Introduction

Conflicting traffic movements, make roadway intersections are a source of great concern to traffic engineers.

Intersections are a major source of crashes and vehicle delay (as vehicles yield to avoid conflicts with other vehicles).

Most roadway intersections are not signalized due to low traffic volumes and adequate sight distances.

At some point, traffic volumes and crash frequency/severity (and other factors) reach a level that warrant the installation of a traffic signal.

Why Signalization - Advantages

- potential reduction of some types of crashes (particularly angle crashes),
- provisions for pedestrians to cross the street,
- provisions for side-street vehicles to enter the traffic stream,
- provisions for the progressive flow of traffic in a signal-system corridor,
- possible improvements in capacity, and
- possible reductions in delay.

Why Signalization - Advantages

- poorly-timed signal or one that is not justified can have a negative impact on the operation of the intersection by:
  - increasing vehicle delay,
  - increasing vehicle crashes (particularly rear-end crashes),
  - causing a disruption to traffic progression (adversely impacting the through movement of traffic), and
  - encouraging the use of routes not intended for through traffic (such as routes through residential neighborhoods).
Traffic signals considerations:

- **Cost:** in excess of $100,000.
- **Warrants:**
  - Eight warrants dealing with vehicle volumes, pedestrian volumes, school crossings, signal coordination, and crash experience.

Signal Control Characteristics

- **Intersection:** at-grade crossing of two or more roadways.
- **Approach** consists of a lane or group of lanes through which vehicles enter the intersection.
- **Lane group** is an individual lane or multiple lanes which are grouped based on the allowed movements (left, through, right) within each lane and the sequencing of allowed movements by the traffic signal.

Turn Bays

- Turn bays, hold a limited number of queued vehicles.
- Queuing analysis used to determine the length of bay necessary to prevent:
  - **Spillover** queued turning vehicles overflowing the bay and blocking the through lanes and/or
  - **Spillback** queued through vehicles blocking the entrance of the turn bay (known as spillback).
Signal Head Configuration

Traffic Signal Design: definitions

- **Indication** The illumination of one or more signal lenses (greens, yellows, reds) indicating an allowed or prohibited traffic movement.
- **Interval** A period of time during which all signal indications (greens, yellows, reds) remain the same for all approaches.
- **Cycle** One complete sequence (for all approaches) of signal indications (greens, yellows, reds).

Traffic Signal Design: definitions

- **Cycle length** The total time for the signal to complete one cycle ($C$ expressed in seconds).
- **Green Time** The amount of time within a cycle for which a movement or combination of movements receives a green indication. (G seconds).
- **Yellow Time** The amount of time within a cycle for which a movement or combination of movements receives a yellow indication. Also called the change interval: alerts drivers that the signal indication is about to change from green to red. (Y seconds)
- **Red Time** The amount of time within a cycle for which a movement or combination of movements receives a red indication. (R Seconds)
- **All-Red Time** The time within a cycle in which all approaches have a red indication. Also called the clearance interval: allows for vehicles that might have entered at the end of the yellow interval to clear the intersection before the green phase starts for the next conflicting movement(s). All-Red is common because the number of vehicles entering at the end of the yellow and beginning of the red has become more widespread in recent years. (AR seconds)
Traffic Signal Design: definitions

**Phase**  The sum of the displayed green, yellow, and red times for a movement or combination of movements that receive the right of way simultaneously during the cycle. The sum of the phase lengths (in seconds) is the cycle length.

Movement is a directional descriptor, such as left, through, and right, another distinction is made by categorizing movements as either protected or permitted.

**Protected movement** A movement which has the right-of-way and does not need to yield to conflicting movements, such as opposing vehicle traffic or pedestrians.

- Through movements, which are always protected, are given a green full circle indication (or in some geometric configurations, a green arrow pointing up).
- Left- or right-turn movements that are protected are given a green arrow indication (pointing either left or right).

**Permitted movement** A movement which must yield to opposing traffic flow or a conflicting pedestrian movement. This turn is made during gaps (time headways) in opposing traffic and conflicting pedestrian movements.

- Left- or right-turn movements with a green full circle indication are permitted movements
  - Left turning vehicles in this situation must wait for gaps in the opposing through and right turning traffic before making their turn.
  - Right turning vehicles must yield to pedestrians in the adjacent crosswalk before making their turn.