11.0 PEDESTRIAN & BICYCLE

- **General**

The purpose of this chapter is to provide general guidance for bicycle and pedestrian movements. Other chapters addressing intersections and interchanges, urban design, and public transportation provide additional and/or similar information on bicycle and pedestrian design considerations. This chapter is meant to be a guide. For a complete description of pedestrian and bicycle design standards, consult the *Oregon Bicycle and Pedestrian Plan*.

11.1 THE NEED TO CONSIDER PEDESTRIAN & BICYCLE FACILITIES

ORS 366.514 requires that ODOT, cities and counties provide walkways and/or bikeways wherever a highway, road or street is being constructed, reconstructed, or relocated. They are not required if (1) sparsity of population or other factors indicate an absence of any need; if (2) costs are excessively disproportionate to need or probable use; or (3) where public safety is compromised. The designer should start with the assumption that accommodation is required, and seek an exemption only where it is obvious that one of the three above exceptions applies. The designer should also reference planning documents to see if prior efforts have already established if sidewalks or bikeways are needed. The provisions of ORS 366.514 can be met on rural highways by providing shoulders of adequate width. The greatest need for walking and bicycling facilities are on urban highway projects.

11.2 RURAL HIGHWAYS

In the majority of rural highway projects, the paved shoulder widths recommended in Chapters 6 and 7 are sufficient to accommodate bicycle travel. The occasional pedestrian using a rural highway is also served by paved shoulders. At signalized intersections, pedestrian heads, push-buttons and crosswalks should be provided, even in the absence of sidewalks. Transit operations may require consideration of additional improvements at specific locations.

11.3 URBAN HIGHWAYS

11.3.1 BICYCLE ACCOMMODATION

Shoulders are necessary on urban highways for safety, capacity and maintenance reasons. Shoulders are often striped as bike lanes in urban areas; this designates the shoulder as an area for travel by bicyclists. Low potential bicycle use is not a reason to not provide a shoulder. The decision to designate bike lanes should be based on anticipated bike use and other factors.

Typically bikes are accommodated along the roadway rather than a separated path. The *Oregon Bicycle and Pedestrian Plan* should be reviewed for the criteria for providing a separated path.

The standard width for bike lanes is 6 feet (minimum widths: 4 feet on open shoulder, 5 feet against curb, guardrail or parking). This may be wider if necessary. In constrained areas, narrower lanes may be acceptable through a design exception. Bicyclists should not be precluded from the state highway or signed onto other local routes because of constraints.

11.3.2 PEDESTRIAN ACCOMMODATION

Sidewalks separated with a buffer are the preferred facility for pedestrians. Sidewalks should be provided on all urban highways within city limits with the possible exception of limited access expressways. Sidewalks will most likely be needed on highways between the city limits and the urban growth boundary, based on existing and anticipated land use.

11.3.3 SIDEWALK DIMENSIONS

The standard width for sidewalks is 6 feet; local agency requirements may be greater. Sidewalk widths are exclusive of curb and clear of utility poles, signs, signal poles, trees and other obstructions. The minimum clear width of a sidewalk is 5 feet. This width should only be considered in constrained areas with low anticipated pedestrian use. Several conditions require greater widths:

- In the absence of a buffer, an additional 2 feet is encouraged and should be added to the width of a curbside sidewalk unless right of way or other constraints preclude this option; 6 feet should be considered the minimum width for curbside sidewalks.
- Curbside sidewalks should not be placed directly adjacent to a high-speed (design speed of 45 mph and above) travel lane. Buffers may include a planting strip, a shoulder barrier, a parking lane or a bike lane.
- Sidewalks should be wider in Commercial Business Districts (CBDs), STAs and other high use areas. 10 feet should be considered in traditional downtowns where buildings are located at the back of the sidewalk.

- Curbside sidewalks on bridges shall be at least 7 feet wide, to account for a shy distance from the bridge rail. In no case shall the bridge sidewalk width be less than the approach sidewalk width; in instances where the approach sidewalks are of differing widths, the lesser of the two widths may be used on the bridge.
- Raised sidewalks may require a barrier at curb line on bridges with design speeds equal to or greater than 45 mph. In these situations, the sidewalk shall be at least 7 feet wide.

11.3.4 BUFFER STRIPS

Separating the sidewalk from the curb with a buffer (also called planting strip) has many advantages for pedestrians and other road users. Planting strips provide extra separation from motor vehicle traffic, yielding the following benefits:

1. Benefits for Pedestrians:

- Increased sense of security;
- Less splashing of water from puddles;
- Sign posts, mailboxes, parking meters, fire hydrants, utility and signal poles, etc., are not in the sidewalk;
- Aesthetic enhancements such as landscaping and street trees, create shade;
- Sidewalks, curb cuts and crosswalks line up better at intersections;
- An enhanced environment for wheelchair users - the sidewalk is kept level at driveways (the apron is built into the planting strip area).

2. Benefits for the roadway users:

- Easier for motorists to identify and find driveway entrances, as the buffer strip provides a visual distinction;
- Decreased water runoff, with corresponding decreases in overall drainage requirements;
- A place to store snow removed from the roadway (and sidewalk).

All sidewalks should be designed as separated, unless right of way or other constraints preclude this feature. A planted buffer strip should be 5 feet wide or greater (minimum 3 feet), and landscaped with low-maintenance plantings. Buffers are not recommended in downtown areas with on-street parking; the sidewalk should be widened to create space for street furniture out of the walking path. Where constraints preclude the use of a buffer throughout a project, it can be interrupted and then resume where the constraint ends.

Trees, street furniture and other objects should not reduce visibility of pedestrians, bicyclists and signs, especially at intersections. Plants should be selected that require little maintenance and watering; their roots should not buckle sidewalks.

If a buffer strip cannot be provided, the width of a curbside sidewalk should be 8 feet where design speeds are 45 mph and above.

11.3.5 SURFACING

Concrete is the preferred material for sidewalks. It provides a smooth, durable finish that is easy to grade and repair. Brick pavers can provide an aesthetically pleasing affect if:

They are laid with a great degree of smoothness (no beveled edges);
The surface is slip-resistant when wet; and
Long-term maintenance costs are recognized.

An alternative to pavers is stamped and dyed concrete. This alternative provides much of the aesthetic value of bricks with the durability and smooth surface of concrete.

11.3.6 AMERICANS WITH DISABILITIES ACT (ADA)

ADA is a federal Civil Rights law that mandates both the private and public sectors to make their facilities accessible, within reason. For ODOT, that means that sidewalks and connections to private properties must be built so people with limited mobility and sight can easily use them. Most ODOT standards for sidewalks meet or exceed ADA requirements.

- **Width**

The 6 foot standard, 5 foot minimum sidewalk width meets ADA requirements; however, in very constrained areas, such as around obstacles that cannot be moved, a minimum passage of 3 feet must be maintained.

- **Grade**

ADA requires that constant grades be kept to 5% or below; short sections may be built up to 8.3% if a level landing is provided for every 2.5 feet in rise. However, for most practical applications, sidewalks parallel to the road are built to the grade of the land, so an exception is not required if a street is steeper than 5%. The requirement to keep grades below 5% (or 8.3% for up to a 2.5 feet rise) applies primarily to man-made features such as curb cuts, ramps to buildings, the dip created by driveways, etc.

- **Cross-slope**

The maximum allowable cross-slope for a walkway is 2%. For discussion purposes, 2% is considered "level." It is critical to maintain a 3 foot wide minimum level passage across driveways, curb cuts and road approaches (in crosswalks, marked or unmarked). The following techniques can be used to maintain a level area at driveways and prevent exaggerated warp and cross-slopes.

- Reduce the number of accesses, reducing the need for special provisions at every driveway;
- Separate the sidewalks from the curb with a buffer; this allows the sidewalk to remain level, with the driveway grade change occurring in the planting strip;
- Where constraints don't allow a planting strip, wrapping the sidewalk around the driveway entrances has a similar effect;
- Dip the entire sidewalk to keep the cross-slope at a constant grade on curbside sidewalks.

In downtowns, sidewalk grades are influenced by the elevation of building entrances. A level (2 % cross-slope) area should be provided in the middle of the sidewalk; any warpage should be handled within the area adjacent to the buildings, or within the outer edge, where signs and trees are most likely to be placed. See Standard Drawings RD720, RD725, RD730, RD735, RD740, RD745, and RD750 for detailed driveway construction drawings.

- **Curb Cuts**

ADA requires two curb cuts per corner at intersections for new construction, as one oblique cut may direct users into the travelway. Curb cuts constructed as part of preservation, 3-R or sidewalk infill projects are considered retrofits, not new construction. A 3 foot wide passage with a cross slope of 2% must be maintained behind curb cuts.

As the corner radius increases, it becomes more and more difficult to place two ramps that are in line with the crosswalks and the approaching sidewalks. Attempts to move the crosswalks away from the intersection to achieve better ramp geometry may place the crosswalk too far from the intersection for safety. In these circumstances, one diagonal ramp is acceptable. See Standard Drawing RD760 for detailed curb cut construction drawings.

- **Designing for the Vision-Impaired**

Pedestrian facilities should be designed so people with impaired vision can track their way safely along the sidewalk, across approaches and through intersections. Keeping the sidewalk clear of obstructions is important.

The most critical areas for the vision impaired are locations where street crossing points may not be readily apparent to motorists, for example at a corner with a large radius. Complex intersections with many turn lanes, skewed angles and slip lanes with free-flowing traffic are particularly confusing to the blind. There are several techniques that can help reduce confusion:

- Keep the radius as tight as possible and place the crosswalks in areas where they are expected: in line with the approach sidewalks;
- Provide a clear and straight path through raised islands, pointed straight at the crosswalks; and
- Use special surface texture at curb cuts to identify the edge of the roadway.

11.3.7 PEDESTRIAN RAIL REQUIREMENT

- **Criteria for Determining Need for Pedestrian Rail at Back of Walk**

The need for a rail at the back of the sidewalk depends on the combination of several factors. No one factor alone can trigger a need, and mitigating for one may remove the need for a rail. Consider the combined effect of the following when determining the need for a rail:

1. Height
2. Steepness of slope
3. Material of slope
4. Shy distance
5. Hazard at bottom of slope
6. Users

Height: A vertical drop of 2.5 feet or more would normally require a rail.
Steepness of slope: A slope steeper than 1:2 would normally require a rail.
Material of slope: Riprap or other hard and sharp materials may trigger a need for rail.
Shy distance: A shy distance of 2 feet or greater may be sufficient to mitigate the need for a rail.
Hazard at bottom of slope: Moving traffic, deep or fast-running water would normally require a rail.
Users: A preponderance of elderly, disabled or very young pedestrians would benefit from a rail if there is a higher likelihood they would lose their balance if they wandered off the sidewalk.

For example, a sidewalk on a 10 foot high fill, with a 1:1 side-slope made up of rip-rap, at the edge of a deep river, would undoubtedly require hand rail. But a 10 foot high fill, with a grassy side-slope, at the edge of a field, could be mitigated by ensuring there is a 2 foot shy distance beyond the back of walk (see Figure 11-1). For rail details, refer to Standard Drawing BR246.

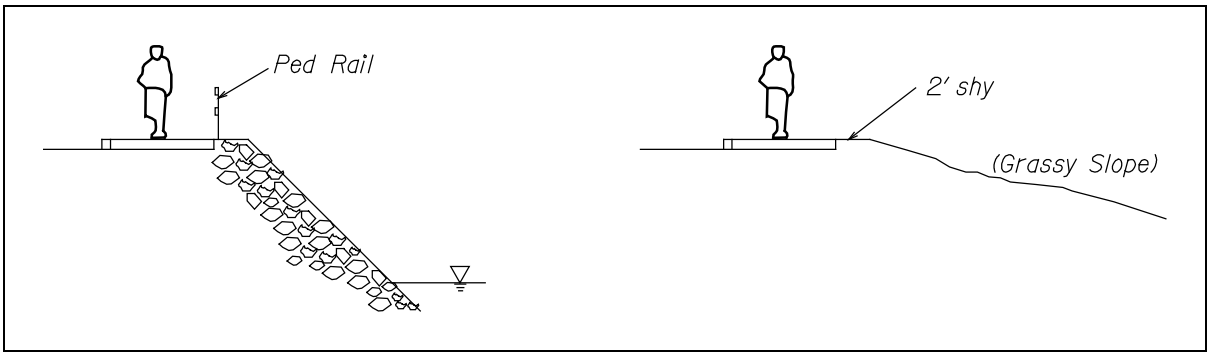

Figure 11-1
Criteria for Pedestrian Rail At Back Of Walk

11.4 TRANSIT STOPS

Refer to Chapter 12 for details on transit design.

If a highway project is on a transit route, a complete sidewalk system should be provided for the length of the project. If the project ends at a transit stop, sidewalks should continue to the nearest intersection or to the nearest section of existing sidewalk. Sidewalks should wrap around corners to join existing sidewalks on side streets.

ADA requires an 8 foot by 5 foot landing pad at bus entrances and exits. It is preferable to construct a continuous 8 foot wide sidewalk the length of the bus stop, or at least to the front and rear bus doors.

A standard-size bus shelter requires a 6 foot by 10 foot pad, with the shelter placed no closer than 2 feet from the curb. The adjacent sidewalk should be 6feet with a 5 foot clear passage. Orientation of the shelter should take into account prevailing winter winds. Bike racks should be considered at bus stops in urban fringe areas.

One of the most critical phases of designing for pedestrians on transit routes is the location of bus stops in relation to street crossing opportunities. A curb extension helps pedestrian crossing movements, prevents motorists from entering the bus pullout area and reduces conflicts with through bicyclists. Crossing islands should be considered to aid in pedestrian crossings too. Each stop should be designed to meet roadway conditions and bus characteristics. On streets with parking, near-side bus stops also benefit from curb extensions, so passengers can board or dismount the bus directly without stepping onto the street; this also makes it easier to meet ADA requirements (the bus pulls up right next to the curb). The designer should contact the local transit agency to ensure that appropriate ameneties are included in the project.

11.5 STREET CROSSINGS

Sidewalks provide mobility along the highway, but full pedestrian accommodation also requires frequent, safe and convenient crossing opportunities. Wide highways carrying large traffic volumes can be barriers to pedestrians, making facilities on the other side difficult to access.

Crossing opportunities are not limited to marked crosswalks and signals; there are many other design elements that can enhance the pedestrian’s ability to cross a highway.

Most pedestrian crashes occur when a pedestrian crosses a road, often at locations other than intersections. Mid-block crossings need to be considered, as people will take the shortest route to their destination. Prohibiting such movements is counter-productive if pedestrians cross the road with no protection. It is better to design highways that enable pedestrians to cross safely.

11.5.1 RELATED ISSUES

Safe and convenient pedestrian crossings cannot be considered in isolation from the following issues, which should be addressed when seeking solutions to specific problems:

- **Volume to Capacity (V/C) and Design Standards**

Determining the desirable V/C and appropriate design standards for a highway takes into account the needs of pedestrians. In downtowns or near schools pedestrian crossings may be more important than the smooth flow of motorized traffic. There is often an inverse relationship between the ease of pedestrian crossing and traffic volumes and/or speeds. This can lead to conflicting goals when determining priorities for a roadway:

- Some design features reduce pedestrian crossing safety (e.g., many wide travel lanes increase the distance a pedestrian must cross);
- Some designs facilitate pedestrian crossings but reduce vehicle capacity (e.g., pedestrian signals);
- Other design features benefit all users (e.g., improved sight distance at intersections and raised medians).

In some cases, actual travel speeds may be higher than is appropriate for the adjacent land use, and improvements that facilitate crossing may be useful in reducing traffic speeds to a desirable goal. The design of a highway should not encourage excessive speeds in areas of high pedestrian use.

- **Land Use**

Pedestrian-accessible origin and destination points increase the demand for pedestrian crossings. On corridors with scattered development, it is difficult to predict where crossings may occur. On corridors with concentrated nodes of activity, special crossing treatments are easier to provide at locations where crossings will likely occur (apartment complexes, senior citizen centers, schools, parks, shopping areas, libraries, hospitals, etc.).

- **Transit Stops**

Most transit stops require a pedestrian to cross the highway at one point in the trip. Transit providers and ODOT should cooperate to ensure safe pedestrian crossings. By coordinating roadway design and transit stops, passengers will be more secure when boarding or leaving a bus, and walking to or from their destination.

- **Signal Spacing**

Signalized intersections may be the preferred pedestrian crossing points at peak traffic hours; other crossing opportunities close to signalized intersections benefit from the "platooning" affect of gaps in traffic created by traffic signals. The affect decreases:

- As the distance from the signalized intersections increases;
- As high traffic volumes are spread out throughout the day; or
- If poor access management allows vehicles to continually enter the roadway.

- **Access Management**

Motor vehicles entering and exiting a busy highway at multiple and uncontrolled locations decreases pedestrian crossing opportunities - when a gap occurs in the traffic stream, it is quickly filled by motorists entering the road. Pedestrians seeking refuge in a center turn lane are unprotected.

Reducing conflicts with vehicles entering and leaving the highway benefits pedestrians. A well-designed raised median provides a refuge for pedestrians so they can cross one direction of traffic at a time. However, eliminating road connections and signals also eliminates potential pedestrian crossing opportunities. Creating an expressway can increase traffic speeds. Concrete barriers placed down the middle of the road (rather than a raised median) effectively prohibit pedestrian crossings.

- **Grade-Separation and Out-of-Direction Travel**

Grade-separated pedestrian crossings may seem to offer greater safety, but the added travel distance, climbing, and security reasons cause many pedestrians to choose the shorter, more direct route of crossing at-grade. Grade-separation must offer obvious advantages over an at-grade crossing. A structure that is unused because of inconvenience creates a situation whereby pedestrians are at risk when they cross the road with no protection. Overcrossings and undercrossings require long approaches to meet ADA grade standards. Undercrossings with obscured, partially hidden entrances present security problems. It is usually not worth the expense to create structures to separate pedestrians from motor vehicle traffic. Well-designed at-grade crossings are generally preferred.

11.5.2 SOLUTIONS

No one solution is applicable in all situations as the issues will vary on any given section of highway. In most cases, it is best to combine measures to improve pedestrian crossing opportunities and safety.

- **Raised Medians**

Raised medians benefit pedestrians on two-way, multi-lane streets, as they allow pedestrians to cross only one direction of traffic at a time. Raised medians should be constructed so they provide a pedestrian refuge by ensuring that they have a smooth level surface. On landscaped medians, plants should be low enough so they do not obstruct visibility, and spaced far enough apart to allow passage by pedestrians - concrete or brick paver pads can be provided approximately every 50 feet (see Figures 11-2 and 11-3).

- **Crossing Islands**

Where it is not possible to provide a continuous raised median, crossing islands can be created between intersections and other accesses. These should be located across from high pedestrian generators such as schools, park entrances, senior and disabled residential facilities, libraries, parking lots, etc.

At wide intersections, there is often a triangular area between the through lanes and right turn lane that is not used by motor vehicle traffic. Placing a raised island in this area benefits pedestrians by:

- Allowing pedestrians to cross fewer lanes at a time, and to judge conflicts separately;
- Providing a refuge so that slower pedestrians can wait for a break in the traffic stream;
- Reducing the crossing distances (which provides signal timing benefits); and
- Providing an opportunity to place easily accessible pedestrian push-buttons.

An island can also be provided in the middle of an intersection. An island must be a minimum of 4 feet wide, preferably 8 feet or more.

Islands must be large enough to provide refuge for several pedestrians waiting at once. For wheelchair accessibility, it is preferable to provide at-grade cuts rather than ramps. Poles must be mounted away from curb cuts and out of the pedestrian path.

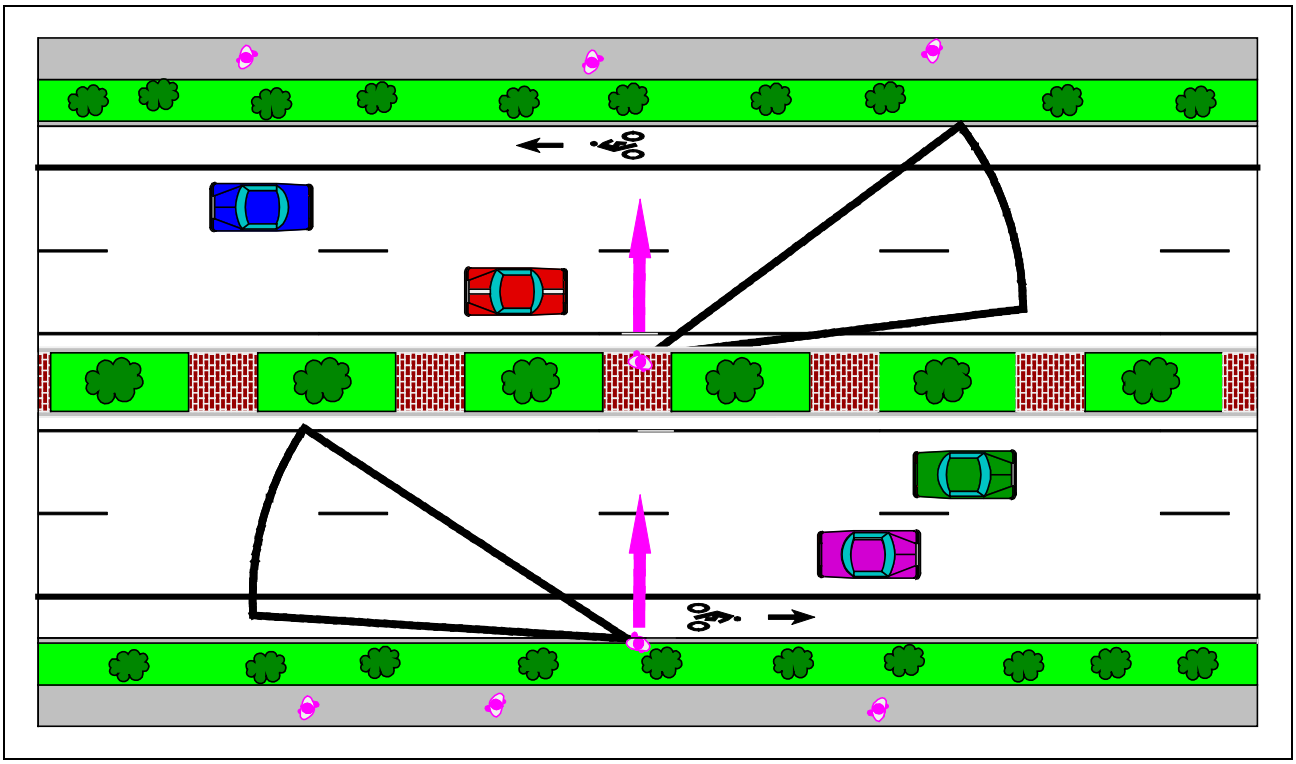

Figure 11-2,
Sight Distance At Mid-Block Raised Median Crossing

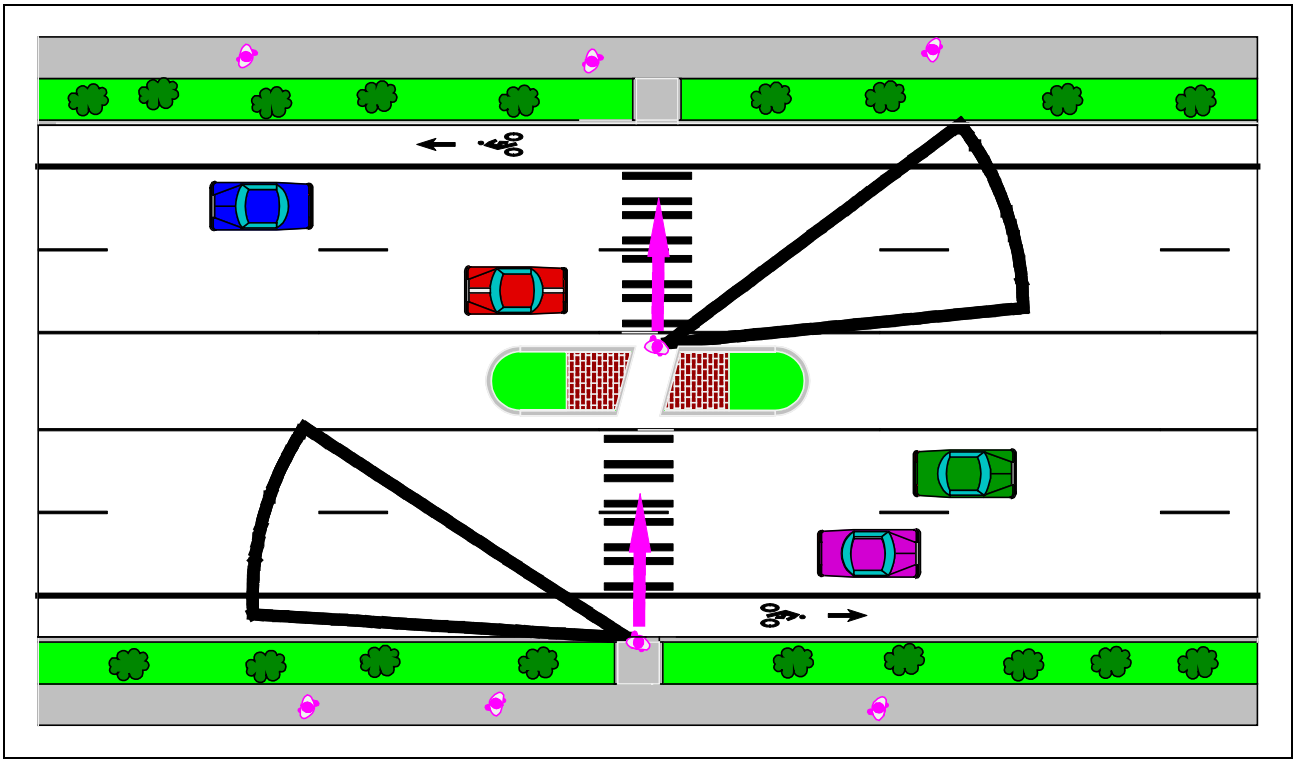

Figure 11-3
Cut Through Median Crossing

- **Curb Extensions**

Curb extensions reduce the pedestrian crossing distance and improve the visibility of pedestrians for motorists on streets where parking is allowed (see Figure 11-4). Reducing pedestrian crossing distance improves signal timing if the pedestrian phase controls the signal. The time saved is substantial when two corners can be treated with curb extensions.

Non-signalized intersections also benefit from curb extensions: reducing the time pedestrians are in a crosswalk improves pedestrian safety and vehicle movement.

Mid-block crossing curb extensions may be considered where there are pedestrian generators on both sides of the road.

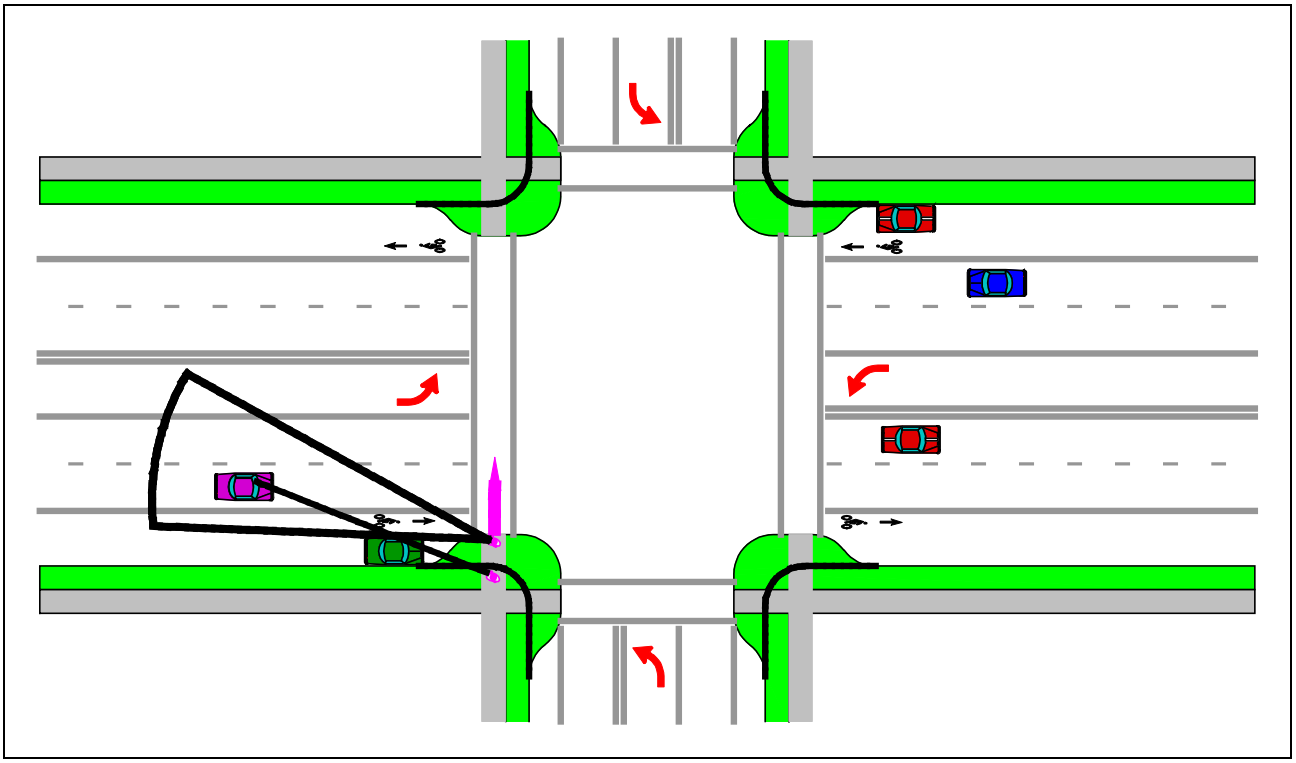

Figure 11-4
Sight Lines with Curb Extensions

- **Illumination**

Providing adequate illumination is essential to increase nighttime safety, especially at mid-block crossings which are often not expected by motorists.

- **Crosswalks**

All legs of signalized intersections should have a marked crosswalk. Crosswalks may also be considered at other locations. Combined with curb extensions, illumination and signage, marked crosswalks can improve the visibility of pedestrian crossings. Crosswalks send the message to motorists that they are encroaching on a pedestrian area. A traffic study will determine if a marked crosswalk will enhance pedestrian safety. This is usually in locations that are likely to receive high use, based on adjacent land use. Refer to the ODOT crosswalk policy (ODOT Traffic Manual, March 2001, Section 6) for further details on marking crosswalks.

Crosswalks should be 10 feet wide, or the width of the approaching sidewalk if it is greater. Consider high visibility crosswalks to increase their effectiveness.

Textured crossings, using non-slip bricks or pavers, are generally not recommended on state highways. They give the initial impression that the visibility of the crosswalk is enhanced, but after time they fade and are barely distinguishable from the roadway surface. The inherent roughness also makes them difficult for wheelchair users.

- **Pedestrian Signals**

A pedestrian activated signal may be warranted where a significant number of people are expected to cross a roadway at a particular location. Anticipated use must be high enough for motorists to get used to stopping frequently for a red light (a light that is rarely activated may be ignored when in use). Additionally, sight-distance must be adequate to ensure that motorists will see the light in time to stop. Warning signs should be installed on the approaching roadway.

Refer to the Manual on Uniform Traffic Control Devices(MUTCD) for pedestrian signal warrants. Pedestrian signals may be combined with curb extensions, raised medians and refuges.

- **Signing**

Recommended signs include both advance warning signs and pedestrian crossing signs at the crossing itself, and regulatory signs at intersections to reinforce the message that motorists must yield to pedestrians. These signs should only be placed at warranted locations, because excessive signage leads to signs being missed or ignored.

- **Sight Distance**

One of the greatest factors determining the safety of a pedestrian crossing is visibility. Every effort should be made to remove or relocate objects that could obscure the view of and by pedestrians. These include signs, traffic control boxes, tall vegetation, kiosks, etc. Efforts should also be made to ensure that objects that could be a distraction to drivers are not located close to a crossing point. These include neon and other illuminated signs which are located on private property.

11.6 INTERSECTIONS

For a thorough and detailed discussion on intersection design, see Chapter 9. The following discussion will help the designer understand some of the key intersection design features that help enhance the safety and convenience of pedestrians and bicyclists.

Most conflicts between roadway users occur at intersections, where one group of travelers crosses the path of others. Good intersection design indicates to those approaching the intersection what path they must follow and who has the right of way, including pedestrians and bicyclists, whose movements are complicated by their lesser speed and visibility.

11.6.1 BASIC DESIGN PRINCIPLES FOR PEDESTRIANS AND BICYCLISTS

- Unusual conflicts should be avoided.
- Access management practices should be used to remove additional conflict points.
- Signals should be timed so they do not inconvenience bicyclists or pedestrians with excessively long waits or insufficient crossing times.
- Good intersection designs are compact and avoid free-flowing movements.
- Simple right angle intersections are best for bicycle and pedestrian movement. The problems are more complex at skewed and multiple intersections.

11.6.2 BASIC DESIGN PRINCIPLES FOR BICYCLISTS

- The path for bicyclists should be direct, logical and close to the path of motor vehicle traffic; only in rare cases should they proceed through intersections as pedestrians.
- Bicyclists should be visible and their movements should be predictable.
- Bike lanes should be carried 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.

11.6.3 BASIC DESIGN PRINCIPLES FOR PEDESTRIANS

- All legs of an intersection should be open to pedestrians.

- The pedestrian's path of travel should be direct with minimal out-of-direction travel.
- Pedestrians should not have to travel over an excessive expanse of uninterrupted pavement.
- At signalized intersections, pedestrian signal heads should be clearly visible - this requires that they not be placed too far from the nearest safe refuge.
- Crossing islands should be used to decrease crossing distances.

11.6.4 DESIGN PRINCIPLES FOR INTERCHANGE AREAS

- Bicycles are vehicles and should be accommodated as roadway users where possible.
- Continuous bike lanes and sidewalks should be provided on both sides of the roadway.
- Designs must accommodate pedestrian and bicyclist of varying abilities and disabilities.
- Free-flow ramps should be avoided. Where they are provided, “Right Turn Yield to Peds” sign should be used for unprotected pedestrian crossings.
- Consider grade separation when there are two-lane right turn lanes or ramps