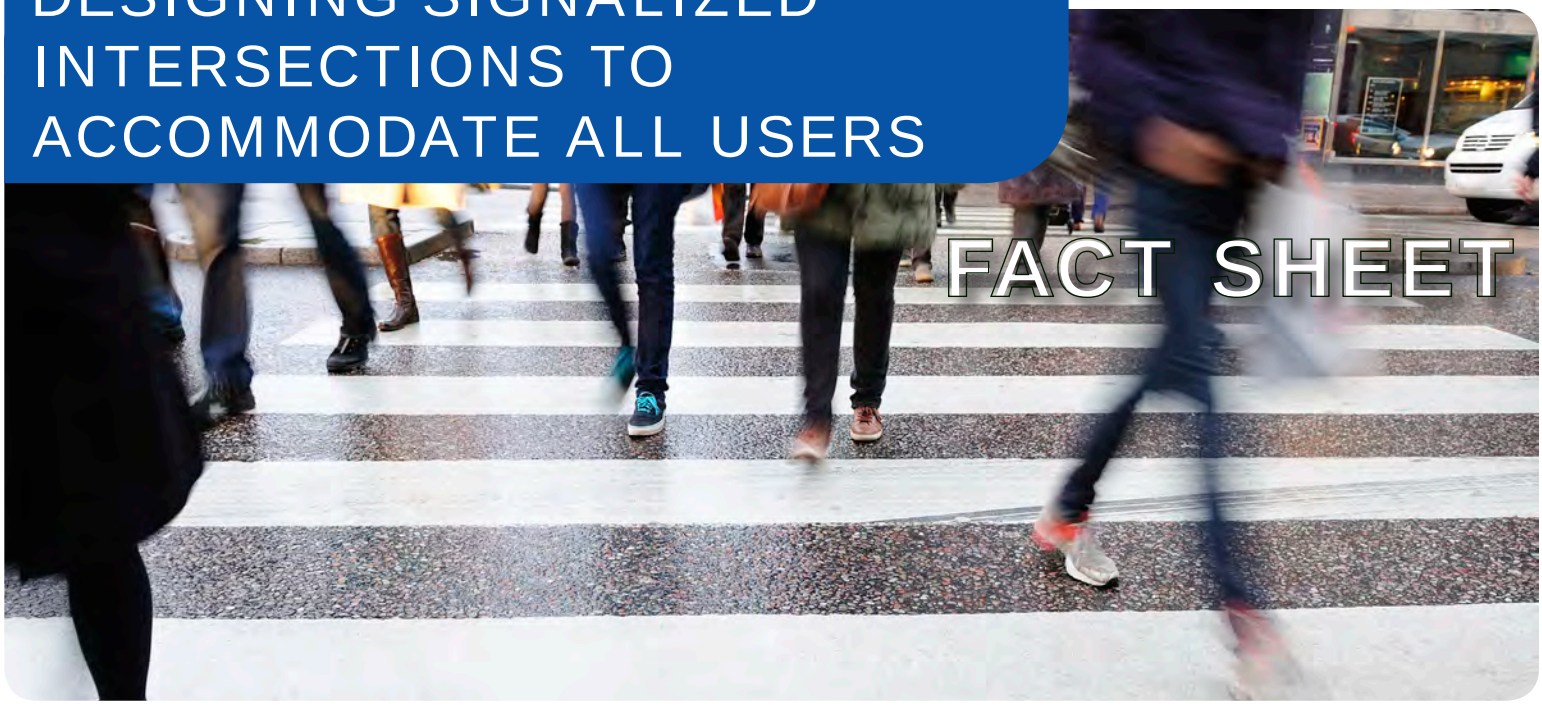
DESIGNING SIGNALIZED INTERSECTIONS TO ACCOMMODATE ALL USERS



Overview

The primary purpose of traffic signals is to assign right-of-way to travelers through an intersection, thereby improving their safety. There is a set of guidelines in the Manual of Uniform Traffic Control Devices (MUTCD) that aids in the process of deciding if an intersection needs a signal. Once a signal is placed at an intersection, an engineer must develop a timing plan, and then keep it up to date when conditions change. When thinking only of cars, optimizing signal timing becomes relatively straightforward, using the methodologies of the Highway Capacity Manual and MUTCD.

But intersections are complex places, and are shared not only by automobiles and trucks making various movements, but also by transit buses, pedestrians, and bicyclists. Each of these users has different needs:

- Drivers want to minimize delay, avoiding what they may see as time wasted at a red light or in a queue of vehicles waiting to make a turn.
- Bus drivers are trying to stay on schedule and reach the next bus stop, often at the far side of an intersection.
- Pedestrians want enough time to cross safely without feeling rushed, or threatened by turning cars.
- Bicyclists want to be able to ride adjacent to the traffic stream and safely make turns.

At busy intersections, it may be impossible to meet all of these needs in the available time, so trade-offs must be incurred. But the safety of all users is paramount.

When we look at an intersection, we must recognize that the most vulnerable of these users is the pedestrian. There is a limit to how fast people can walk to reach the far curb or a median refuge island. This is especially true of senior citizens, children, and those with mobility or visual impairments. As such it is important to examine ways to make signalized intersections safe for people on foot.

First, there are intersection design features that can improve pedestrian safety. An important technique is to reduce the crossing distance, and therefore the required time the signal stays green for pedestrians. Doing so provides for pedestrian safety while providing more capacity for vehicle movements.

The first thing to do is look at the turning radius (the amount the curb is rounded to accommodate large trucks and buses). Simply reducing the radius can shorten the crosswalk. A related technique is a "bulb out" or curb extension. This is often used where there is on-street parking; in addition to shortening the crossing distance, it prevents parked cars from encroaching on the intersection. A median refuge is especially useful on wide arterial streets. This provides a physically safe place for pedestrians to stand if they cannot cross the entire street. They can wait there for the next green phase.

Signal Timing Plan

Once the crossing distance is shortened to the greatest extent possible, the traffic engineer develops a signal timing plan. In doing so, a first step is to collect data about the operation and geometry of the intersection, including vehicle and pedestrian counts. But the engineer must also survey the area near the intersection, often working with planners and even community residents. Are there land uses nearby that generate pedestrians of special concern, like housing for seniors and/or persons with disabilities, a senior center, a school, a park, neighborhood shopping, or a transit station or stop? It is only by understanding who is using the intersection that a decision can be made about signal design.

The traffic engineer must use current practice for timing the signal. The Manual of Uniform Traffic Control Devices specifies a walking speed of 3.5 feet/second. The MUTCD also states that a slower walking speed can be used if people who walk more slowly or use wheelchairs "routinely use the crosswalk". Current research suggests that a walking speed of 3.0 feet/second should be used in this situation.

When there is a crosswalk with a high volume of pedestrians being crossed by a large number of turning vehicles, it can be a safety hazard for the pedestrians. A signal timing technique that may be considered in that situation is called a Leading Pedestrian Interval, which keeps the signal red for all vehicles while displaying a Walk indication for the direction that will receive the next green phase. This allows pedestrians to cross at least one lane of traffic or, in the case of a large corner radius, to travel far enough to establish their position ahead of the turning traffic before that traffic is released.

Countdown pedestrian signal displays have been shown to have a safety benefit in informing people how long they have to cross the street. The MUTCD now requires them for most new signals.

Prohibiting Right Turn on Red

There are also requirements in the MUTCD for prohibiting Right Turn on Red. Among them:

"An unacceptable number of pedestrian conflicts with right-turn-on-red maneuvers, especially involving children, older pedestrians, or persons with disabilities."

Intersections and Cyclists

The needs of bicyclists are also sometimes ignored at signalized intersections. Cyclists are expected to act as vehicles unless they choose to use a crosswalk, in which case they are considered pedestrians. If the street has marked bicycle lanes, they must be carried through the intersection, and properly placed, for example between the through lane and an exclusive right-turn lane.

There is a special concern at intersections where the signal relies on vehicle detection to turn the light green for certain movements like side roads and turn lanes. While a standard vehicle detector will not be triggered by a bicycle, there are detectors designed specifically for that purpose. These must be installed so cyclists can get a green light when there are no cars present.

While this may seem very technical, what is important is that any government that owns traffic signals has a policy in place that dictates that all intersections will be designed and signals will be timed to ensure that all users, including cyclists and at-risk pedestrians, will be safe.

Some worthwhile references include:

New York State Department of Transportation Highway Design Manual, Chapter 18 - Pedestrian Facility Design *http://www.nysdot.gov/divisions/engineering/design/dqab/hdm/hdm-repository/chapt_18.pdf*

Presentation on Pedestrian Signal System by John La Plante *http://www.signalsystems.org.vt.edu/documents/Jan2009AnnualMeeting/Presentations/1-LaPlante_Jan09%20TRB%20Signals%20for%20Peds.pdf*