

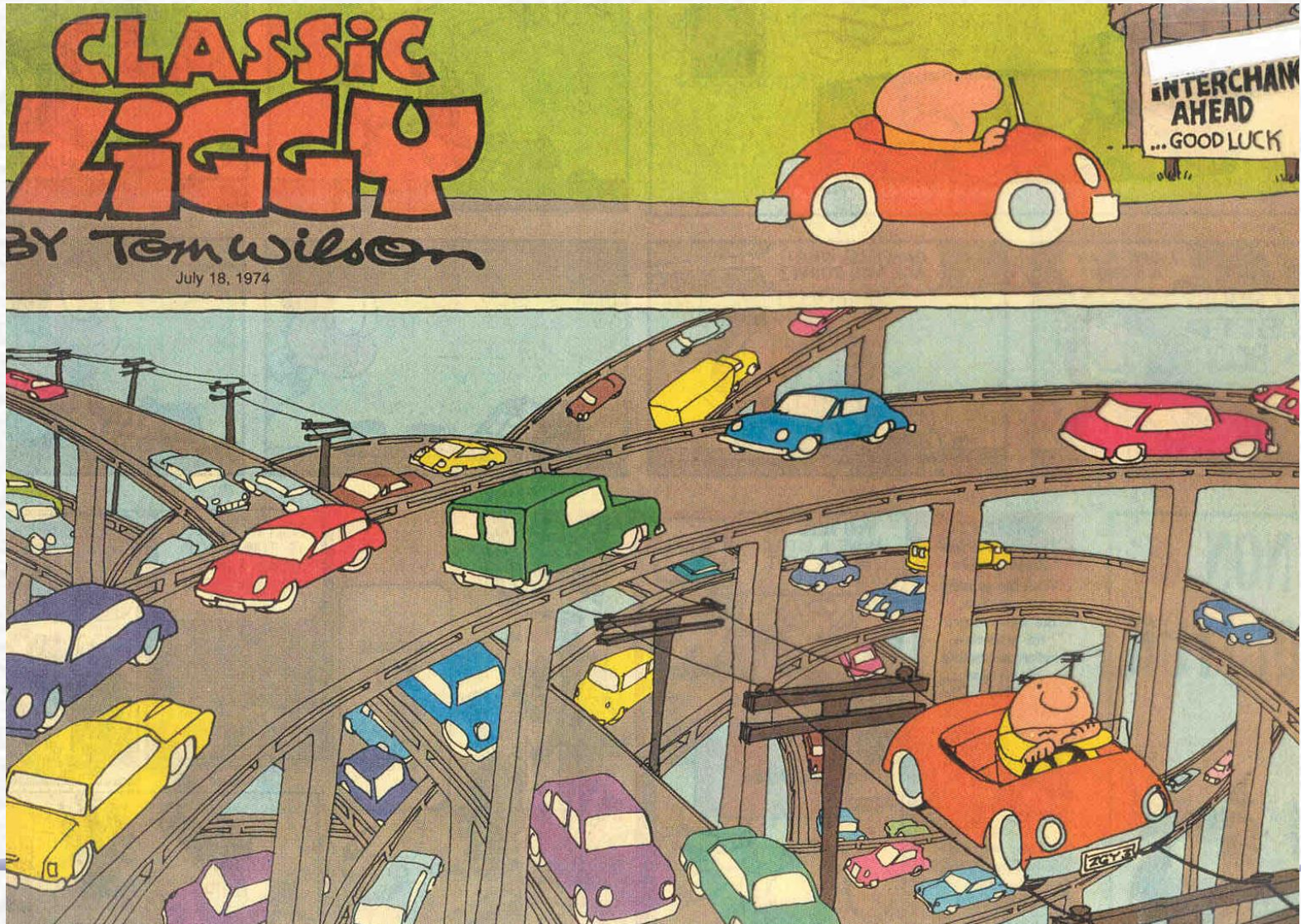
Lec 14, Ch.8, pp.277-291: Intersection control and warrants (objectives)

- ✓ Know the purpose of traffic control
- ✓ Know what MUTCD is and what's in it
- ✓ Know what types of control can be used to reduce conflict points at intersections
- ✓ Know what types of warrants need to be met to place a traffic signal
- ✓ Be able to apply warrants to determine whether a traffic signal is really needed

What we cover in class today...

- ✓ Counting the number of conflict points at intersections
- ✓ MUTCD and effort to have effective traffic control devices
- ✓ Types of intersection control
- ✓ Traffic signal warrants
- ✓ A sample problem to test warrants

We want to avoid this...



The Manual of Uniform Traffic Control Devices (MUTCD)

“The purpose of traffic control is to assign the right of way to drivers and thus to facilitate highway safety by ensuring the orderly and predictable movement of all traffic on highways.” p.277

Control may be achieved by using traffic signals, signs, markings, or markers that regulate, guide, warn, and/or channel traffic. → MUTCD provides guidelines for determining whether a particular control type is suitable for a given location; it also provides details on the size, color, shape, and legends, if necessary, and location for a particular control type.





MUTCD (cont)

Requirements to make a traffic control device effective:

- Fulfill a need → Place a proper one, place only the one needed
- Command attention → Make it stand out by color, shape, etc.
- Convey a clear simple meaning → Do not confuse the driver by wordy legends. Give only one instruction by device.
- Command the respect of road users → When you place it, you really mean it.
- Give adequate time for proper response → Make it visible well in advance of the decision point

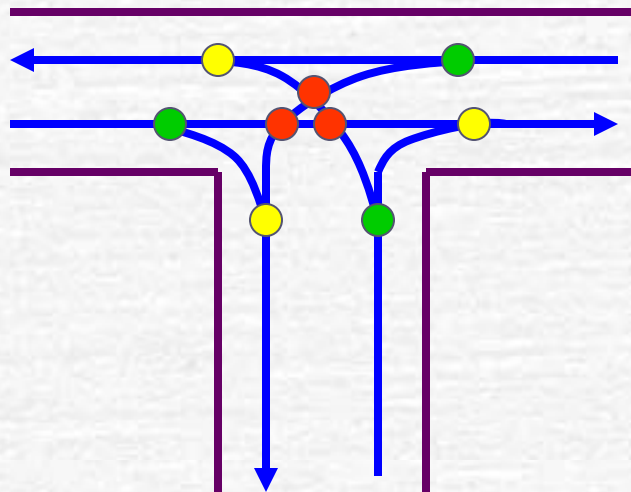
Factors to consider for placement of traffic control devices to ensure these five requirements: Design (size, color, shape), Placement (within cone of vision, consistency in use), Operation (consistent and uniform usage), Maintenance (maintain legibility), and Uniformity (respond to drivers' expectation).

Incorrect pavement marking example



Conflict points at unsignalized intersections

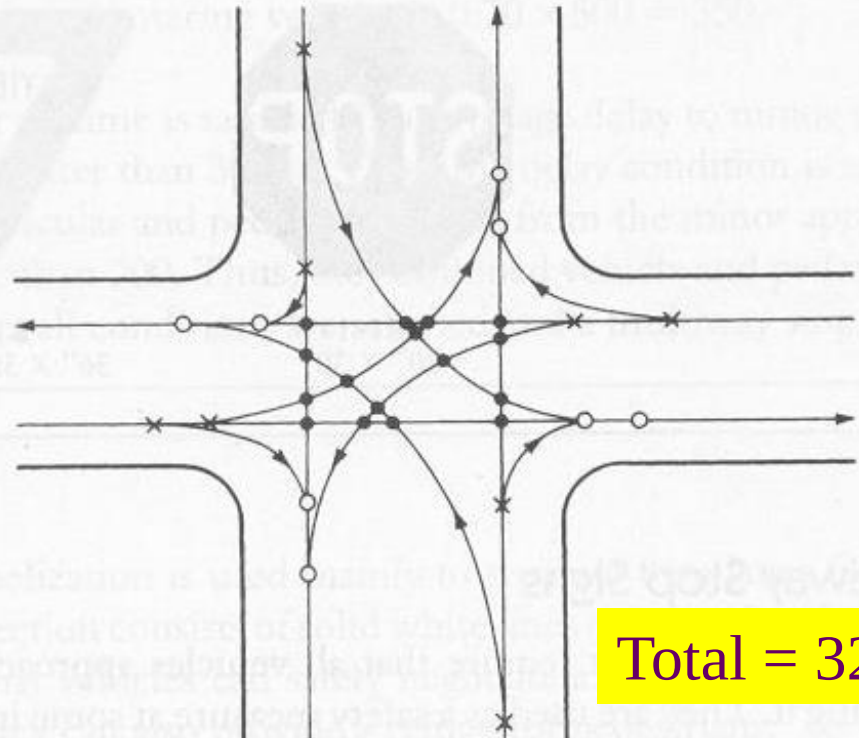
T intersection



- Crossing = 3
- Merging = 3
- Diverging = 3

Total = 9

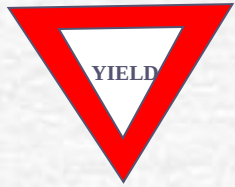
4-leg intersection



Total = 32

- Merging conflict points = 8
- × Diverging conflict points = 8
- Crossing conflict points = 16

Types of intersection control



Main road – relatively low volume; minor road – low volume. Not warranted when the approach speed on the minor road is 10 mph or less. Warranted with a right-turn lane but not enough acceleration lane.



Two-way stop signs: Main road – high speed approach, relatively high volume; minor road – low volume, with restricted view, previous right-angle accidents. We have multi-way stop signs, also.

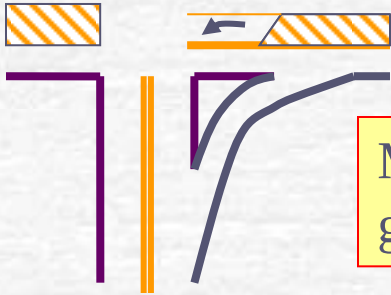
Multiway stop signs: Requires that all vehicles approaching the intersection stop before entering it. Used when the traffic volumes on all the approaches are about equal.

Warrants are (see Example 8.1):

- Total approach volume – not less than 500 vph for 8 hr of an average day, AND
- the combined volume of vehicles and pedestrians from the minor approach – not less than 200 units per hour for the same 8 hours
- the average delay on the minor street – not less than 30 sec/veh during the maximum hour.
- May reduce the values by 30% if the 85th percentile speed on the major approach is greater than 40 mph.

Types of intersection control

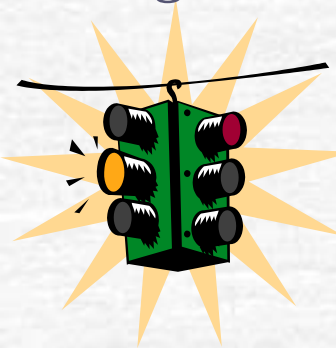
Channelization



Used mainly to separate turn lanes from through lanes. → islands (raised or not raised) and channel lines

MUTCD 2003 has 8 warrants) or a traffic signal. They are guides, not specs. Use professional judgments.

Signals



- ❖ 8-hour volume warrants:
Min vehicular volume,
interruption of continuous
traffic, combination of
warrants

- ❖ Minimum pedestrian
volumes

- ❖ School crossing

- ❖ Coordinated signal system

- ❖ Crash experience

- ❖ Roadway network

- ❖ 4-hour vehicular volume

- ❖ Peak hour: Peak-hour delay,
Peak-hour volume (8)

Signal warrants (1a)

*** Min. vehicle volume:** Principal factor is the intersection traffic volume.
Must satisfy for each of any 8 hour of an average day.

Table 8.1

Volume Requirements for Minimum Vehicular Volumes Warrant

Number of Lanes for Moving Traffic on Each Approach		Vehicles per Hour on Major Street (total of both approaches)	Vehicles per Hour on Higher-Volume Minor-Street Approach (one direction only)
Major Street	Minor Street		
1	1	500	150
2 or more	1	600	150
2 or more	2 or more	600	200
1	2 or more	500	200

➤ May reduce the values by 30% if the 85th percentile speed on the major approach is greater than 40 mph OR population is less than 10,000 (built-up area of isolated community).

Signal warrants (1b)

*** Interruption of continuous traffic:** The volume requirements must be met for each of any 8 hours of an average day.

Table 8.2

Minimum Vehicular Volumes for Interruption of Continuous Traffic Warrant

Number of Lanes for Moving Traffic on Each Approach		Vehicles per Hour on Major Street (total of both approaches)	Vehicles per Hour on Higher-Volume Minor-Street Approach (one direction only)
Major Street	Minor Street		
1	1	750	75
2 or more	1	900	75
2 or more	2 or more	900	100
1	2 or more	750	100

➤ May reduce the values by 30% if the 85th percentile speed on the major approach is greater than 40 mph OR population is less than 10,000 (built-up area of isolated community).

Signal warrants (1c)

- * Combination of warrants: Only in exceptional cases. When none of the first two vehicular volume warrants is satisfied but when the first two warrants are satisfied to the extent of 80% of the stipulated volumes.

Signal warrants (2,3,4)

2. Minimum pedestrian volume: The pedestrian volume crossing the major street → At least 100 for each of any 4 hr or 190 during any 1 hr and there are fewer than 60 gaps per hr that are acceptable by pedestrians (i.e., once every 1 min on average) for crossing. AND, the nearest signal along the major street should be at least 300 ft away. → Use a pedestrian-actuated signal.

3. School crossing: The frequency of occurrence of gaps and the lengths of gaps are inadequate for safe crossing of the street. The number of acceptable gaps is less than the number of minutes in that period (e.g., if the crossing lasts 30 minutes, there must be at least 30 occurrences of critical gaps or greater gaps for the children to cross) AND at least 20 students during the highest crossing hour. → Use a pedestrian-actuated signal. Parking prohibitions 100ft upstream, 20 ft downstream.

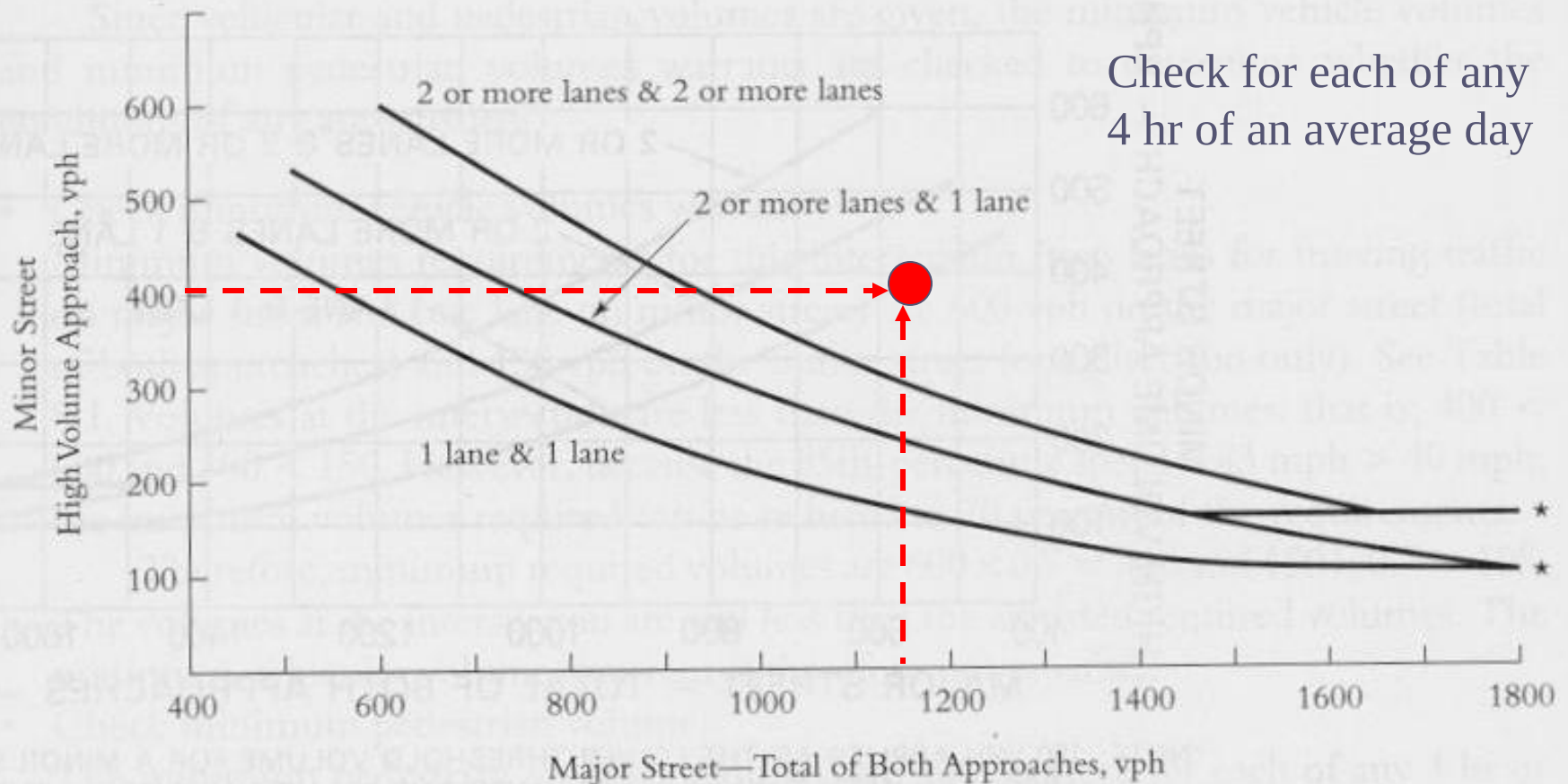
4. Coordinated signal system: Used when lights would not otherwise have been installed. Justifies a signal if it will help maintain a proper grouping (platooning) of vehicles and effectively regulate group speed. This warrant is not applicable when the resultant spacing of the traffic signal will be less than 300 ft.

Signal warrants (5,6)

5. Crash experience: Less restrictive measures must be used before this warrant is used. 5 or more injury or property-damage-only accidents within a 12-month period, AND signal control is a suitable countermeasure. AND, the traffic and pedestrian volumes should not be less than 80% of the requirements of vehicular and pedestrian warrants.

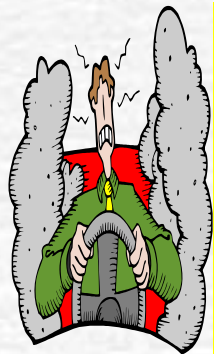
6. Roadway network: When lights help to encourage concentration and organization of traffic networks. (1) The total existing or immediately projected volume is at least 1000 during the peak hour of a typical day AND the 5-year projected traffic volumes satisfy the requirements of the following warrants: vehicular volume warrants (3 warrants), 4-hr volume warrant, and peak volume warrants, OR (2) The total existing or projected entering volume is at least 1000 vehicles for each of any 5 hr of a Saturday and/or a Sunday.

Signal warrants (7. 4-hour volume)



*Note: 150 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor street approaching with one lane.

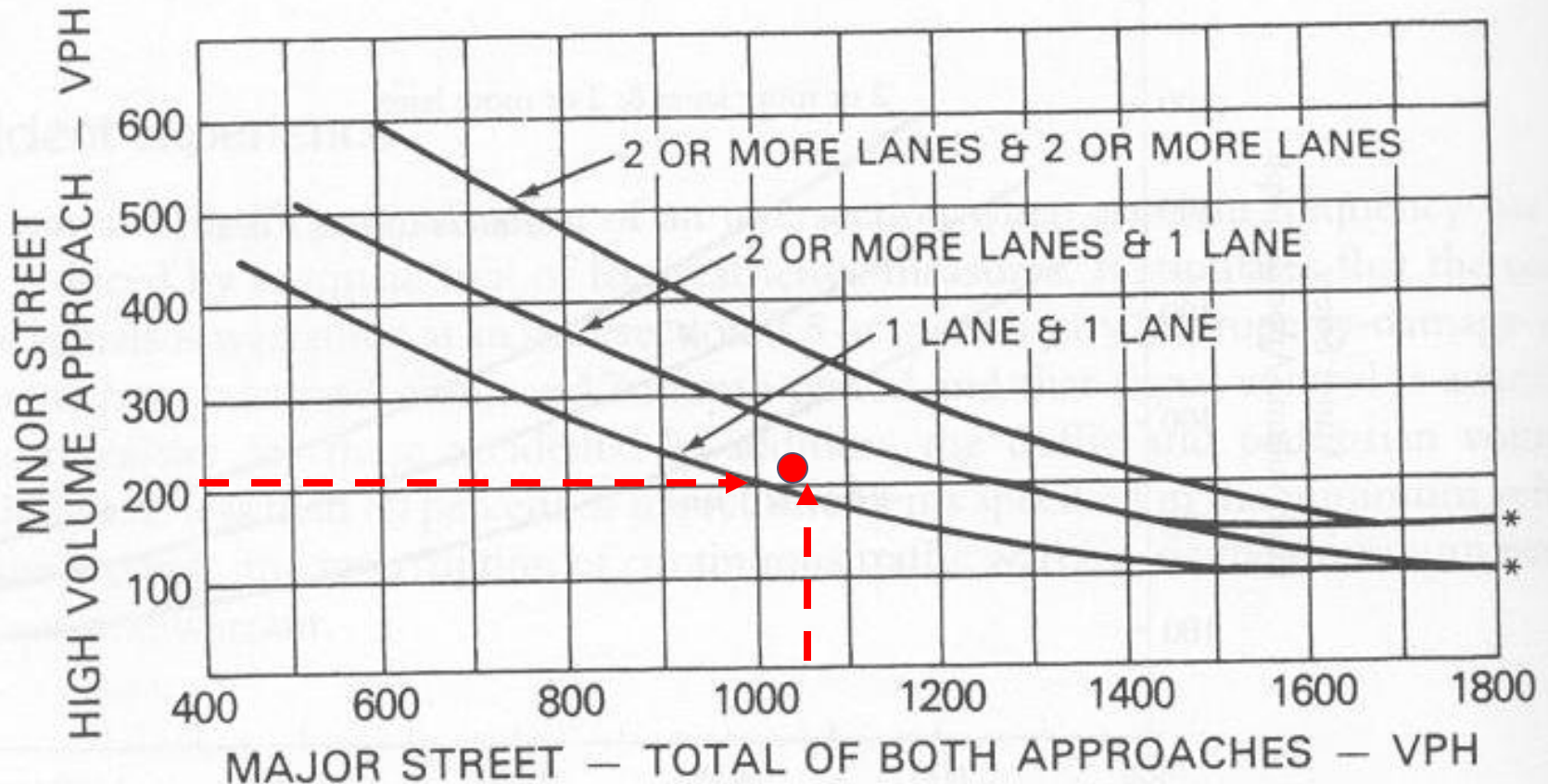
Signal warrants (8a. Peak-hour delay)



This warrant is satisfied when the delay during any four consecutive 15-minute periods on one of the minor-street approaches (one direction only) controlled by a stop sign is equal to or greater than specified levels AND the same minor-street approach (one direction only) volume and the total intersection entering volume are equal to or greater than the specified levels:

- Delay → 4 vehicle-hours for a one-lane approach and 5 vehicle-hours for a two-lane approach.
- Volume → 100 vph for one moving lane of traffic, 150 vph for two moving lanes of traffic, AND 800 vph entering volume for intersections with four or more approaches or 650 vph for intersections with 3 approaches.

Signal warrants (8b. Peak-hour volume)



Justified where traffic condition during 1 hr of the day result in undue delay to traffic on the minor street.