Wisconsin Traffic Engineering Council
Issue Paper 4 – Traffic Signal Clearance Intervals

Background / Overview

Clearance intervals provide temporal separation between conflicting movements (both pedestrian and vehicular) at signalized intersections. Longer clearance intervals increase the safety of the intersection but decrease the intersection capacity and potentially cause the drivers to not take the clearance intervals seriously. The Manual on Uniform Traffic Control Devices (MUTCD) defines three traffic signal clearance intervals: yellow, all-red and pedestrian flashing DONT WALK. However, the MUTCD does not provide guidance for calculating the duration of the clearance intervals. Only ranges of acceptable values are provided. Also there is no guidance for conditions under which all-red should be used or how pedestrian clearance should be used. Thus it is up to the discretion of the engineer how to apply the clearance intervals. The differing preferences result in inconsistencies at state, county and municipal levels. More definitive guidance is required in determining and applying clearance intervals.

Current National Practices

There is no national standard, although several documents such as the ITE Traffic Engineering Handbook provide guidance for determining the clearance intervals. Most commonly used method is the "ITE formula"

$$Y + R = t + \frac{v}{2a + 2Gg} + \frac{w + l}{v}$$

where:
Y = yellow change interval (seconds [sec.])
R = red clearance interval (sec.)
t = perception-reaction time (sec.)
v = design velocity (feet/sec.)
a = deceleration rate (feet/sec.^{2})
G = acceleration due to gravity (32.2 feet/sec.^{2})

The first two terms are used for determining yellow and the third term for all-red. The MUTCD recommends yellow change intervals between 3 and 6 s and all-red intervals not exceeding 6 s.

For Pedestrian Clearance interval the following is used

$$t = d / s$$

where
t = duration of the pedestrian clearance interval (sec.)
d = street width
s = walking speed (between 3 feet/sec. and 4 feet/sec.)

North Carolina
Modified the ITE Methodology and developed a consistent method for calculating Red and Yellow intervals. The methodology has been incorporated into NCDOT Traffic Management and Signal Systems Unit Design Manual.

Current Wisconsin Practices

Currently Wisconsin uses three methods to determine the red and yellow clearance intervals:

- Kinematic Method (same as ITE Method)
- Uniform Timing (Standardized interval, regardless of location; to address driver expectancy)
- Rule-of-Thumb (standardized duration based on approach speed or movement type or roadway classification)

Technical Issues

- Vehicular Speed
  - Speed limit
  - 85th percentile speed
  - Design speed
- Pedestrian Walking Speed
  - Ranges from 2.5 ft/s to 7 ft/s
  - Need to consider presence of elderly and children
- Yellow Times for Protected Left Turns
- Treatment of Dilemma Zones
- Safety Ramifications
  - Longer clearance intervals can lead to driver disregard
  - Shorter intervals not sufficient to safely clear intersection
- Operational Impacts
  - Capacity
  - Delay

Additional Resources

- Application of the ITE Change and Clearance Interval Formulas in North Carolina, ITE Journal, Jan 2008
- Traffic Signal Clearance Intervals, ITE Journal, Apr 2004
- Signal Timing Practice and Procedures: State of the Practice. ITE, 2004
- Traffic Management and Signal Systems Unit Design Manual. North Carolina Department of Transportation (NCDOT), 2004
- Manual on Uniform Traffic Control Devices for Streets and Highways 2003 Edition, Part 4,Federal Highway Administration, 2003
- Institute of Transportation Engineers (ITE). Transportation and Traffic Engineering Handbook. Prentice-Hall, 1982
- Professional Development Module: Traffic Signal Clearance Intervals, ITE.