SECOND PART:

THE PLANNING, DESIGN, MAINTENANCE & SAFETY OF BIKEWAYS & WALKWAYS

INTRODUCTION

This Design Guide implements Action 2 of the Policy and Action Plan:

Create a safe, convenient and attractive bicycling and walking environment.

- ***STRATEGY 2A.*** *Adopt design standards that create safe and convenient facilities to encourage bicycling and walking.*
- ***STRATEGY 2B.*** *Provide uniform signing and marking of all bikeways and walkways.*
- ***STRATEGY 2C.*** *Adopt maintenance practices to preserve bikeways and walkways in a smooth, clean and safe condition.*

A. THE IMPORTANCE OF GOOD DESIGN

Well-designed bicycle and pedestrian facilities are safe, attractive, convenient and easy to use. It is costly to plan, design and build a facility that is little used, or is used irresponsibly because of poor design. *Inadequate facilities discourage users and unnecessary facilities waste money and resources.*

Bicycle and pedestrian facilities must be considered at the inception of transportation projects and incorporated into the total design, so that potential conflicts with the safety and level of service for various modes are resolved early on. Bikeways and walkways may be under-designed if they are considered add-on features.

Sidewalk on arterial

Good design cannot solve all safety problems: enforcement and education are needed to make all road users aware of the presence of others.

Good design does more than provide a facility for people already bicycling or walking; ODOT encourages greater use of non-motorized transportation. Examples of facilities that encourage use are:

Bike lanes: By providing cyclists with their own space on the road, bike lanes improve access to destinations and commute options. Bike lanes on arterials:

- Establish the correct position of bicyclists on the roadway;
- Reduce bicycle/pedestrian conflicts as fewer cyclists ride on sidewalks;
- Provide bicyclists a space to travel at their own speed next to motorists;
- Guide bicyclists through intersections;
- Allow bicyclists to pass motor vehicles backed up at intersections (a bike lane is a legal travel lane); and
- Send a message to motorists that bicyclists have a right to the roadway.

Planting Strips: Sidewalks separated from the roadway with a planting strip create a pleasant environment for pedestrians. Besides creating a buffer from the noise and splash of moving vehicles, planting strips provide:

- Room for street furniture such as signs, utility and signal poles, mailboxes, parking meters, fire hydrants, etc.;
- An opportunity for aesthetic enhancements such as landscaping and shade-producing trees, increasing the appeal of a roadway and pedestrians' sense of comfort; and
- A better environment for wheelchair users, as sidewalks can be kept at a constant grade without dipping at every driveway.

B. BICYCLISTS & PEDESTRIANS: SIMILARITIES & DIFFERENCES

Many early bikeway designs assumed that bicyclists resemble pedestrians in their behavior. This led to undesirable situations: bicyclists are under-served by inadequate facilities, pedestrians resent bicyclists in their space, and motorists are confused by bicyclists entering and leaving the traffic stream in unpredictable ways.

Only under special circumstances should designs allow bicyclists and pedestrians to share the same space, e.g. on multi-use paths.

The modes are similar in three ways:

- LOCATION: Bicycle and pedestrian facilities, though separate from each other, are found at the roadway edge and often allocated insufficient space for their needs. This puts them close to the right-of-way line and in conflict with other demands such as parking, utility poles and signs. This creates competition for this valuable space.
- EXPOSURE: Pedestrians and bicyclists are exposed to the elements and are more vulnerable than motorists.
- BEHAVIOR: Pedestrians and bicyclists can be of any age and no license is required. Their actions and reactions change with age and are sometimes unpredictable.

B.1. BICYCLIST BEHAVIOR

Bicycle riders are legitimate road users. They are, however, slower, less visible and more vulnerable than motorists. They need special treatment on busy, high-speed roads and at complex intersections. In congested urban areas, bicyclists can often proceed faster than motorists if well-designed facilities are provided.

Bicyclists have certain unique characteristics: they are operating vehicles, yet they are exposed to the elements and use their own power; they don't like to interrupt their momentum; they are vulnerable in crashes; they must constantly maintain their balance; and they can interact socially with other bicyclists and pedestrians.

Well-designed bicycle facilities guide cyclists of various skill levels to ride on the roadway in a safe manner that conforms to the vehicle code. This is in the same direction as traffic, usually in a position 1 to 1.2 m (3 to 4 ft) from the edge of the roadway or parked cars, to avoid debris, drainage grates and other potential hazards. Bikeways should allow cyclists to proceed through intersections in a manner that is as direct, predictable and safe as possible.

Bicyclists and pedestrians do not mix well on sidewalks

B.2. PEDESTRIAN BEHAVIOR

Pedestrians prefer greater separation from traffic and are slower than bicyclists. They need extra time for crossing roadways, special consideration at intersections and traffic signals, and other improvements to enhance the walking environment.

Pedestrians are the most vulnerable of roadway users, as they are exposed to the weather and are often not visible to motorists. They are also the least tolerant of out-of-direction travel, and will often take short cuts where there is no convenient or direct facility. Pedestrian facilities must be designed to meet or exceed the requirements of the Americans with Disabilities Act (ADA).

Some design details are important for their contribution to safety (e.g. pedestrian signals, illumination), some because they make walking more convenient (e.g. paths that provide short-cuts), and others because they make the walking experience more pleasant and minimize the sensory impact of adjacent motor vehicles (e.g. planting strips).

Standard intersection treatment guides bicyclists in a predictable manner

C. STANDARD BIKEWAY & WALKWAY DESIGN

To establish primary design practices, ODOT has adopted the American Association of State Highway and Transportation Officials' (AASHTO) standards. Most ODOT highway design standards are contained in the "Highway Design Manual," available from ODOT. AASHTO also publishes the "Guide for the Development of Bicycle Facilities."

ODOT has adopted several design standards that are greater than AASHTO, e.g. 1.8 m (6 ft) bike lane and sidewalk width. Also included in this plan are several standard designs that ODOT has developed, most notably for intersections, that are not covered by AASHTO.

ODOT encourages local agencies to use the AASHTO guidelines and ODOT standards recommended in this plan.

Traffic control devices must conform to the "Manual on Uniform Traffic Control Devices" (MUTCD) as supplemented and adopted by the Oregon Transportation Commission. All bikeway signing and striping plans should be reviewed by a traffic engineer.

D. STANDARDS & MINIMUMS

Standards are developed to create conditions for users that are safe and comfortable under optimum conditions. Whenever possible and appropriate, facilities should be built to standard.

There are situations where a standard cannot be maintained due to geometric, environmental or other constraints, or may not be appropriate, due to the nature of the surroundings or users. In these circumstances, a design using dimensions less than the standard may be acceptable; however, a facility should not be built to less than minimum standards.

There is always a range between the standard and the minimum, so intermediate values may be used. For example, the standard width for a sidewalk is 1.8 m, with a minimum of 1.5 m; sidewalks may also be 1.7 or 1.6 m wide, depending on circumstances.

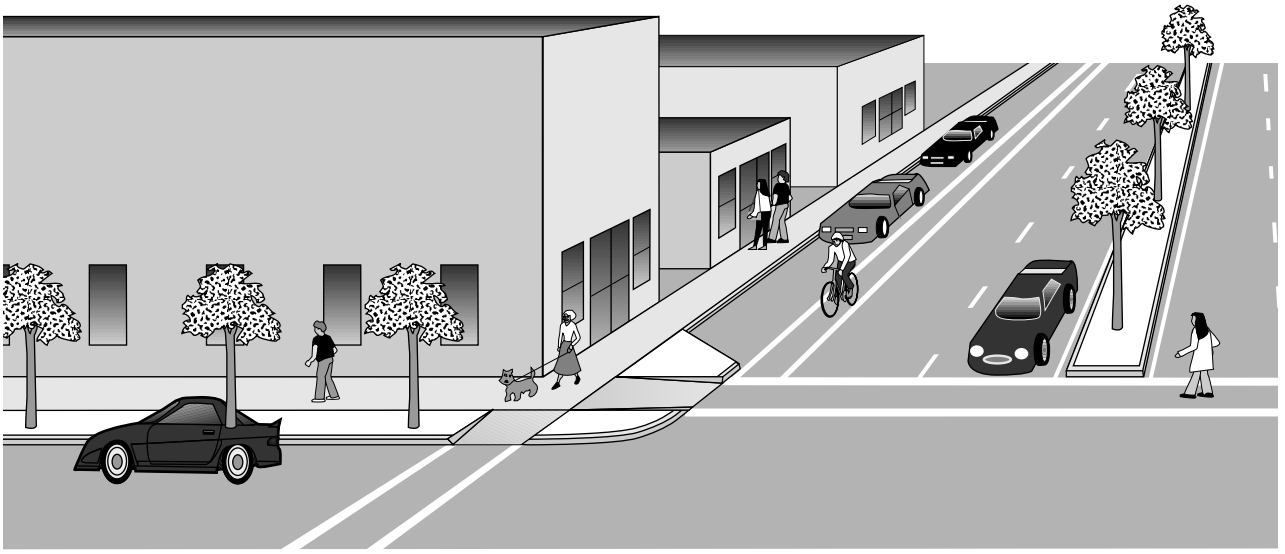


Figure 1: Urban arterial cross-section that accommodates all modes

E. OTHER INNOVATIVE DESIGNS

There are many innovative designs that facilitate bicycling and walking that are not yet found in existing design manuals. Some chapters present ideas that have been implemented successfully in Oregon, other parts of the country or other countries. Some designs enhance the roadway environment for bicyclists and pedestrians, such as contra-flow bike lanes, while others lessen the negative impacts of designs aimed at improving motor-vehicle flow, such as dual right-turn lanes.

Sections where these practices are presented are preceded with the following paragraph:

These concepts are presented as information, to help ODOT, cities and counties to come up with new solutions to common problems.

Colored bike lanes are commonly used in Europe

Raised and textured crosswalk (Switzerland)

I. PLANNING WALKWAY & BIKEWAY NETWORKS

I.1. BACKGROUND

INTRODUCTION

Successful bikeway and walkway plans are integrated into the overall transportation plan of a city, region or state. They reflect the mobility and access needs of a community, and are placed in a wider context than simple movement of people and goods. Issues such as land use, energy, the environment and livability are important factors.

Bikeway and walkway planning undertaken apart from planning for other modes can lead to a viewpoint that these facilities are not integral to the transportation system. If bikeways and walkways are regarded as amenities, bicycling and walking may not receive sufficient consideration in the competition for financial resources and available right-of-way. ODOT proposes a comprehensive vision for establishing bikeway and walkway networks.

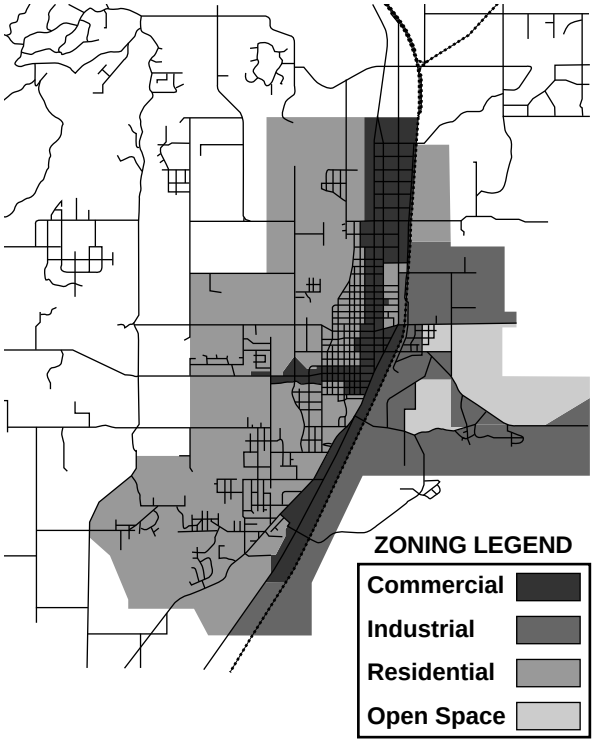


Figure 2: Segregated land-use increases travel distance

A. RELATED PLANNING ISSUES

A.1. LAND USE

The ease of bicycling and walking is often determined by land use patterns. Much of recently built development creates a situation where an automobile is required for most trips:

- Segregated land use increases the distance between origin and destination points;
- Businesses are designed to be readily accessible by automobile: buildings are set back and separated from the roadway with parking;
- The transportation system discourages bicycling and walking, due to high traffic volumes and speeds.

Land use patterns conducive to bicycling and walking include:

- **Greater housing densities** allow more residents to live closer to neighborhood destinations such as stores and schools;
- **Mixed-use zoning** allows services such as stores and professional buildings to be closer to residential areas, making it easier to access these facilities on foot or by bicycle;
- **Multiple-use zoning** allows residences and businesses to share the same structure, reducing travel demands;

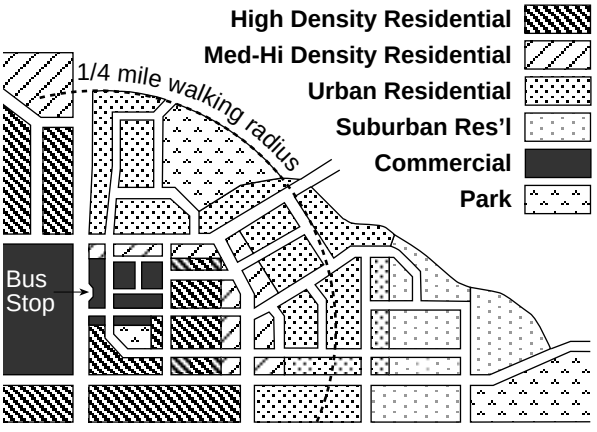


Figure 3: Mixed land use encourages walking, bicycling and transit

- **Locating buildings close to the street** allows easy access by pedestrians;
- **The preservation of open spaces between communities** creates a greenbelt, a natural buffer that helps prevent urban sprawl; and
- **Resolving conflicts** with neighborhood traffic management (traffic calming) makes streets more inviting to walkers and cyclists.

Buildings oriented to the street facilitate walking

Integrating land-use and transportation planning allows new developments to implement these strategies from the onset. Communities planned to support balanced transportation make walking, bicycling and public transit attractive options (adjacent land-use affects transit ridership).

Shopping centers fronted by parking are difficult to access on foot

In established communities, many of these goals can be met with "in-fill development" to increase density, changes in zoning laws to allow mixed-use development, and building bicycle and pedestrian connections.

Pedestrians and bicyclists are vulnerable to left-turning cars

A.2. ACCESS MANAGEMENT

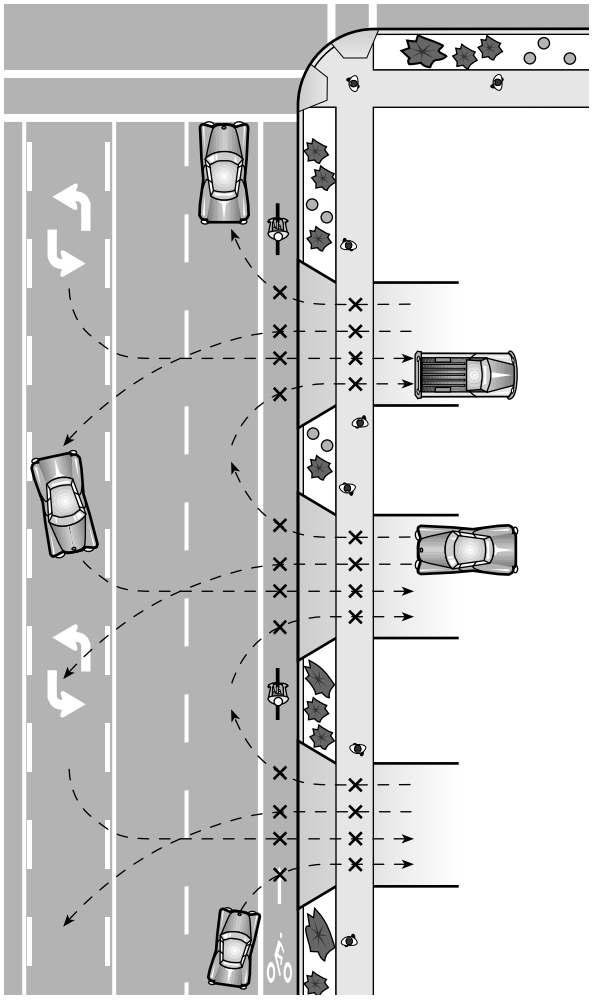
A.2.a. Problems with Uncontrolled Access

Urban thoroughfares should accommodate bicyclists and pedestrians, but these streets are often perceived as undesirable for non-motorized travel because of high traffic volumes and speeds. Yet conflicts rarely occur with users traveling in the same direction: most conflicts occur at intersections, driveways and alleys.

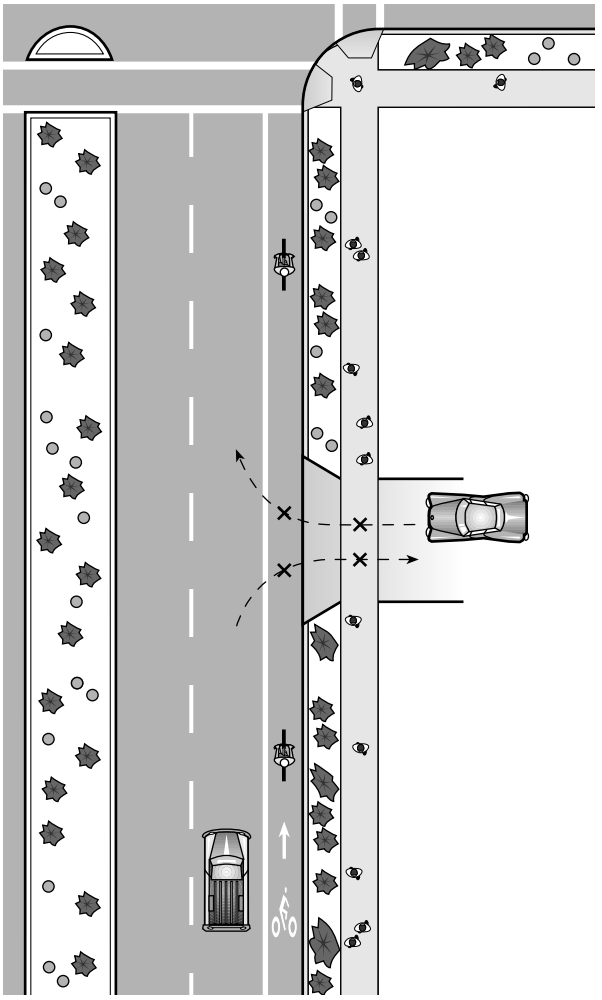
Unlimited access creates many conflicts between cars entering or leaving a roadway and bicyclists and pedestrians riding or walking along the roadway, who are vulnerable if motorists fail to see or yield to them.

Pedestrians crossing a roadway require gaps in the traffic stream, but with unlimited access, vehicles entering the roadway quickly fill available gaps.

Fewer driveways means fewer conflicts



Uncontrolled accesses create 8 potential conflict points at every driveway.



A raised median and consolidating driveways reduce conflict points.

Figure 4: Benefits of access management for bicyclists and pedestrians

A.2.b. Benefits of Access Management to Bicyclists & Pedestrians

By limiting and consolidating driveways, by providing raised or landscaped medians, or by creating frontage roads, bicyclists and pedestrians benefit in several ways:

- The number of conflict points is reduced; this is best achieved by replacing a center-turn lane with a raised median (left turns account for a high number of crashes with bicyclists and pedestrians);
- Motor vehicles are redirected to intersections with appropriate control devices;
- Pedestrian crossing opportunities are enhanced with an accessible raised median and fewer conflicts with turning cars;
- Accommodating the disabled is easier, as the need for special treatments at driveways is reduced;
- Traffic volumes on the arterial may decrease if local traffic can use other available streets or frontage roads for local destinations; and
- Improved traffic flow may reduce the need for road-widening, allowing part of the right-of-way to be recaptured for bicyclists, pedestrians and other users.

While new roads can be designed using these principles, it is more difficult to retroactively reduce, consolidate or eliminate existing accesses. Yet this is an important strategy to make existing roads more attractive to bicyclists and pedestrians.

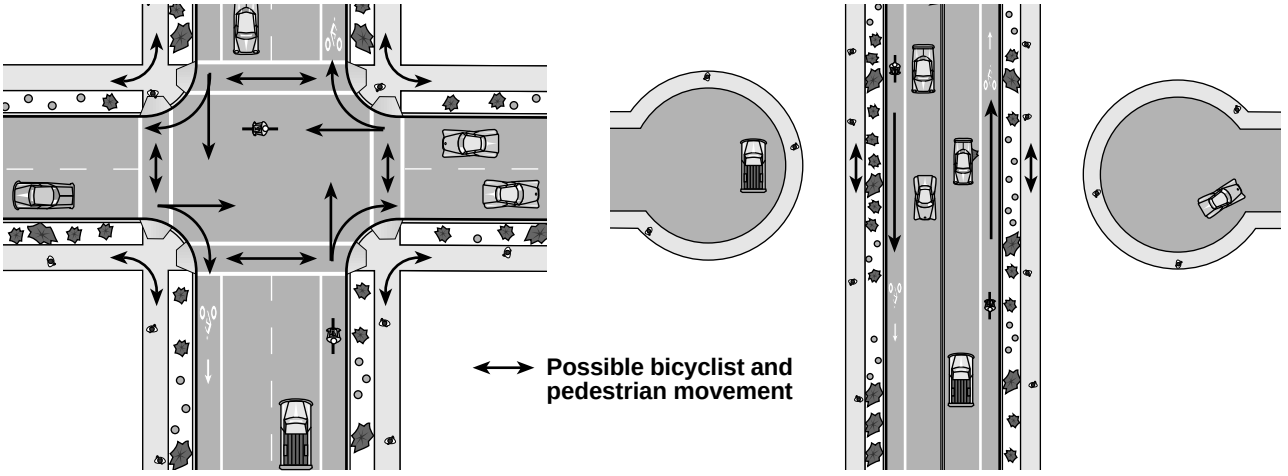


Figure 5: Reducing the number of street connections reduces pedestrian mobility and crossing opportunities

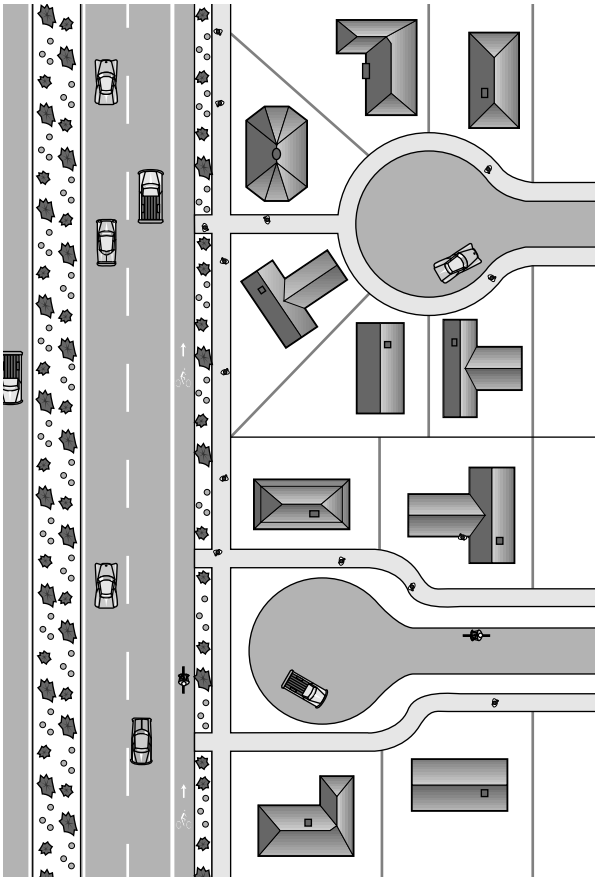


Figure 6: Connecting cul-de-sacs to arterial with open pathways

A.2.c. Negative Impacts of Access Management to Bicyclists & Pedestrians

Limiting the number of street connections may have a negative impact on non-motorized mobility, especially for pedestrian crossings:

- Creating a thoroughfare may increase traffic speeds and volumes;
- Eliminating local street crossings eliminates pedestrian crossing opportunities, reduces pedestrian and bicycle travel choices, and may increase out-of-direction travel;
- Reduced access to businesses may require out-of-direction travel, discouraging walking and bicycle trips;
- Placing concrete barriers down the middle of the road (rather than a raised or landscaped median) effectively prohibits pedestrian crossings; and
- Improperly designed raised medians act as barriers: pedestrians should be able to see to the other side of the street (vegetation should not decrease visibility) and curbs should be no more than standard height.

Where limited access thoroughfares exist in urban areas, safe and frequent crossings should be provided. Parallel local streets should be improved for bicycle and pedestrian circulation as well.

Concrete barrier in median prevents pedestrian crossing

Traditional land use allows a mix of businesses and residences, which is more conducive to walking and transit

A.3. PUBLIC TRANSIT

Transit trips begin and end with a walk or bike ride. Pedestrian and bicycle facilities in transit corridors make transit systems more effective. Therefore, high priority should be given to providing sidewalks and bikeways on transit routes and on local streets feeding these routes from neighborhoods.

Transit users need to cross the road safely at stops: on a typical two-way street with residences and development on both sides, half the riders will need to cross a road when boarding or exiting a bus.

Bus stops should provide a pleasant environment for waiting passengers, with shelters, landscaping, adequate buffering from the road and lighting. Bus stop design should minimize conflicts with other non-motorized users, such as bicyclists on bike lanes or pedestrians walking past passengers waiting to board.

Bus stop with shelter

Bus stops should be placed in locations that are readily accessible by pedestrians, or that can be made accessible by changing the configuration of adjacent land use. This can be done by:

- Orienting building entrances to the transit stop or station;
- Clustering buildings around transit stops; and
- Locating businesses close to transit stops.

Transit stop close to high-density housing development

Regional and statewide public transportation systems benefit from bicycle facilities such as:

- Accommodating bicycles on buses and trains;
- Bikeways leading to stations, transit centers and park-and-ride lots; and
- Secure bicycle parking provided at these locations.

Bus equipped with bike rack

A.4. TRANSPORTATION DEMAND MANAGEMENT

Transportation Demand Management (TDM) includes transportation actions that reduce peak period Single Occupant Vehicle (SOV) travel, spread traffic volumes away from the peak period or improve traffic flow. TDM is intended to ease demand on the transportation system by using low-cost strategies that encourage a more efficient use of existing facilities.

Commonly used strategies include park-and-ride lots, carpooling, vanpools, express bus service, bicycling, walking, group transit passes, parking management, impact fees, ramp metering, reversible lanes, signal synchronization, bus bypass lanes, trip reduction ordinances, compressed or staggered work schedules, flex-time and telecommuting.

These strategies tend to be most successful where there are:

- Heavily congested commuter corridors;
- Clearly identifiable work trip travel patterns;
- Clearly identifiable trip origins and destinations;
- Large employer work sites or clusters of small employer work sites;
- Environmentally concerned employers;
- Community commitment to clean air;
- Constrained parking at employer work sites; and
- Available transportation alternatives.

TDM is most effective where strategies are linked and users are offered a combination of viable transportation choices and incentives.

The relationship between TDM and bicycling and walking is two-fold:

1. Encouraging more employees to commute by bicycle and on foot can be part of a package of incentives; and
2. Successful TDM strategies can reduce the volumes of traffic on roadways at peak hours, with the following consequences for bicyclists and pedestrians:
   - Reduced traffic volumes may render the roads less intimidating to bicyclists and walkers;
   - Reduced traffic volumes may decrease the need for additional capacity, freeing up funds and right-of-way for bicycle and pedestrian facilities.

Escorted group rides are an effective form of encouragement

B. PRIOR PLANNING METHODS

Two prior planning concepts have not proven effective in establishing networks: designating "Bike Routes" and classifying bicycle riders into different types. These designations are not used in this plan.

B.1. DESIGNATED BIKE ROUTES

Most bikeway planning has depended on designated Bike Routes; some attempts have also been made to designate Pedestrian Routes. Problems arise when the needs of bicyclists and pedestrians are not taken into consideration, with routes chosen mainly to minimize the impact on motor vehicle traffic.

Disadvantages of plans based on bike or pedestrian routes are:

- *The best routes are not chosen:* if routes are indirect, inconvenient or don't serve origin and destination points, current riders and walkers may ignore them, while others see no incentive to take them; pedestrians tolerate very little out-of-direction travel.
- *Other potential routes are missed:* roads that are not yet built should be designed to accommodate bicyclists and pedestrians; existing streets may need to better accommodate bicyclists and pedestrians if their functional classification is upgraded.
- *Thoroughfares are excluded:* arterials usually serve the community well, with many origin and destination points; well-traveled streets provide a sense of security for walkers, due to the presence of other people.
- *It may be implied that bicyclists and pedestrians should only use certain streets:* the public right-of-way should include, not exclude, bicyclists and pedestrians; roads should be designed to properly accommodate them.
- *Improvements may go no further than the placement of BIKE ROUTE signs:* allocating road space to bicyclists, improving road conditions or removing obstacles to bicycling are more effective ways to make streets more "bicycle-friendly."
- *Improvements for walking and bicycling are restricted to the routes:* bikeways and walkways are often built as part of road improvement projects, or when other opportunities arise; opportunities may be missed when modifications are made to roads not on designated routes (every road project is a potential bikeway and walkway project).

ODOT Approach: All roads open for public use should be considered for their potential to improve bicycling and walking, based on need and road characteristics.

B.2. DEFINING BICYCLE TRAVEL & RIDER TYPES

Some plans have segregated bicyclists into four general use categories (recreational, commuting, touring and racing), or according to skills - riders with highly developed skills, riders with moderate skills, and children and beginners.

ODOT Approach: Facilities should safely accommodate the majority of users. Roads designed to accommodate cyclists with moderate skills will meet the needs of most riders; special consideration should be given close to school areas, where facilities designed specifically for children should be provided. Roads designed to accommodate young, elderly and disabled pedestrians serve all users well.

This busy Dutch street accommodates many travel modes

I.2. PLANNING PRINCIPLES

A. THE IMPORTANCE OF THE STREET SYSTEM

For a roadway network to serve the transportation needs of a community, it must serve all users. Bikeway and walkway planning addresses how existing and future roads can meet bicycle and pedestrian needs. It is physically, financially and politically impractical to provide a new and separate network in built-up urban environments. In planning new developments, it may be possible to incorporate a separate system of pathways, but the street system will link all destinations together.

ODOT has adopted a comprehensive concept in designing bikeway and walkway systems, based on the premise that the public right-of-way should serve all users; people riding bicycles or walking need to use the same facilities that provide access and mobility to motorists.

By designing roads for all travel modes, in a safe, attractive and convenient manner, bicycle and pedestrian systems can gradually evolve. Often, only minor improvements are needed to accommodate bicyclists and pedestrians.

Most bicycling and walking occurs on the existing roadway system for several reasons:

- It is already in place;
- It serves all destinations; and
- Safety is improved when cyclists and walkers are visible to motorists and obey the same traffic laws and control devices.

Examples of successful examples include:

- Corvallis and Eugene have most of their arterial and collector streets striped with bike lanes; bicycle use is high, as one can ride virtually anywhere with ease;
- Downtown Portland is a pedestrian-friendly environment, with sidewalks on all streets, short blocks, traffic signals that accommodate pedestrian movements, and many destinations accessible on foot, such as offices, stores, restaurants and residences; walking use is high;
- Ashland is a small community with compact development and a high rate of walking; and
- Many communities in central, eastern and southern Oregon are very walkable due to their relatively small size.

B. THE 4 PRINCIPLES OF BIKEWAY & WALKWAY PLANNING

Effective bikeway and walkway networks depend on:

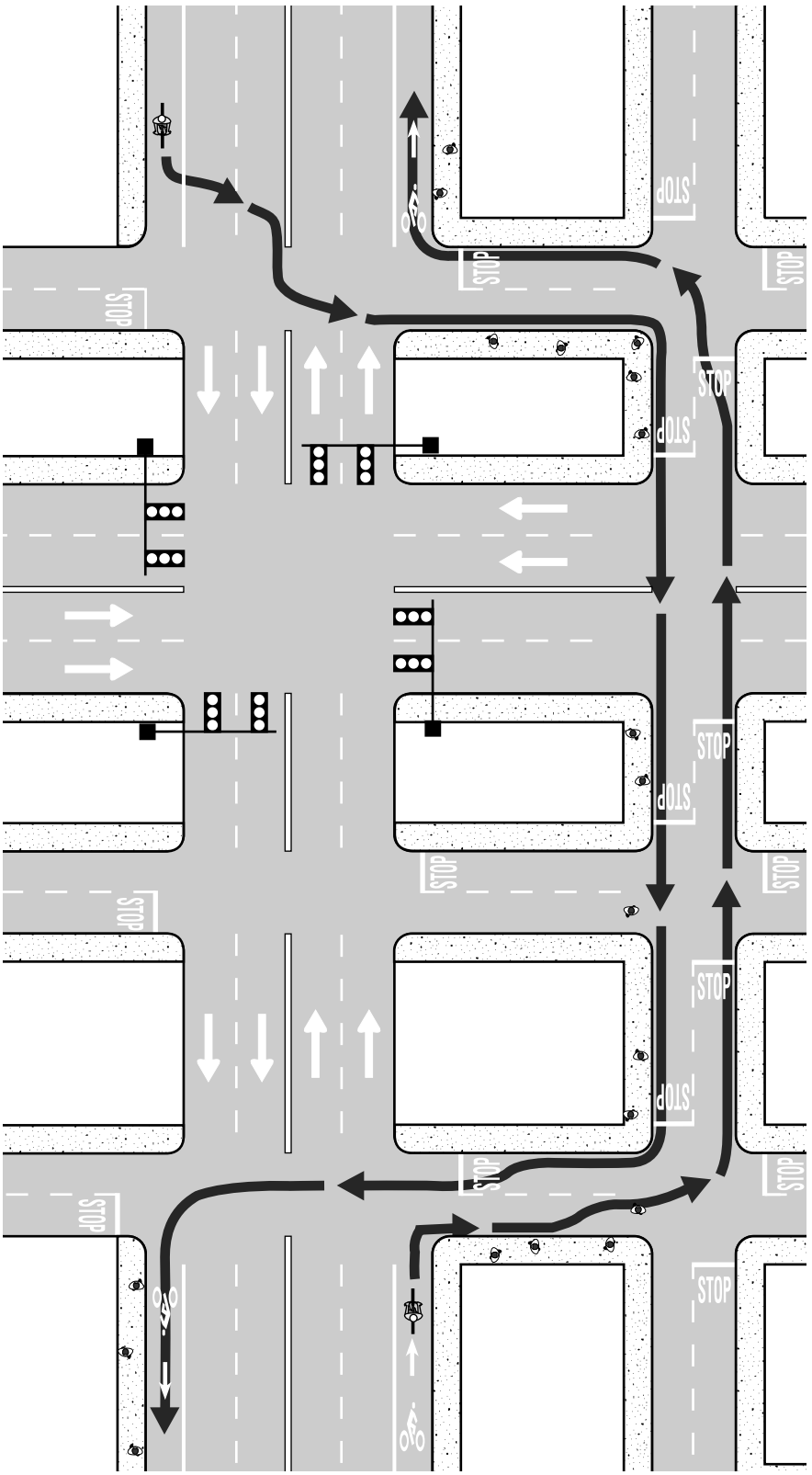
1. Accommodating bicyclists and pedestrians on arterial and collector streets;
2. Providing appropriate facilities;
3. Creating and maintaining a system of closely spaced, interconnected local streets; and
4. Overcoming barriers such as freeway crossings, intersections, rivers and canyons.

B.1. ARTERIAL & COLLECTOR STREETS

B.1.a. The Importance of Main Streets

Arterials and collectors are the backbone of urban transportation systems, and failure to accommodate non-motorized travel on thoroughfares leads to fragmented systems that do not realize their full potential, denying access to non-motorized users and creating hazardous conditions for motorists, pedestrians and bicyclists. Arterials and collectors are important because they:

- Serve the mobility and access needs of the community;
- Provide direct, continuous and convenient access to most destination points;
- Have many destination points located on them;
- Provide controlled crossings of other arterials; and
- Bridge obstacles such as rivers, freeways and railroad tracks.



Why bicyclists and pedestrians prefer to stay on the thoroughfare:

- The thoroughfare provides the most direct route for bicyclists and pedestrians;
- There may be destinations along the thoroughfare that are inaccessible from side streets;
- Less-traveled streets will often have many stop signs, whereas traffic on the through street has the right-of-way or signals that favor through traffic; and
- Potential conflict points are increased with rerouting, especially for cyclists and pedestrians who must cross the thoroughfare (some cyclists have the added difficulty of additional left turns).

Consequences of rerouting without providing adequate facilities:

- Many cyclists and pedestrians stay on the thoroughfare, causing possible safety problems and reduced capacity (bicyclists riding slowly in a narrow travel lane can cause traffic delays);
- Pedestrians and bicyclists may be routed through uncontrolled crossings of thoroughfares;
- Circuitous route signing that is ignored breeds disrespect for other signing;
- Some motorists will not respect bicyclists or pedestrians who are perceived to be where they don't belong; and
- The importance of bicyclists and pedestrians in the transportation network is diminished.

Figure 7: Why bicyclists and pedestrians should be accommodated on thoroughfares

B.1.b. Problems with Existing Streets

Existing streets are often difficult for bicyclists and pedestrians to use for several reasons:

- High traffic volumes and speeds may intimidate people who want to bike or walk;
- Busy intersections can be difficult for bicyclists and pedestrians to cross;
- Existing bicycle and pedestrian facilities may be absent, inadequate, discontinuous or poorly maintained; and
- Local streets are often disconnected, requiring a person to take a circuitous route; they have fewer destination points; arterial crossings are unsignalized, or signalized to favor through traffic on the arterial.

Sidewalk ends abruptly

B.1.c. How to Make Needed Improvements

Arterials and collectors can be made more bicycle and pedestrian friendly by:

- Including bikeways and walkways when roads are built or reconstructed;
- Renovating roads with bikeways and walkways;
- Improving pedestrian crossing opportunities; and
- Improving and better maintaining existing, but inadequate, facilities.

In built-up urban environments there is often little opportunity to add bikeways and walkways by widening roadways, because rights-of-way are often fully used and building setbacks are shallow. Some roadway space may have to be reallocated for provide bikeways and walkways.

B.1.d. Alternatives to Thoroughfares

Expressways

Along limited access expressways with no destinations directly on the roadway, it is appropriate to accommodate bicycle and pedestrian traffic on parallel streets or frontage roads. These should be direct, convenient routes that serve local and longer trips. Ideally, a frontage road should be provided on each side of an expressway, as well as crossing opportunities, either at-grade or with grade-separation.

Other Arterials

When it is not feasible or practical to provide bikeways and walkways on an arterial, or if an arterial does not serve the mobility and access needs of bicyclists and pedestrians, other options may be explored on a parallel and adjacent street. To determine if it is better to provide facilities on a parallel street, the following guidelines should be used:

1. There are compelling safety, economic or environmental reasons that preclude providing adequate bikeways and walkways on the arterial;
2. The arterial does not provide adequate access to destination points within reasonable walking or bicycling distances;
3. Parallel streets provide continuity and convenient access to facilities served by the arterial;
4. The costs to improve parallel streets are no greater than the costs to improve the arterial; and
5. The proposed facilities on parallel streets can be built to proper bikeway and walkway standards.

Other factors may need to be considered. The appropriate government agency or agencies should negotiate cooperative cost-sharing based on usage and benefits to the system.

Note: Emphasizing arterials and collectors does not preclude making improvements on other facilities or providing multi-use paths; arterials and collectors are the backbone to which other facilities will connect.

B.2. APPROPRIATE FACILITIES

Well-designed bicycle and pedestrian facilities attract users, while inadequate bikeways or walkways discourage users. Making urban streets more inviting to bicyclists and pedestrians also requires that adjacent land use, traffic speeds, transit access and street connectivity be considered in urban designs. Refer to design chapters for standards.

B.2.a. Rural Bikeways

On most rural roadways, shoulder bikeways are appropriate, accommodating cyclists with few conflicts with motor vehicles. In general, the shoulder widths recommended by AASHTO for rural highways are adequate for bicycle travel. These standards take into account traffic volumes and other considerations.

Shared roadways are adequate on low-volume rural roads, where motor vehicle drivers can safely pass bicyclists due to the low likelihood of encountering on-coming traffic.

Shoulder bikeways can be added to roads with high bicycle use, such as in semi-rural residential areas or close to urban areas. It may be appropriate to stripe and mark shoulders as bike lanes near schools or other areas of high use.

Even adding minimal-width shoulders can improve conditions for bicyclists on roads with moderate traffic volumes. On roads with high use, it may be necessary to add full-width shoulders in areas of poor visibility due to topography.

Rural shoulder bikeway

B.2.b. Rural Walkways

In sparsely populated areas, the shoulders of rural roads usually accommodate pedestrians. There are, however, roadways outside urban areas where the urban character creates a need for sidewalks, such as on highly developed commercial strips or in residential clusters along county roads or state highways. Where sidewalks are not provided, shoulders should be wide enough to accommodate both pedestrians and bicyclists.

Paths provided on one or both sides of a roadway in a rural community may be appropriate for providing access to schools. These paths will also serve the needs of young bicycle riders.

Bike lanes used by pedestrians

B.2.c. Urban Bikeways

In urban areas, the need to provide special facilities for bicycle use is determined by the speed and volume of motor vehicle traffic.

Arterials and Major Collectors

The appropriate facilities are bike lanes, which:

- Help define the road space;
- Provide bicyclists with a path free of obstructions;
- Decrease the stress level of bicyclists riding in traffic; and
- Signal to motorists that cyclists have a right to the road.

Bike lanes also provide advantages for other users: they help buffer pedestrians from traffic, and increase motorist safety by improving sight distance.

On retrofit projects, where it is not physically possible to provide bike lanes due to constraints such as existing buildings or environmentally sensitive areas, a wide outside lane may be substituted. A wide outside lane should only be considered after other options have been pursued, such as narrowing or removing travel lanes or parking. Wide lanes allow motor vehicles to pass a bicyclist in the lane, but provide few of the benefits of bike lanes. Bike lanes should resume where the constraint ends.

Effectively reducing running (actual) speeds to less than 40 km/h (25 MPH) creates a more comfortable environment for bicycling where there is insufficient width for bike lanes. This may be appropriate for Central Business Districts.

Bike lane on urban arterial

Minor Collectors and Local Streets

The appropriate facilities for bicyclists are shared roadways, as low traffic speeds and volumes allow bicyclists and motorists to safely share the road.

Bike lanes are appropriate on minor collectors with high average running speeds (above 40 km/h [25 MPH]) or high traffic volumes (ADT over 3000). These numbers reflect practices in cities where bike lanes are common. Local conditions may dictate different thresholds. Bike lanes on minor collectors are also appropriate to connect up with other bike lanes or to extend bike lanes to destination points that generate high bicycle use, such as schools, parks and multi-family housing units.

B.2.d. Urban Walkways

The appropriate facilities for pedestrians are sidewalks. A sidewalk provides positive separation from traffic, an all-weather surface and access for the disabled. They are readily identifiable by both pedestrians and motorists. Planting strips are desirable to buffer pedestrians from traffic, increasing their sense of comfort and safety, and to provide better access for the disabled at driveways.

Arterials and Major Collectors

Sidewalks must be provided on both sides of all arterial and collector streets, unless there are physical limitations and land use characteristics that render a sidewalk unsuitable on one side. In these situations, safe and convenient crossing opportunities must be provided to allow pedestrians to proceed on the side with sidewalks.

Minor Collectors and Local Streets

Sidewalks on both sides of the street are the appropriate facility. There is a point below which sidewalks on both sides of a local street may not be critical: e.g. on short dead-end streets with few potential residences and with no access to other facilities.

Trees and separation from roadway enhance the walking environment

B.3. AN OPEN GRID STREET SYSTEM

A system of interconnected streets offers direct routes with minimal out-of-direction travel. Street patterns that include cul-de-sacs and dead-end streets require a long circuitous route to cover a short distance, increasing out-of-direction travel for what could otherwise be a fairly short bicycle or walking trip.

The best solution is to link disconnected streets together with through streets. Where the right-of-way is insufficient for a street, or where cul-de-sacs are incorporated into a development, a path can be provided for bicycle and pedestrian access (see Figure 6, page 44).

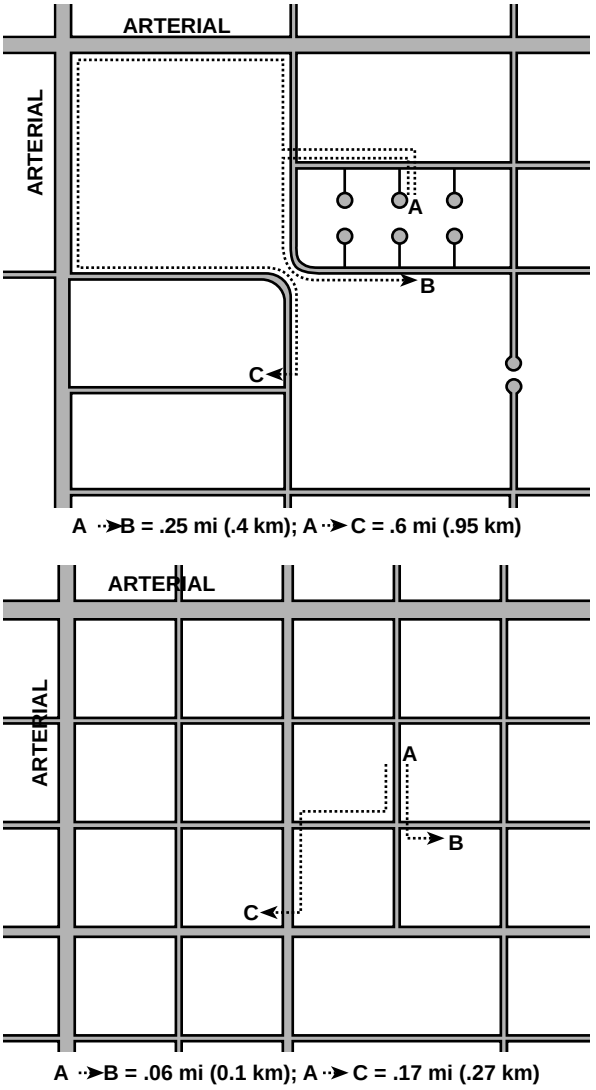


Figure 8: Travel distance savings with an open street grid

B.4. OVERCOMING BARRIERS

Establishing bikeways and walkways along streets is not enough to fully accommodate bicycle and pedestrian travel. The major barriers, and ways to overcome them, are:

- **Freeways, rivers and canyons** often divide a community if there are few crossing opportunities.
  Solutions: bridges built to accommodate all modes: existing and planned bridges must include the appropriate bicycle and pedestrian facilities. For security reasons, these are preferable to separate bicycle-pedestrian bridges. If bicycle-pedestrian bridges are needed, they should be located so they are visible, accessible from the existing roadway network and close to areas with high potential use, such as residential and commercial areas, schools or parks.
- **Wide streets**, if improperly designed, can be barriers to pedestrian and bicycle cross-movement when they carry large volumes of traffic.
  Solutions: pedestrian crossing treatments, such as raised median islands and curb extensions.
- **Intersections** are difficult areas for pedestrians and bicyclists when designed for high speed, free-flowing motor vehicle traffic.
  Solutions: special treatments such as islands, smaller radius corners and through bike lanes.
- **At-grade railroads crossings** are often difficult for bicyclists to negotiate; when crossings are eliminated, pedestrian and bicycle crossing opportunities are also removed.
  Solutions: maintaining existing crossings in safe condition for bicyclists and pedestrians, and keeping pedestrian and bicycle access across railroad tracks if street crossings are closed.
- **Heavy motor vehicle traffic volumes** discourage many walkers and bicyclists from using certain streets.
  Solutions: Well-designed bicycle and pedestrian facilities will attract hardy users; more timid users, who perceive that they are no longer alone, will also be attracted; Transportation Demand Management practices and traffic calming can help reduce traffic volumes and speeds at peak hours.

C. OTHER PLANNING CONSIDERATIONS

C.1. SUBURBS

Legally, land use designations for transportation purposes are either rural or urban. Yet many areas have land use characteristics commonly known as suburban, incorporating both urban and rural elements: streets tend to be wide, with high traffic speeds and volumes, busy intersections and many accesses. Discontinuous streets and cul-de-sacs are common. Destinations tend to be widely separated. These factors create an environment that is not conducive to walking or bicycling.

Most suburbs are within an urban growth boundary. Others are not, yet have the characteristics of urban areas. These "urbanized" areas should be considered urban when planning for bicycle and pedestrian travel.

Many enhancements other than providing bikeways and walkways are needed to make a suburban environment more conducive to bicycling and walking:

- Controlling private accesses on arterials;
- Providing safe pedestrian and bicycle access to shopping malls;
- Redesigning parking lots to allow better pedestrian access and circulation;
- Providing safe crossings of multi-lane roads;
- Encouraging land-use patterns that place origin and destination points within reasonable walking and bicycling distance;
- Connecting cul-de-sacs and dead-end streets with streets or paths; and
- Shortening travel distances with multi-use paths.

The appropriate bicycle facilities on suburban arterials and major collectors are bike lanes. Shoulder bikeways are appropriate on roadways with a more rural character. Bike lanes or shoulder bikeways may be appropriate on minor collectors where speeds and traffic volumes are high, or where visibility is impaired due to topography.

The appropriate pedestrian facilities on suburban arterials and collectors are sidewalks.

C.2. MULTI-USE PATHS

Multi-use paths can enhance bicycle and pedestrian travel in urban areas where the existing road system does not serve bicyclists and pedestrians well, or where abandoned railroads or other open spaces provide a corridor free of obstacles. Discontinuous street systems benefit from paths to reduce out-of-direction travel. Paths function best where street crossings can be eliminated or minimized.

The following guidelines ensure that a path system is an effective component of a walkway and bikeway network:

1. Neighboring jurisdictions should coordinate planning to link elements when paths cross jurisdictional boundaries (state, county or city rights-of-way or parks; and private property, including railroads).
2. Paths must connect to the street system in a safe and convenient manner - busy streets should accommodate bicyclists and pedestrians, with bike lanes and sidewalks.
3. Connections should be well-signed with destination and directional signing.
4. Paths should not substitute for a good system of on-street facilities.
5. Paths must be located in corridors that serve origin and destination points, such as residential areas, schools, etc.; they should not lead to nowhere.
6. Paths should be built in locations that are visible and easily accessible, for the personal safety of users.
7. Paths should be located where motor vehicle crossings can be eliminated or minimized; paths rarely function well when placed adjacent to a roadway, because of conflicts at intersections.
8. Crossings must be well-designed.
9. Paths should be built to high standards, with sufficient width and clearance to allow users to proceed at reasonable speeds, and constructed so they are durable, with low long-term maintenance requirements.
10. Paths should be maintained in a usable condition year-round, including snow removal in areas of heavy snowfall. Maintenance agreements should reflect the various jurisdictions' responsibilities.

See Figure 77 on page 114 for examples of multi-use paths in urban areas.

Bicycle boulevards include traffic-calming techniques such as traffic circles

C.3. BICYCLE BOULEVARDS

Bicycle boulevards can improve safety and mobility for bicyclists in areas with well-developed grid street patterns where alternatives are not feasible: urban multi-use paths are expensive to construct, and bike lanes on arterial streets may be difficult to implement if the street space is limited. As a result, many local plans show paths and bike lanes that may be difficult to implement.

The bicycle boulevard is a refinement of the shared roadway concept: the operation of a local street is modified to function as a through street for bicycles while maintaining local access for automobiles. Traffic controls limit conflicts between automobiles and bicycles and give priority to through bicycle movement. Traffic calming devices reduce automobile speeds and through travel.

C.4. TRAFFIC CALMING

In many cases, local streets would be more attractive to pedestrians and bicyclists if traffic speeds and volumes were reduced. See page 159 for information on traffic calming.

C.5. BICYCLE TOURING ROUTES

Bicycle touring is an important activity in Oregon with many economic benefits. The Oregon Coast Bike Route generates $2,000,000-$3,000,000 annually from out-of-state tourists. Cycle Oregon is a major annual event, attracting 2,000 riders, many from out of state.

Regional governments, chambers of commerce, cities and counties can cooperate to develop guides, maps and brochures to increase interest in their bicycling environment. Specific tour routes can be designated. Special signing along the route requires agreements from the responsible jurisdictions.

There are also several private bicycle tour operators who organize cycling vacations in Oregon; these attract many cyclists from out of state.

Bicycling in the Historic Columbia River Gorge

D. IMPLEMENTING BIKEWAY & WALKWAY PLANS

INTRODUCTION

Once a plan has been adopted, its successful implementation depends on the commitment of the governing jurisdiction(s) to ensure that the planned facilities are constructed. All interested parties should be aware of the plan; these include public works officials, planners, construction and maintenance engineers, regulatory agencies, citizen advisory committees and virtually any institution, private or public, that deals with transportation and land-use.

There are many levels at which bikeways and walkways are implemented. Complete networks will not be built all at once; they require a step-by-step process. As sections of walkways and bikeways are established, use may not increase immediately: users must first become familiar with the new facility, or a section may not be fully operational until other missing sections are completed.

D.1. PROJECT SELECTION

Good planning efforts should lead to a comprehensive list of projects designed to meet transportation needs, with many projects proposed for inclusion in a TIP. See Appendices G and H for the selection criteria ODOT uses when evaluating projects.

D.2. PROJECT PRIORITIZATION

Needs assessments should result in a prioritization of projects, balancing immediate needs with available funding. Highest priority should be given to projects that create new opportunities for bicycling and walking, such as:

- Providing access to trip generators such as schools, employment centers, recreational facilities and multi-family housing;
- Opening up corridors with constraints such as narrow bridges or travel lanes;
- Addressing specific hazards such as railroad crossings or busy intersections;
- Providing access to transit facilities; and
- Adding continuity to existing but incomplete facilities.

However, prioritization should not be used too strictly - because of unforeseen opportunities, such as grants or other construction activities, some projects of lower priority may be completed before others of higher priority. This is especially true in regards to road reconstruction: ORS 366.514 requires providing bikeways and walkways. Costs and needs should be balanced - some lower priority projects may be constructed simply because they are inexpensive and easy to fund.

D.3. COORDINATION

All jurisdictions should be aware of the pedestrian and bicycle needs of a community. Cities, counties and the state should cooperate with each other and with transit providers, parks districts, utility companies, etc., to take advantage of all opportunities whenever projects impact the potential walkway or bikeway system.

Examples include using utility company rights-of-way, linking up recreational trails to the street network, providing bike racks on buses, etc.

D.4. IMPLEMENTATION METHODS

D.4.a. General Road Improvements

The basic principle of ORS 366.514 is that wherever a road, street or highway is constructed, reconstructed or relocated, bikeways and walkways must be provided, unless one of three exceptions is met (cost, safety or absence of need). This may create temporarily incomplete bikeway and walkway segments, but as road improvements continue, these segments will become linked.

There are two ways to avoid dead-ending bikeways and walkways:

1. By extending the bikeway or walkway portion of a road project to link up with existing bikeways or walkways. On intersecting side streets, sidewalks that wrap around intersection corners should be extended to a logical point, preferably to existing sidewalks; and
2. Through stand-alone bikeway or walkway projects.

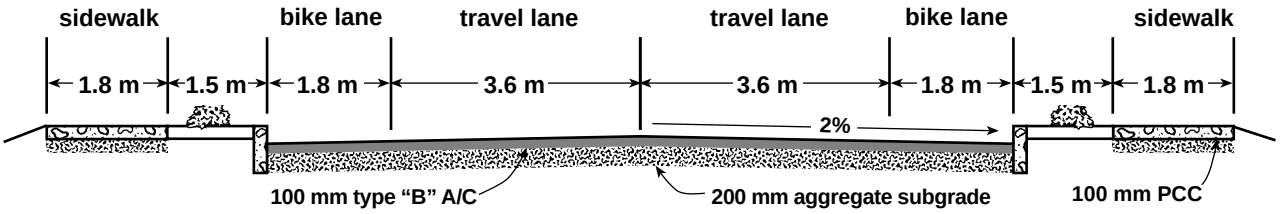


Figure 9: Typical urban roadway cross-section with bike lanes and sidewalks

D.4.b. Stand-Alone Bikeway or Walkway Projects

Missing links in bikeway and walkway networks should be constructed to complete a corridor or to link up existing bikeways and walkways.

Improvements range from simple bike lane restriping or sidewalk paving to major road-widening projects. The latter are expensive in urban areas, if right-of-way, drainage and utility relocation are needed. The scoping of bikeway or walkway projects may bring to light other needed roadway improvements, presenting an opportunity to implement access management techniques, improve road alignment, repave the road surface, etc. This may increase costs, but will provide an overall benefit to the corridor.

See Appendices G and H for a copy of ODOT's bicycle and pedestrian project selection criteria.

D.4.c. Maintenance Preservation Overlays

Though pavement overlay projects are designed to preserve the existing roadway surface, some low-cost improvements can be incorporated to provide benefits to bicyclists and pedestrians.

Rural Overlay Projects

On uncurbed roads with wide, stable gravel shoulders, there are often opportunities to widen shoulders without major grading. If the shoulders are paved prior to a resurfacing project, the ensuing overlay provides seamless shoulders and a roadway that is safer for all users.

Some sections of roadway may require minor grading to provide additional width; this can be justified on roads with high or potentially high bicycle use.

Bicycle and Pedestrian Program staff review construction plans for bicycle and pedestrian compatibility

Urban Overlay Projects

In areas where widening isn't possible because of existing curbs and sidewalks, the most effective way to provide bike lanes is by reconfiguring lanes after paving. This saves the expense and inconvenience of removing existing stripes. Coordination with local stakeholders ensures that all interested parties agree, especially when parking removal is required.

Low-cost pedestrian improvements that can be made during urban paving projects include completing segments of missing sidewalk and adding accessible curb ramps.

A beaten path indicates need for a sidewalk here

D.4.d. Minor Betterment Projects

Many inexpensive improvements can be made to enhance the bicycling and walking environment:

For bicyclists

- Raising drainage grates flush with the road surface, or replacing them with curb inlets;
- Removing curbs, pavement markers and other obstructions;
- Improving sight distance at curves by regrading or removing vegetation;
- Fixing surface irregularities in bike lanes or shoulders; and
- Adjusting signal loop detectors to be more sensitive to bicycles.

For pedestrians

- Replacing sidewalks in disrepair;
- Filling in sections of missing sidewalks;
- Installing curb ramps at intersections;
- Improving crossing opportunities, such as with curb extensions; and
- Replacing abandoned, illegal approaches with sidewalks.

TIPS FOR LOW-COST IMPROVEMENTS

1. **Combine Projects:** Several small jobs of a similar nature can be combined into one larger project.
2. **Combine with other similar improvements:** Most bid items for bicycle and pedestrian projects (asphalt, concrete surfacing, curb, etc.) can be found in standard road construction; bicycle and pedestrian improvements can be added to many road projects.
3. **Combine with maintenance activities:** If a crew is working in an area, it may not take much more time, money and effort to make minor pedestrian/bicycle improvements.
4. **Bid in winter months:** Most contractors are very busy during the summer, but are looking for work in the winter and may bid low to keep their crews busy.

Table 6: Tips for low-cost improvements

D.4.e. Private Development

Many road improvements are made by private parties, such as widening the roads immediately adjacent to their property, providing new accesses, reconstructing existing roadways and intersections, and constructing new roads within a development.

The same standards should apply to privately funded transportation projects as to other public works projects. The need for sidewalks and bike lanes on urban roadways exists regardless of project origin. It is the responsibility of the agency with jurisdiction over the roadway to ensure that adequate provisions for bicyclists and pedestrians are provided.

All jurisdictions are encouraged to adopt ordinances requiring sidewalks on streets built by private parties. When roads are dedicated to the city or county, they become a public right-of-way; therefore, they should be built to the same standard as public roads. They can become a financial burden and a liability if they must be retrofitted later with sidewalks or bikeways at the public's expense.

I.3. LOCAL TRANSPORTATION SYSTEM PLANS

A. BACKGROUND

The Transportation Planning Rule requires communities with a population over 2500 to adopt a Transportation System Plan (TSP) as part of the local comprehensive plan.

A TSP provides for the development, operation and maintenance of an integrated network of transportation facilities and services that considers the various needs throughout an urban area; identifies solutions to transportation problems, determined through system analysis based on a 20-year time period; and recognizes and integrates all modes of transportation for the movement of people and goods through and within the community. Each mode's role, contribution and connection to the transportation network is considered.

To develop a plan that will be implemented with community support, the process must include opportunities for the public, stakeholders and other interest groups to participate and be heard. Identified improvements must be feasible, based on known environmental constraints and mitigation possibilities, as well as fundable, based on reasonable expectations of funding available over the planning period.

B. RELATION TO OTHER DOCUMENTS

The plan must be coordinated with regional (county and MPO) and state transportation plans (OTP, modal plans, corridor plans, etc.).

Integrating a bicycle and pedestrian plan into a TSP ensures that people with an interest in transportation and community development will be aware of the bicycle and pedestrian needs of the community. This includes planners, designers, architects, developers, engineers, etc. A stand-alone document runs a greater risk of being ignored. All discussions of surface transportation facilities within the planning area must include the need to accommodate bicyclists and pedestrians.

C. PUBLIC INVOLVEMENT & INTERAGENCY REVIEW

Public input is an essential component of good planning. Interagency review assures compatibility with local, regional and state plans. Public input can be in the form of workshops, public hearings, notices in the media and the formation of Bicycle/Pedestrian Advisory Committees.

Effective committees draw on people with diverse viewpoints, representing those in the community with a common interest in bicycling and walking: education groups, business leaders, law enforcement agencies, bike clubs, the disabled, the elderly and the poor. Local officials (elected and staff) responsible for implementation should attend meetings to clearly understand the committee's recommendations.

Interagency review assures involvement by all affected agencies. All city plans must be compatible with county and state plans. There must be agreement when a planned facility runs through several jurisdictions.

D. THE BICYCLE & PEDESTRIAN ELEMENT OF A LOCAL TSP

A plan based on this model will meet the requirements of the Transportation Planning Rule and ORS 366.514. ODOT will apply these principles when cooperating with local jurisdictions in the development of their TSP's, or when reviewing draft TSP's prior to adoption.

D.1. STATEMENT OF PURPOSE

This section defines the role of bicycling and walking within the community, and how the plan will guide local planning efforts. The overall goal is to provide non-motorized travel within the community. Current and anticipated usage should be discussed; if current bicycle and pedestrian usage is low, the provision of bikeways and walkways may encourage greater use and decrease reliance on the automobile.

Bikeways and walkways also provide low-cost transportation options for people without cars (the young, elderly, poor and disabled). Specific local objectives should be stated.

D.2. EXISTING FACILITIES INVENTORY

The inventory should include a general assessment of streets, roads and highways by function, type, ownership, width and condition, as well as existing bikeways and walkways, plus paths and trails outside the street system; information on disabled access is needed too. This inventory will identify where walkway and bikeway deficiencies exist.

For large jurisdictions, it may be necessary to schedule an inventory over a period of years, by starting with the arterial and collector streets first, or by dividing the area into more manageable districts.

D.3. BICYCLE & PEDESTRIAN NEEDS

This section outlines the overall planned bikeway and walkway system. A realistic cost estimate can only be derived from a complete needs assessment.

D.4. IMPLEMENTATION STRATEGIES

Implementation strategies are necessary to meet identified needs, both on existing roadways and in the design of new roadways. A mechanism must be provided to ensure that all street, road and highway construction addresses bicycle and pedestrian needs, per ORS 366.514. Opportunities for low-cost improvements on incidental projects such as preservation overlays, utility work, etc. need to be identified. Local development ordinances may have to be modified to ensure that private development accommodates bicycle and pedestrian needs.

D.5. STANDARDS

Standards for the various road classifications must include the appropriate bikeway and walkway, as shown on roadway typical sections, including design standards for new subdivisions. The local plan may reference the state plan for bicycle and pedestrian facility standards.

D.6. BIKEWAY & WALKWAY PROJECTS

This section identifies and prioritizes bicycle and pedestrian construction projects, which should be included in a Transportation Improvement Program (TIP) and be given full consideration along with other transportation improvements. Projects should be identified by roadway name, beginning and end points, bikeway or walkway type, a description of the work needed, and the estimated cost.

The priority listing must be based on local goals and objectives. High priority should be given to projects that open up major corridors, overcome barriers and provide linkage or continuity to existing facilities.

D.7. BICYCLE PARKING

Bicycle parking needs are identified, as well as standards for spacing, numbers of spaces, placement, etc. Incorporating bicycle parking requirements into the local development code ensures that parking is provided as part of new development and redevelopment.

D.8. PLANNING MAPS

Maps provide interested parties an overview of existing and planned facilities; they can be used at meetings, by the media or for mailings.

Separate maps should be provided for bikeways and walkways. The existing and proposed system should be illustrated. Black and white maps are easier to copy and fax. Legends must clearly indicate the type of facility, and whether it is planned or existing. Proposed projects should be referenced on the planning map.

D.9. FINANCING PROGRAM

This section discusses the funding available for bicycle and pedestrian projects. The list of project priorities must reflect the availability of funds.