and left-turn collisions as well as right-angle collisions.
- C. Minimum volumes:
 - 1. The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 veh/h for any 8 hours of an average day, and
 - 2. The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units/h for the same 8 hours, with an average delay to minor-street vehicular traffic of at least 30 s/veh during the highest hour, but
 - 3. If the 85th percentile approach speed of the major highway exceeds 40 mi/h, the minimum vehicular volume warrants are 70% of the above values.
- D. Where no single criterion is satisfied, but where criteria B., C1. and C2 are all satisfied to 80% of the minimum values. Criterion C3 is excluded from this condition.

(Source: *Manual on Uniform Traffic Control Devices*, Draft, Federal Highway Administration, Washington DC, December 2007, p. 72, available at www.fhwa.com.)

Traffic Control Signals

- Traffic signals must operate at all times
- If properly designed signals will:
 - Provide for orderly flow of traffic
 - Reduce frequency of some crashes
 - Increase capacity
 - Provide gaps for minor movements
- If improperly designed may:
 - Result in excessive delay
 - Increase frequency of some crashes
 - Cause disregard for the signal
 - Encourage drivers to use less appropriate routes



Traffic Signals

- Warrants
 - Warrant 1, Eight-Hour Vehicular Volume.
 - Warrant 2, Four-Hour Vehicular Volume.
 - Warrant 3, Peak Hour.
 - Warrant 4, Pedestrian Volume.
 - Warrant 5, School Crossing.
 - Warrant 6, Coordinated Signal System.
 - Warrant 7, Crash Experience.
 - Warrant 8, Roadway Network.
 - Warrant 9, Highway-Rail Crossings



Example

- Determine whether a signal is warranted

