tool kit

Multi-Modal Intersection Design

Many of the RTN corridors serve several modes—transit, trucks, pedestrians, bicyclists—all of which must be considered in designing roadways that all these modes to operate safely in tandem with each other. Those thoroughfares tasked with serving several modes of transportation must strike a balance, in which all modes are accommodated and no one mode predominates. Achieving this balance can be especially challenging at intersections, where many of these needs compete for priority. Considering the best intersection design practices for pedestrians, bicyclists, trucks and transit, as well as tested solutions for reducing conflict among them, will allow thoroughfares to operate more safely and efficiently.

Intersection Design for Pedestrians

Crosswalk length should be minimized, and crosswalks should be placed in a direct line with pedestrian travel or at the location in the roadway where the crossing is shortest.

Pedestrians should be able to cross the street on all sides of the intersection. Pedestrians should not be directed to one side of the street for crossing.

Pedestrians should not have to cross too many lanes without an island to use as refuge from the traffic. Islands separate traffic conflicts and decrease crossing distances.

Where there is on-street parking, curb extensions should be used to grant pedestrians greater visibility at crossings.

At signalized intersections, there should be clearly visible pedestrian signals. If push buttons are necessary, they should be placed close to the level landing at the top of curb ramps or where they're easy to reach, next to the sidewalk, with signage that makes it clear which signal the button activates. Push buttons are not appropriate in urban environments and other high pedestrian use areas but may be appropriate for use in rural and suburban areas.

The above intersection, in a suburban area with wide, multi-lane roadways, has an island to provide a mid-crossing refuge for pedestrians. Islands such as these break up the length of the crossing for people who take longer to cross, such as the disabled or the elderly, who may not clear the intersection in the course of a normal pedestrian signal phase.

Pedestrian and bicycle signals at intersections can provide for the safety of all modes of transportation. Signals with push-button activation should have buttons at appropriate heights, and positioned so that bicyclists need not dismount in order to reach them.

In urban areas and other areas where pedestrian use is high, a pedestrian phase should be included in the signal sequence. Short signal cycles should be used to limit pedestrian wait time.

Intersection Design for Bicyclists

In many ways, intersections designed for vehicle travel are already designed for bicyclists, which can in most cases proceed through them as if they were any other vehicle. However, due to their particular vulnerability, some precautions should be taken on state bicycle routes and areas with high numbers of bicyclists. In general, bicyclists should be visible and their movements predictable, and the traffic flow through the intersection should not encourage or depend on bicyclists acting as if they were pedestrians.

Where bike lanes are included in the roadway design, they should be striped to a marked crosswalk or a point where turning vehicles would normally cross them. The lanes should resume at the other side of the intersection. The bike lane stripe may be dashed prior to the crosswalk to indicate a potential conflict point to both bicyclists and drivers.

At signals that are activated by the presence of a vehicle, cyclists may be unable to proceed on their own. To benefit cyclists, loop detectors can be placed in bike lanes on side streets to trip the signal, or where there are no bike lanes, the sensitivity of existing loop detectors can be increased or push-buttons can be placed close to the roadway where a bicyclist can reach them without dismounting. Push-buttons placed at intersections for pedestrians are unlikely to be convenient for bicyclists.

On streets with bike lanes and heavy bicycle use, there is often competition for space and time after a light has turned green at an intersection, as bicyclists, through and right-turning motorists try to proceed at the same time. An emerging practice in bicycle planning and design is the **bike box**, or a dedicated space in front of vehicles at an intersection approach that allows cyclists to better position themselves for turn movements. Vehicle traffic is controlled by a stop bar located behind the bike box, and cyclists waiting at a red light wait inside the area if they are making a turn.

The bike box reduces conflicts as cyclists can pull forward to the front of the queue when the light is red and motor vehicle traffic is stopped. Bicyclist can then be the first to proceed when the light turns green. The bike box works best at intersections with no right turn on red and with high bicycle use, so drivers understand why they're being asked to hold back. At the time of these guidelines' development bike boxes were still considered to be experimental in use, and they should be used judiciously and consideration should be given to expected bicycle volume and turning movement demand.

Bike boxes, like the one above being installed in Seattle, are still considered experimental, and require education for both drivers and bicyclists.

Intersection Design for Trucks and Buses

At intersections, right-turning truck traffic requires a wide radius. The wider radius can be accommodated through the construction of a wider turning radius at the intersection or through of wider travel lanes or the presence auxiliary lanes. On freight routes expected to carry truck traffic, intersections will usually use larger curb radii. In other areas, trucks and buses can maneuver through intersections in which curb-return radii are not sufficient, but they typically will need space to swerve out into the adjacent lanes.

Where lane widths are 12 ft. or wider, and where bicycle lanes or on-street parking lanes are available on the receiving street, they may provide increased clearance at the corner for the truck's turn.

In addition to the use of wider travel lanes, if large vehicles need to encroach into an opposing travel lane, a designer may also consider placing the stop line for opposing traffic further from the intersection. This allows large vehicles navigating a turn movement a degree of 'cushion' space in which to straighten their path in the correct lane.

*Georgia Governor Nathan Deal recently signed HB 101, which stipulates that motorists must allow bicycles **three feet** of clearance when passing them. Previously, Georgia law only required motorists to leave a safe distance of undetermined width.*

Areas of Conflict

Wide roadways in suburban areas require longer pedestrian crosswalks. For a more pedestrian friendly crossing, islands can be used to break up the crosswalk.

Right turn lanes facilitate the movement of vehicles through an intersection but can pose problems for pedestrians and bicyclists. At right turn lanes, motorists may not anticipate or look for interruptions in their travel, especially when a right turn lane is channelized. Pedestrians therefore may be unable to find a break in traffic in which they can cross the street. In addition, right-turning vehicular traffic crosses bicycle through-traffic on the right side of the shared lane or in a bicycle lane.

If a right turn lane is necessary, a raised island should be placed between the through lanes and the right turn lane as a pedestrian refuge. Right-turning cars should approach channelization islands at such an angle that crossing pedestrians would be clearly visible. The island should be roughly twice as long as it is wide and it should cuts in it at the location of the crosswalk.

The larger curb radii included in truck-friendly roadway design allow trucks to make right turns without jumping curbs and directly threatening pedestrian traffic on the sidewalk. Larger curb radii, however, can also compromise pedestrian safety by requiring longer crossing distances and allowing vehicles to make faster right turns through the pedestrian path. A balance between these two competing priorities can be found when on-street parking, bicycle lanes or other auxiliary space is provided beyond the basic travel lane width. This provides space in which turning vehicles can encroach without coming into contact with the curb or pedestrians waiting at the corner to cross. When the pedestrian path is clear, this shortens the distance the pedestrian must cross.

Signalized intersections can create conflicts between pedestrians and vehicles. Pedestrians are vulnerable when the walk signal comes at the same time as the left turn signal. Left-turning traffic accounts for the greatest number of pedestrian crashes at signalized intersections.

At these intersections, **pedestrian countdown signals** may be installed to let pedestrians know how much time is left to cross. These signals can reduce conflicts between turning vehicles and pedestrians still in the crosswalk at the end of the crossing phase. Or, the intersection can utilize **protected left turns**, in which as the walk phase is not concurrent with left-turning vehicular movements, eliminating left-turn conflicts.

Another option is the **longer all-red phase**, which can prevent conflicts with vehicles entering the intersection late in the amber light phase. These vehicles may be just entering the far crosswalk as the steady walk pedestrian phase begins. A longer all-red phase allows vehicles to clear the intersection before pedestrians enter it.

Skewed intersections may be difficult for vehicle traffic to navigate and may be particularly challenging for bicyclists and pedestrians.

Bicyclists and pedestrians may not very visible to motorists. Pedestrians have to negotiate longer crosswalks and require a longer pedestrian signal phase.

Redesigning skewed intersections to meet at right angles is an ideal solution for bicyclists, pedestrians, and motorists. Where this is not possible, exceptionally long crosswalks should include pedestrian refuges. Bike lanes may be striped with dashes, or colored, to guide bicyclists through a long undefined area.

Multi-leg intersections are complicated for bicyclists, pedestrians, and motorists alike. Additional directions from which travelers are arriving at the intersection create additional points of friction between vehicles and among modes. Pedestrians and bicyclists may be harder to see at these intersections, and their behavior, as well as that of motorists, is less predictable than at four-approach intersections. In addition, the issues involved with skewed intersections will also apply to multi-leg intersections. Therefore, where possible, intersections should be designed or redesigned to include only four approaches that intersect at right angles.

To do this, one or more legs is removed from the major intersection and a minor intersection is created to handle secondary movements. In some cases, a roundabout could be introduced to handle the many approaches while reducing the number of points of friction among modes.

References

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