



SOLUTIONS TOOLBOX

THIS LIST OF COUNTERMEASURES INCLUDES NATIONALLY RECOMMENDED DESIGN ELEMENTS THAT PROVIDE **SAFER CROSSINGS, SAFER SPEEDS, AND SAFER STREETS FOR ALL USERS.**

These treatments were selected based on the crash patterns and trends from data, observations from field reviews, and professional resources such as the American Association of State Highway and Transportation Officials (AASHTO), the Manual on Uniform Traffic Control Devices (MUTCD), and the National Association of City Transportation Officials (NACTO) regarding systemic safety.

Some treatments are inexpensive retrofits, pavement markings, and signage that can be changed and quickly implemented. Some require greater study, coordination, and funding.

In addition to these site-specific treatments, network improvements to complete gaps, provide alternative routes, or establish new, lower-conflict facilities can shift non-motorized user demand from high injury networks and enhance user experience and safety.





BICYCLE FACILITIES

MULTI-USE PATH



Anchorage, AK

Multi-use paths are paved, bi-directional trails away from roadways that can serve both pedestrians and bicyclists. Multi-use paths can be used to create longer-distance links within and between communities and provide regional connections. They play an integral role in recreation, commuting, and accessibility due to their appeal to users of all ages and skill levels.

Benefits

- Provides facility for both pedestrians and bicyclists in less space than separate facilities.
- Separation from motor vehicles can attract users of all levels.

Constraints

- May be unsafe in areas with frequent crossings or driveways.
- When parallel to roadways, requires substantial space for buffer.
- Potential for conflicts between bicyclists and pedestrians due to shared facility.
- Isolated paths may introduce personal security concerns.

Typical Applications

- Medium- to long-distance links within and between communities that also serve as recreational facilities.
- Parallel to roads in rural areas where sidewalks and on-street facilities are not present.

Design Considerations

- Best suited in areas where roadway crossings can be minimized (such as parallel to travel barriers such as highways, railroad tracks, rivers, shorelines, natural areas, etc.).
- Require high-visibility treatments for crossings.
- A minimum width of 10 feet is recommended for low-pedestrian/bicycle-traffic contexts; 12 to 20 feet should be considered in areas with moderate to high levels of bicycle and pedestrian traffic.
- Pavement markings can be used to indicate distinct space for pedestrian and bicycle travel.



BICYCLE FACILITIES

ONE-WAY SEPARATED BIKE LANE (CYCLE TRACK)



A one-way separated bike lane (SBL), also known as a cycle track or protected bike lane, is a bicycle facility within the street right-of-way separated from motor vehicle traffic by a buffer and a physical barrier, such as planters, flexible posts, parked cars, or a mountable curb. On two-way streets, a one-way SBL would be found on each side of the street, like a standard bike lane.

Benefits

- Provides physical separation from motor vehicle traffic, which can attract users of all levels.
- Buffer can provide opportunities for landscaping.
- Reduced risk of “dooring” when parked cars are present.

Constraints

- Requires additional right-of-way over standard bike lane.
- Construction may be more expensive than standard bike lane.

Typical Applications

- Roadway segments with sufficient right-of-way or where a “road diet” (vehicle lane reduction) can be implemented.
- Key segments of the bicycle network where more protection is desirable, such as areas with higher traffic volumes or speeds, or routes to common destinations, like schools.
- Roadways with infrequent driveways and side street accesses.

Design Considerations

- Intersections must be designed to ensure visibility of bicyclists using the facility. Treatments include separate signal phases for bicyclists and high visibility pavement markings.
- Buffer type can vary depending on context, presence of parking, and available right-of-way.
- Green pavement markings or striping can add visibility and awareness in “conflict areas” or intersections where bicycle and vehicle travel paths cross.



BICYCLE FACILITIES

TWO-WAY SEPARATED BIKE LANE (CYCLE TRACK)



A two-way separated bike lane (SBL), also known as a two-way cycle track or protected bike lane, is a facility within the street right-of-way separated from motor vehicle traffic by a buffer and a physical barrier, such as planters, flexible posts, parked cars, or a mountable curb. Two-way SBLs serve bi-directional bicycle travel within the facility on one side of the street.

Benefits

- Requires less right-of-way than a one-way SBL, due to the need for only one buffer.
- Provides physical separation from motor vehicle traffic, which can attract users of all levels.
- Reduced risk of “dooring” when parked cars are present.

Constraints

- May be less intuitive for drivers and bicyclists due to apparent “wrong-way” travel on one side of street.
- May be unsafe in areas with frequent crossings or driveways.
- Construction may be more expensive than standard bike lane.

Typical Applications

- On-street connections between off-street multi-use paths.
- Roadways with infrequent driveways and side street accesses.
- Key segments of the bicycle network where more protection is desirable, such as areas with higher traffic volumes or speeds or routes to common destinations, like schools.
- On one-way streets where two-way bicycle travel is desirable.

Design Considerations

- Intersections must be designed to ensure visibility of bicyclists using the facility. Treatments include separate signal phases for bicyclists and high visibility pavement markings.
- Buffer type can vary depending on context, presence of parking, and available right-of-way.
- Green pavement markings or striping can add visibility and awareness in “conflict areas” or intersections where bicycle and vehicle travel paths cross.





BICYCLE FACILITIES

BUFFERED BIKE LANE



Buffered bicycle lanes are on-street lanes that include an additional striped buffer of typically 2-3 feet between the bicycle lane and the vehicle travel lane and/or between the bicycle lane and the vehicle parking lane.

Benefits

- A parking-edge buffer on streets with on-street parking can reduce the likelihood of “dooring.”
- Increased separation from motor vehicles (over standard bicycle lanes) can increase bicyclist comfort.

Constraints

- Does not provide physical protection and therefore may not attract bicyclists of all levels.
- The additional width provided by the buffer may invite motorists to illegally park in the lane if not adequately signed and enforced.



Typical Applications

- Long-distance links within and between communities.
- Streets with sufficient pavement width to provide a buffer.
- Widely applicable in both urban and rural settings.
- Segments of the bicycle network with moderate vehicle speeds or volumes.

Design Considerations

- Typical buffer width is 2-3 feet, in addition to standard bicycle lane width of 5-6 feet.
- Green pavement markings or striping can add visibility and awareness in “conflict areas” or intersections where bicycle and vehicle travel paths cross.
- Buffer space can have diagonal stripes or rumble strips to deter vehicles from traveling or parking in the space.



BICYCLE FACILITIES

STANDARD BIKE LANE

A standard bike lane is an on-street facility that provides space designated for bicyclists, separated from vehicles by pavement markings.



Anchorage, AK

Benefits

- Provides a designated facility for bicyclists using the minimum pavement width.
- Provides increased visibility for bicyclists.
- Relatively inexpensive treatment when pavement width is available.

Constraints

- Can position bicyclists in the “door zone” if located adjacent to parked vehicles without a buffer.
- Motorists may illegally park in the lane if not adequately signed and enforced.
- Does not provide physical protection or horizontal buffer from vehicles and therefore does not attract bicyclists of all levels.

Typical Applications

- Arterials, collectors, and other non-local streets with speeds higher than 25 mph or over 3,000 average daily motorized traffic volumes.
- Streets without sufficient right-of-way or pavement width for buffered bike lanes or separated bike lanes (SBLs).

Design Considerations

- Typical bike lane width is 6 feet, with 5 feet in constrained locations. A minimum 4-foot width can be used on constrained segments where on-street parking is not present.
- Green pavement markings or striping can add visibility and awareness in “conflict areas” or intersections where bicycle and vehicle travel paths cross.



Anchorage, AK



BICYCLE FACILITIES

ADVISORY BIKE LANE



Advisory bike lanes, also known as “suggestion lanes,” are bicycle lanes that motor vehicles can use to pass oncoming motor vehicles after yielding to bicyclists. Advisory bicycle lanes are used in combination with a single center lane (without a centerline) for bi-directional motor vehicle travel on relatively low-volume streets.

Benefits

- Provides striped bicycle facility on roadways with very limited right-of-way or pavement width.
- Encourages slower motor vehicle speeds and yielding to bicyclists.
- Very inexpensive treatment consisting of only signing and striping.

Constraints

- Motorists may not initially understand advisory lanes due to limited applications in the US to date.
- Does not provide physical protection from vehicles and may not attract bicyclists of all levels.

Typical Applications

- Streets with less than 6,000 average daily motorized traffic that do not have sufficient width for unshared bicycle facilities.
- Can be applied in urban or rural contexts.

Design Considerations

- Advisory bike lanes can be striped as 5-7 foot lanes with a single center motorized vehicle lane of 10 to 18 feet.
- Explanatory signage may be helpful in US contexts to communicate to motorists that they must yield to bicyclists before passing oncoming vehicles.



BICYCLE FACILITIES

PAVED SHOULDER



A paved road shoulder can serve as a bicycle facility that provides space separated from motor vehicle traffic in rural areas.

Benefits

- Provides a space separated from motorists.
- Requires less right-of-way than a separated multi-use path.

Constraints

- Does not provide physical protection from vehicles and may not attract bicyclists of all levels.
- Shoulders serving other uses, such as broken-down vehicles, may force bicyclists into travel lanes.

Typical Applications

- Typically applied on rural roadways.
- Also used as an interim treatment in urbanizing areas.

Design Considerations

- A 6-foot width is preferred to accommodate bicycle travel, with a 4-foot minimum in constrained areas. Greater widths can be used in higher-speed locations.
- Rumble strips or profiled striping can be used to enhance safety and minimize motorists encroaching on the shoulder.



BICYCLE FACILITIES

BICYCLE BOULEVARD



Anchorage, AK



Bicycle boulevards are low-volume, low-speed streets where bicycles and motorized vehicles share road space, but where bicycle movements are prioritized and optimized through use of motorized vehicle restrictions, traffic calming elements, and intersection crossing treatments.

Benefits

- Typically does not require additional right-of-way.
- Can create a comfortable space for bicyclists of all levels.
- Enhances connectivity of the network for bicyclists.

Constraints

- Bicycle boulevards may reduce through routes for motorized vehicles
- Some treatments, such as traffic circles or chicanes, may be expensive.

Typical Applications

- Local routes parallel to larger, higher-traffic roadways, such as arterials or collectors.
- Low-traffic neighborhood routes that can enhance the bicycle network connectivity.

Design Considerations

- A variety of traffic calming elements can be employed, including speed humps, traffic circles, chicanes, median barriers, and traffic diverters in order to keep traffic volumes low and minimize through-traffic.
- Consider providing “bicycle-only” through movements at intersections, where motorists are required to turn off the bicycle boulevard.
- Include shared lane markings and wayfinding signage for bicyclists.
- Recommended for streets with posted speeds of 25 mph or lower and volumes less than 3,000 average daily motorized traffic.



BICYCLE FACILITIES

SHARED LANE ROADWAYS



Shared lane roadways include roadways without separate bicycle facilities on which bicycle travel is not prohibited. Most roadways, with the exception of some limited access freeways, are “shared lane roadways” if they do not have a different type of bicycle facility. Shared lane roadways that are part of a designated bicycle network may include shared lane markings (“sharrows”) or signage to indicate the legal presence of bicyclists in the travel lane.

Benefits

- Allows for bicycle travel when other treatments are not feasible.
- Low- to no-cost.

Constraints

- Does not provide any separation from vehicles.
- Without additional traffic-calming treatments, it is likely to attract only strong and fearless bicyclists.

Typical Applications

- Rural roadways without shoulders often use “share the road” signage to indicate to road users that bicyclists may be present.
- Sharrows are typically used in urban or suburban locations on bicycle network links where other facilities are not present.

Design Considerations

- Sharrows should be placed at least 4 feet from the edge of the curb or on-street parking.



PEDESTRIAN FACILITIES

MULTI-USE PATH



Multi-use paths are paved, bi-directional, trails away from roadways that can serve both pedestrians and bicyclists. Multi-use paths can be used to create longer-distance links within and between communities, provide regional connections, and play an integral role in recreation, commuting and accessibility due to their appeal to users of all ages and skill levels.

Benefits

- Provides opportunity for a scenic recreational pedestrian facility.
- Hard surface allows for universal accessibility.

Constraints

- Pedestrian and bicycle conflicts may occur in shared space.
- When parallel to roadways, requires substantial space for buffer.
- Isolated paths may introduce personal security concerns.

Typical Applications

- Medium- to long-distance links within and between communities that also serve as recreational facilities.
- Rural areas where sidewalks and on-street facilities are not present.

Design Considerations

- Best suited in areas where roadway crossings can be minimized (such as parallel to travel barriers such as highways, railroad tracks, natural areas, rivers, shorelines, etc.).
- Necessitate high-visibility treatments for crossings.
- A minimum width of 10 feet is recommended for low-pedestrian/bicycle-traffic contexts; 12 to 20 feet should be considered in areas with moderate to high levels of bicycle and pedestrian traffic.
- Pavement markings can be used to indicate distinct space for pedestrian and bicycle travel



PEDESTRIAN FACILITIES

SIDEWALK



A sidewalk is a dedicated pedestrian facility adjacent to the roadway and separated from traffic by a curb.

Benefits

- Provides pedestrians with a dedicated physically separated space.
- Provides means of mobility for people using wheelchairs, people with strollers, or others who may not be able to travel on an unpaved surface.

Constraints

- Adding a concrete curb and sidewalk to streets adds a substantial expense to the overall construction cost.

Typical Applications

- Typically provided on urban (non-rural) and residential streets, with the exception of limited access freeways.
- Typically added to streets in urbanizing areas as development occurs.

Design Considerations

- Typically 6 to 8 feet wide. Sidewalks should be constructed at least 5 feet wide, with a minimum of 4 feet of clear width, excluding a shy distance of 1.5 feet from the curb and any adjacent obstructions.
- A landscaped buffer is preferable in residential areas and in locations with higher traffic speeds and volumes.
- Wider sidewalks of 12 to 20 feet can be beneficial in commercial or “town center” areas in order to accommodate higher pedestrian volumes, street furniture, pedestrian scale lighting, business signage, bike parking, transit stops, and other amenities.

Anchorage, AK



PEDESTRIAN FACILITIES



Anchorage, AK

PEDESTRIAN PATH (SIDEPATH)



Anchorage, AK

A pedestrian path is a hard-surface path adjacent to the roadway in lieu of a sidewalk in areas where other bicycle facilities exist. Similar to a multi-use path, pedestrian paths are narrower in width and generally do not invite bicycle travel.

Benefits

- Provides a hard surface for pedestrians buffered from the roadway.
- Requires less right-of-way than a multi-use path.
- Lower cost than construction of a full sidewalk with curb and gutter.

Constraints

- May also attract bicyclists, creating the potential for conflicts between pedestrians and bicyclists.

Typical Applications

- In constrained rural areas where sidewalks are not present and multi-use paths cannot be accommodated.
- As an interim treatment in urbanizing areas to make connections between sidewalk facilities.



PEDESTRIAN FACILITIES



Anchorage, AK

Design Considerations

- Typically 5- to 8-foot wide asphalt surface.
 - Pedestrian paths are typically separated from the roadway by a gravel or vegetated buffer instead of a curb and gutter.
 - Should follow ADA standards to allow for universal access.
 - Though not intended for bicyclists, pedestrian paths may attract bicyclists if a separate bicycle facility is not provided.
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PEDESTRIAN FACILITIES

SHOULDER PEDESTRIAN FACILITY



A paved shoulder facility provides access for pedestrians on a hard surface in rural areas where sidewalks are not present.

Benefits

- Provides a hard surface space separated from motorists.
- Requires less right-of-way than a separated multi-use path.
- More cost-effective than installing sidewalks.

Constraints

- Does not provide physical protection of a curb and may not be comfortable for all users.
- Shoulders serving other uses, such as broken-down vehicles, may force pedestrians into travel lanes.

Typical Applications

- Typically applied on rural roadways.
- Also used as an interim treatment in urbanizing areas.



Anchorage, AK

Design Considerations

- A 6-foot width is preferred to accommodate pedestrian travel, with a 4-foot minimum of paved surface in constrained areas. Greater widths can be used in higher-speed locations.
- Rumble strips or profiled striping can be used to enhance safety and minimize motorists encroaching on the shoulder.

GRADE SEPARATED CROSSING



A grade-separated crossing is a bridge (overcrossing) or a tunnel (undercrossing) that carries non-motorized traffic over or under a motorized corridor or other barrier to travel.

Benefits

- Provides physical separation from motor vehicle traffic, attracting users of all levels.
- Minimizes crash risk and can provide a safe crossing of any type of facility, including railroads and limited access highways.

Constraints

- Grade-separated crossings can be very expensive.
- Depending on topography, may require significant additional space to make grade changes.
- Long under-crossings have the potential to present safety and security issues.

Typical Applications

- Crossings of limited access highways, multi-lane roadways, or railroads.
- Multi-use path crossings often have grade separated crossings in order to provide comfortable and safe crossings for users of all levels.

Design Considerations

- If a substantial slope or out-of-direction travel is required, some bicyclists or pedestrians may avoid using the crossing, so minimize slope and out-of-direction travel if possible.
- In selecting a grade separated crossing, consider the surrounding topography, natural features, and floodplain.
- Consider whether the crossing needs to accommodate equestrians.
- Ensure adequate sight distance for bicyclists entering the facility to see oncoming bicyclists or pedestrians. If not possible, consider requiring bicyclists to dismount.

GENERAL CROSSING TREATMENTS

PEDESTRIAN HYBRID BEACON



Juneau, AK

A pedestrian hybrid beacon (sometimes called a HAWK signal) is a pedestrian activated signal that is unlit when not in use. It begins with a yellow light alerting drivers to slow, and then displays a solid red light requiring drivers to remain stopped while pedestrians cross the street. Finally, the beacon shifts to flashing red lights to signal that motorists may proceed after pedestrians have completed their crossing.

Benefits

- Has nearly 100 percent rate of motorist yielding behavior at crossing locations.
- Improves pedestrian safety and reduces pedestrian-involved crashes.

Constraints

- Must be activated by pedestrians.
- More costly than other crossing treatments.

Typical Applications

- Midblock crossings with high pedestrian or bicycle demand and/or high traffic volumes.
- At locations where multi-use paths intersect with roadways.

Design Considerations

- The push button to activate the pedestrian hybrid beacon should be easily accessible by pedestrians, wheelchair users, and bicyclists (if applicable).



GENERAL CROSSING TREATMENTS

RAPID RECTANGULAR FLASHING BEACON (RRFB)



These crossing treatments include signs that have a pedestrian-activated “strobe-light” flashing pattern to attract motorists’ attention and provide awareness of pedestrians and/or bicyclists that are intending to cross the roadway.

Benefits

- Provides a visible warning to motorists at eye level.
- Increases motorists yielding behavior at crossing locations over round yellow flashing beacons (80 to 100 percent compliance).
- Allows motorists to proceed after yielding to pedestrians and bicyclists.

Constraints

- Flashing beacons must be activated by pedestrians.
- Motorists may not understand the flashing lights of the RRFB, so compliance may be lower than with a traffic signal.

Typical Applications

- Midblock crossings with medium to high pedestrian or bicycle demand and/or medium to high traffic volumes.
- Locations where multi-use paths intersect with roadways.

Design Considerations

- The push button to activate the RRFB should be easily accessible by pedestrians, wheelchair users, and bicyclists (if applicable).
- Consider adding a push button in the median island for crossings of multi-lane facilities.



GENERAL CROSSING TREATMENTS

CROSSING ISLAND (PEDESTRAIN REFUGE)



Anchorage, AK

A crossing island in the median provides a protected area in the middle of a crosswalk for pedestrians to stop while crossing the street. Also called pedestrian refuge islands or median refuges, they can be used at intersections or mid-block crossings.

Benefits

- Reduces pedestrian exposure at marked and unmarked crosswalks.
- Requires shorter gaps in traffic to cross the street.
- Allows pedestrians to cross in two phases.

Constraints

- Streets with constrained right-of-way may not have sufficient width to allow for a crossing island.

Typical Applications

- Preferred treatment for crossings of multi-lane streets.
- Often used in areas with high levels of vulnerable pedestrian users, such as near schools or senior centers/housing.
- Often applied in areas with high traffic volumes or with a pedestrian crash history.

Design Considerations

- Must have at least 6 feet of clear width to accommodate people using wheelchairs.
- At crossing locations where bicyclists are anticipated, a width of 10 feet or greater is desirable to accommodate bicycles with trailers or groups of bicyclists.
- Can be applied in conjunction with other traffic control treatments.



BULB-OUT/CURB EXTENSIONS



An extension of the curb or the sidewalk into the street (in the form of a bulb), usually at an intersection, that narrows the vehicle path, inhibits fast turns, and shortens the crossing distance for pedestrians.

Benefits

- Shortens crossing distances for pedestrians.
- Reduces motorist turning speeds.
- Increases visibility between motorists and pedestrians.
- Enables permanent parking.
- Enables tree and landscape planting and water runoff treatment.

Constraints

- Can only be used on streets with unrestricted on-street parking.
- Physical barrier can be exposed to traffic.
- Greater cost and time to install than standard crosswalks.
- Can present turning radius problems to large vehicles.

Typical Applications

- Mid-block or intersection pedestrian crossings on streets with unrestricted on-street parking.
- Streets with on-street parking where pedestrian volumes ≥ 20 pedestrians per hour, ADT $\geq 1,500$ vehicles per day, and average right-turn speeds ≥ 15 mph.

Design Considerations

- Include a narrow passage for bicyclists to prevent conflict with vehicles.
- Provide accessible curb ramps and detectible warnings.
- Include landscaping on the curb extension to differentiate path for pedestrian travel, especially for pedestrians with vision impairments.

GENERAL CROSSING TREATMENTS

RAISED PEDESTRIAN CROSSING



Anchorage, AK



Anchorage, AK

Raised pedestrian crossings bring the level of the roadway even with the sidewalk, providing a level pedestrian path and requiring vehicles to slow. Raised crossings can be used at midblock crosswalks or intersections.

Benefits

- Provides a better view for pedestrians and motorists
- Slows down motorists.

Constraints

- Can be difficult to navigate for large trucks, snow plows, and low ground clearance vehicles.
- Relatively expensive.

Typical Applications

- Raised crosswalks are typically provided at midblock crossings on two-lane roads where pedestrian volumes ≥ 50 pedestrians per hour and speed control is needed.
- Raised crosswalks may be provided at intersections where low-volume streets intersect with high-volume streets or where a roadway changes character (such as from commercial to residential).
- Raised crosswalks should not be used on transit routes or where there are steep grades or curves.

Design Considerations

- Raised crosswalks should be even with the sidewalk in height and at least as wide as the crossing or intersection.
- Provide detectable warnings for pedestrians where they cross from the sidewalk in to the crossing area.
- Consider drainage needs and provide appropriate treatments.
- Use colored asphalt as opposed to brick or decorative surface materials to make the crossing smoother for those with mobility impairments.

GENERAL CROSSING TREATMENTS

HIGH VISIBILITY CROSSWALK



High visibility crosswalks consist of reflective roadway markings and accompanying signage at intersections and priority pedestrian crossing locations.

Benefits

- Communicates potential for pedestrian crossings to motorists.
- Designates a preferred crossing location for pedestrians.
- Motorists are required to stop for pedestrians entering crosswalks.
- Low cost.

Constraints

- Can be more effective with other types of traffic control (signals, stop signs).
- At uncontrolled locations (midblock), motorist compliance is not as high as with other treatments.

Typical Applications

- High visibility crosswalks are typically applied at intersections of arterials, collectors, and/or other facilities with moderate to high vehicle volumes and speeds.
- Can be applied at mid-block locations, especially in conjunction with other treatments.

Design Considerations

- Crosswalk striping can vary, and may include continental striping (top photo), ladder striping, zebra striping (bottom photo), etc.
- Can be constructed with paint or thermoplastic material.
- Minimum width is 6 feet, but wider crossings are preferred in areas with high number of pedestrians.



GENERAL CROSSING TREATMENTS

PEDESTRIAN LIGHTING



Pedestrian lighting may increase nighttime street visibility for pedestrians where existing illumination does not readily address crossing locations.

Benefits

- Increases visibility of pedestrians waiting to cross and in the crossing.

Constraints

- Potential to restrict and/or clutter sidewalk environment near the crosswalk.
- On-going maintenance and operating costs.

Typical Applications

- Crossings or areas with high levels of nighttime pedestrian activity (e.g., greater than 20 pedestrians per hour).
- Locations with a high frequency of nighttime pedestrian crashes.
- Could also be considered for crossings with lower pedestrian volume activity if crossing conflict is severe or unexpected (e.g., pedestrian crossing location across a higher speed roadway).
- Can be used in conjunction with other crossing treatments.

Design Considerations

- Illumination could be used to contribute to the identity of a district or neighborhood and serve as a unifying element in the streetscape.
- Lighting should be scaled to the street and land use contexts to avoid light pollution/trespass and ensure a comfortable illumination quality for users.

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GENERAL CROSSING TREATMENTS

LEADING PEDESTRIAN INTERVAL (LPI)



A leading pedestrian interval gives pedestrians a 2-5 second head start before the concurrent vehicle phase turns green to allow pedestrians to enter and occupy the crosswalk before turning vehicles get there.

Benefits

- Pedestrians are more visible in the crosswalk before vehicles start moving.
- Helps reduce conflicts with pedestrians and turning vehicles.

Constraints

- Reduces green time for vehicle movements.
- May add to delays at intersections operating near capacity.

Typical Applications

- Used in areas where right-turning vehicle movements often interfere with pedestrian crossing movements.
- Intersections with a documented history of turning movement-related vehicle-pedestrian crashes.

Design Considerations

- Only possible when pedestrian signal faces are present.
- The leading pedestrian interval should give a minimum head start of 3-7 seconds depending on crossing distance.
- May be combined with a curb extension to improve visibility at high-conflict intersections.

Additional Guidance

- Only possible when pedestrian signal faces are present.
- ITE *Traffic Engineering Handbook*
- NACTO *Urban Street Design Guide*



BICYCLE INTERSECTION TREATMENTS

BIKE SIGNAL



Bicycle-only signals can be used at intersections to provide a separate signal phase that is dedicated to bicyclists.

Benefits

- Provides bicycles with a dedicated signal phase without potential motor vehicle conflicts.
- Provides increased protection for bicyclists.

Constraints

- May increase intersection delay for motorists and bicyclists with the addition of a signal phase.

Typical Applications

- Roadway intersections with multi-use trails.
- At intersections with separated bike lanes on the roadways, or at transitions to and from two-way separated bike lanes.
- At intersections where large numbers of turning vehicles have the potential to conflict with through bicycle movements.

Design Considerations

- Ensure that signal heads are clearly visible to cyclists.
- Install painted indicators on bicycle detectors to show bicyclists where to wait.
- Consider prohibiting right-turn-on-red for motorists if right turns conflict with bicycle movements.



BICYCLE INTERSECTION TREATMENTS

BIKE BOXES



Bicycle boxes are designated spaces at signalized intersections, placed between a set-back stop bar and the pedestrian crosswalk, that allow bicyclists to queue in front of motor vehicles at red lights.

Benefits

- Increases the visibility of queued bicyclists.
- Allows bicyclists to start up and enter the intersection in front of motor vehicles when the signal turns green and/or position for a left-turn.
- Provides queuing capacity for bicycles at signals beyond a typical bike lane.

Constraints

- Driver compliance rates vary.
- Bike boxes may prevent drivers from making right-turn-on-red movements.

Typical Applications

- Signalized intersections, particularly those with high bicycle volumes.
- Signalized intersections where a designated bicycle route turns left.

Design Considerations

- Minimum depth of the bike box should be 10 feet, and it should extend across the bike lane, any buffer space, and at least one adjacent vehicle travel lane.
- Can be extended across multiple vehicle lanes on multilane streets to allow bicyclists to position for left turns.



BICYCLE INTERSECTION TREATMENTS

TWO-STAGE LEFT TURN BOXES



Two-stage left-turn boxes allow bicyclists to safely and comfortably make left turns at multi-lane intersections from a right-side bicycle lane or cycle track. Bicyclists arriving on a green light travel into the intersection and pull out into the two-stage turn queue box away from through-moving bicycles and in front of cross street traffic, where they can wait to proceed through on the next green signal.

Benefits

- Provides a low-stress option for left turns, so that bicyclists do not need to merge into traffic.
- Provides a clear and visible location for queuing bicyclists waiting to cross.

Constraints

- May be difficult to accommodate within a constrained intersection geometry.

Typical Applications

- At signalized intersections with multi-lane roadways.
- At locations where a low-stress left-turn movement for bicyclists is desirable.

Design Considerations

- Should be located out of the way of through bicyclists, usually between the bike lane and the crosswalk. If there is on-street parking, space may be available between the bike lane and vehicle travel lane.
- Consider using passive bicycle detection in the two-stage left turn box to call the green signal phase for bicyclists.





BICYCLE INTERSECTION TREATMENTS

PAVEMENT MARKINGS THROUGH INTERSECTIONS



Pavement markings can be extended through the intersection for both cycle tracks and bicycle lanes. Green paint can be used in “conflict zones” where vehicles and bicycles may cross paths in intersections, at driveways, or at right turn pockets.

Benefits

- Green paint can alert drivers of a conflict zone.
- Paint through an intersection can help bicyclists know where to cross and alert drivers to look for bicyclists.

Constraints

- Paint may wear more quickly in intersections and require additional maintenance due to vehicles crossing it more frequently.

Typical Applications

- Intersections and conflict zones, especially in high-traffic or high-speed areas.



Design Considerations

- Use white dashed lines at a minimum to extend a treatment through an intersection or across a conflict zone. Dashed green pavement can enhance awareness and visibility.
- Other non-standard treatments, such as solid green paint or bicycle “chevron” markings have been used in locations throughout the U.S.



BICYCLE / PEDESTRIAN AMENITIES

STREET FURNITURE AND LIGHTING



Anchorage, AK

Street furniture includes pedestrian seating, information/wayfinding structures, and trash cans. Street furniture and lighting can be used to enhance the pedestrian experience and encourage pedestrian activity on a street.

Benefits

- Encourages walking and sense of comfort and security for pedestrians.
- Relatively inexpensive and easy installation.
- Encourages foot traffic and can make local attractions/businesses inviting.

Constraints

- Requires space in potentially busy areas, such as sidewalks.

Typical Applications

- Typically provided at areas of high bicycle and pedestrian traffic such as bus stations, shopping centers, schools, and multi-use trails.
- Street furniture and pedestrian-scale lighting are usually provided on corridors with commercial activity and anticipated high pedestrian use.

Design Considerations

- Street furniture should not be placed to block the entrance of a building or inhibit pedestrian flow.
- The type and size of street furniture should be based on the available space and anticipated demand.
- Street furniture should be accessible to all users.



Anchorage, AK

BICYCLE / PEDESTRIAN AMENITIES

TRANSIT STOP SHELTERS



Transit stop shelters help protect passengers waiting to load the bus from the elements and provides a great level of comfort. They also increase the visibility of transit stops and attractiveness for riders.

Benefits

- Provides protection from the elements and a place to sit for people waiting for transit.
- Provides a prominent visual cue about where the transit stop is located.

Constraints

- Costs more than a simple signed bus stop.
- Requires additional sidewalk width beyond a standard 6-foot width.

Typical Applications

- Typically provided at bus stops with higher levels of activity or those that serve major transfer points, senior communities, schools, or major trip generators.
- May be paired with other bus stop amenities, like benches and bicycle parking.
- Shelters can be fully enclosed or just an overhead canopy, although semi-enclosed shelters are most common.

Design Considerations

- The style of the transit stop shelter can depend on the preferences of the local jurisdiction.
- At stops with a high number of daily boardings (i.e. over 100), a larger shelter or multiple shelters should be considered.
- Shelters should be cleaned and maintained regularly.
- Shelters should have transparent sides for greater visibility, and panels should be resistant to fading or clouding.

ROADWAY TREATMENTS

RUMBLE STRIPS



Pavement surface treatments intended to cause drivers to experience vehicular vibrations signaling them to slow down. Rumble strips can be raised pavement markers across the roadway or grooves along the shoulder or centerline. Rumble strips are best used in conjunction with other traffic calming treatments.

Benefits

- Low cost.
- Speed reduction and increase in driver awareness.

Constraints

- Vibration noise created may be inappropriate in residential areas.
- Perceived more as a warning to slow down, than a physical measure that forces slower speeds.
- Impacts the comfort and control of bicyclists.
- Potential impacts on pavement deterioration based on pavement quality and placement.

Typical Applications

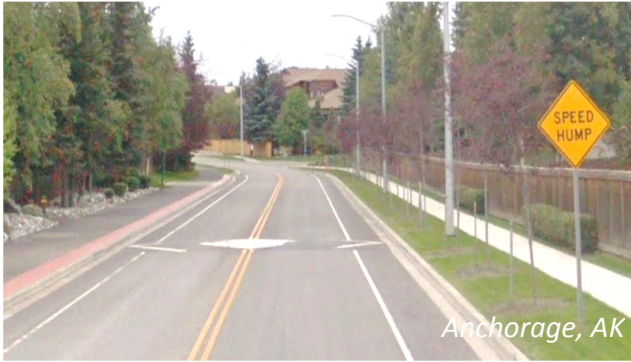
- Roadways with high speeds or where driver inattention is an issue.
- Rumble strips can be used on shoulders to alert drivers they are entering a part of the roadway not intended for use.
- Roadway rumble strips placed across the roadway are used to alert drivers of a changing roadway condition or the need for speed reduction.

Design Considerations

- All road users need to be considered and accommodated. Bicycles need particular attention, especially if they are expected to use the roadway or shoulders.
- There are a variety of types of rumble strips, so the site application should be considered to determine the most appropriate design.

ROADWAY TREATMENTS

SPEED BUMPS, SPEED HUMPS, SPEED TABLES



There are a number of raised treatments that can be used in the roadway to slow vehicular traffic, including speed bumps, humps and tables.

Speed humps utilize a larger vertical radius than speed bumps that results in wider widths and a gentler crossing by vehicles.

Speed tables are wide mountable obstructions installed on the pavement surface across travel lanes and intended to cause vehicles to slow. Speed tables are wider flat-top speed humps and are gentler on vehicles. They can be used on higher order roads than bumps or humps because they allow for a smoother ride and higher speeds.

Benefits

- Relatively inexpensive.
- Effectively slows vehicle speeds, with speed bumps and humps reducing speeds more than speed tables.
- Easily navigated by bicyclists.

Constraints

- May be considered noisy by nearby residents.
- Forces emergency vehicles to slow down.
- Inappropriate on streets with bus traffic due to rider comfort and reduced travel speeds.

Typical Applications

- Speed bumps or humps can be used on lower order roadways, whilst speed tables are appropriate on higher order roadways.
- Roadways where a reduction in speeds and traffic calming is desired.
- Speed bumps, humps, or tables work well with curb extensions.

Design Considerations

- Drainage needs should be considered and accommodated.
- Treatments should be used midblock, not at intersections.
- Treatments are not appropriate on roadways with grades over 8%.
- Advance signing and pavement markings on the treatment can be provided.
- Typically preferred for treatment not to cover a bike lane.

REDUCED CURB RADII



Street corner is reconstructed with a smaller radius to reduce vehicle turning speeds by forcing sharper turns.

Benefits

- Forces sharper turn by right-turning motorists and thus slower speeds.
- Improves safety of pedestrians by reducing crossing width and slowing motorists.

Constraints

- Requires additional space that may not be available.
- Makes turning movements more challenging for large vehicles and may not accommodate all trucks.

Typical Applications

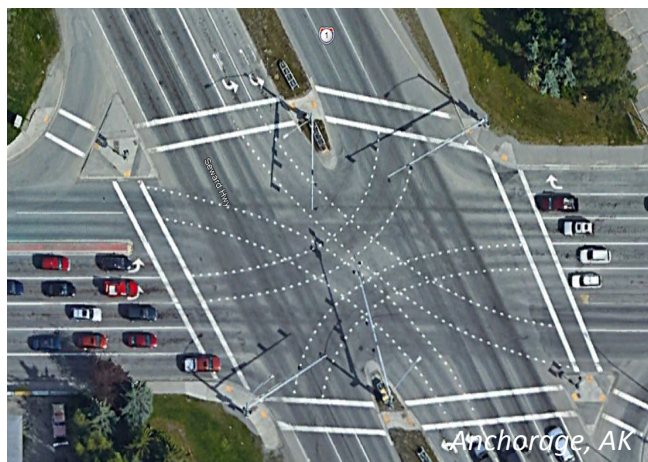
- Typically used at intersections with high vehicle speeds and high pedestrian volumes where space is available.

Design Considerations

- The street type, angle of intersection, land uses, etc. should be considered when designing the curbs.
- Maintenance vehicles, emergency vehicles, school buses, and other anticipated large vehicles should be considered in the design.
- The effective turning radius (considering presence of parking, bike lanes, medians, etc.) should be used to evaluate the ability of vehicles to make a turn, not the curb return radius.
- In locations where reducing the curb radius is challenging based on design vehicles, consider using a compound radius, at-grade paving treatments, or advance stop lines.

ROADWAY TREATMENTS

INTERSECTION PAVEMENT MARKING DELINEATION



This treatment accentuates traffic lines, pavement markings, and channelization used to direct traffic on the roadway.

Benefits

- Helps guide motorists to choose and stay in the proper lane.
- Can be used to visually narrow travel lanes in support of reduced speeds.
- Raises awareness for bicyclists and motorists to potential conflict areas.

Constraints

- Adds to striping costs.
- Maintenance costs.

Typical Applications

- At intersections with multiple adjacent turning lanes, more than four legs, and/or are skewed.
- Along roadways with bike lanes or cycle tracks.

Design Considerations

- Old pavement markings should be properly removed so that drivers are not confused if old markings remain visible.
- Attention to skid resistance of the markings.
- Dotted lines shall bind the bicycle crossing space. See MUTCD Section 3B.08 for dotted line extensions through intersections.



RED LIGHT RUNNING CAMERAS FOR AUTO ENFORCEMENT



This treatment is a type of traffic enforcement that captures an image of the vehicle which has entered an intersection in spite of the traffic signal indicating red, i.e. during the red phase.

Benefits

- Decreases red light running violations.
- Decreases number of intersection crashes.

Constraints

- Maintenance and operating costs.
- Privacy concerns.

Typical Applications

- At signalized intersections with a high rate of red light running.
- At signalized intersections with a high rate of intersection crashes or severe injuries related to intersection crashes.

Design Considerations

- Reevaluate sight distance to the signal at intersections.
- Reevaluate stopping sight distance.



ROADWAY TREATMENTS

SPEED FEEDBACK SIGNS



This treatment is designed to provide a message to drivers exceeding a certain speed threshold. They are known as dynamic warning signs, radar speed/message signs, and dynamic speed display signs.

Benefits

- Alerts drivers of their current driving speed versus the posted speed limit.

Constraints

- Not self-enforcing.
- Duration of effectiveness is limited.

Typical Applications

- Often installed in high speed zones to alert drivers to slow down when they are exceeding the speed limit.
- A speed feedback sign may be used in areas with high pedestrian-related crash history.

Design Considerations

- Speed studies and appropriate modifications to the speed limits should first be considered before deploying a speed feedback sign.
- May be considered when the observed 85th percentile speeds at a study exceed the posted limit by 5 mph or more.

ROADWAY TREATMENTS

AUTOMATED SPEED ENFORCEMENT



This treatment is a type of automated enforcement that records vehicle speed using fixed or mobile cameras or radar and takes a photograph of the vehicle when it exceeds a speed limit threshold.

Benefits

- Increases enforcement to change driver behavior about driving above the speed limit.
- Impartial and consistent in enforcing the speed limit.
- Reduces fatal and non-fatal crash injuries.

Constraints

- Privacy concerns.
- Installation and operating costs.
- Alaska does not have laws specific to speed cameras.

Typical Applications

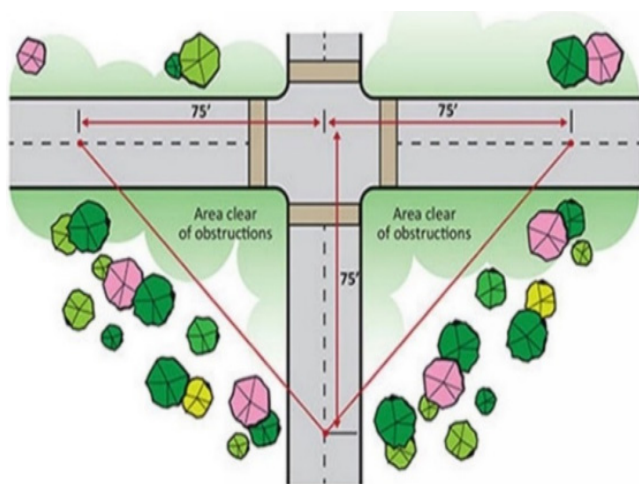
- Locations where dangerous speeding and speeding-related crashes are especially frequent.

Design Considerations

- Consider both a mobile and fixed automated speed enforcement system.
- Do public outreach to educate and get public acceptance prior to designing and installing cameras.
- Awareness of the NHTSA Guidelines.



SIGHT DISTANCE IMPROVEMENTS



Sight distance improvements can often be achieved by clearing sight triangles to restore sight distance obstructed by vegetation, roadside appurtenances, buildings, bus stations, and other objects which are in the right-of-way.

Benefits

- Provides time for drivers to take appropriate actions during hazardous situations.
- Rear end crashes can be reduced with improved forward visibility.
- Good forward visibility at pedestrian crossings will give drivers more time to react.

Constraints

- High cost can be associated with this treatment if realignment of the roadway or acquisition of more right-of-way is required to remove obstructions.

Typical Applications

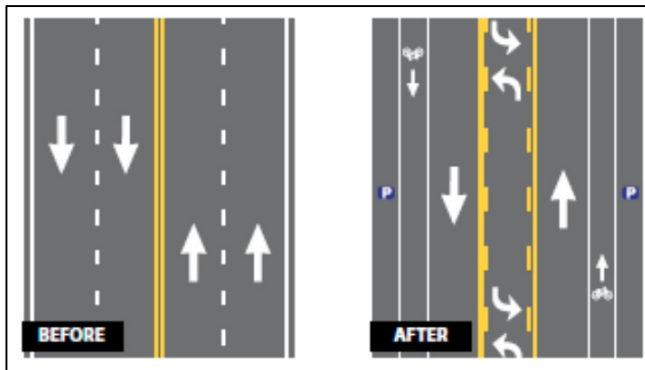
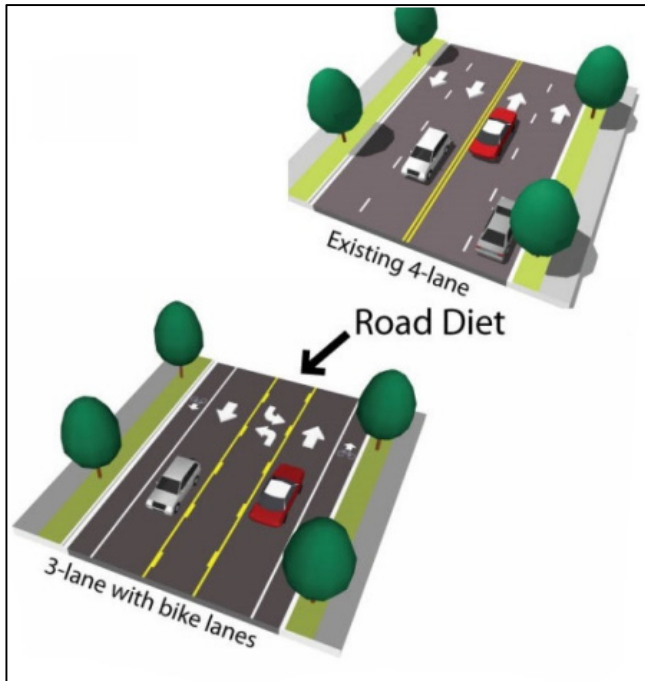
- At intersections with restricted sight distance and patterns of crashes related to poor sight distances.

Design Considerations

- Ensure traffic signs and signal heads are not obstructed by vegetations and street furniture.
- At intersections, sight lines and visibility splays are often required at larger angles to the user's normal viewpoint.

ROADWAY TREATMENTS

ROAD DIETS



This treatment reduces the number of vehicle lanes on roadway to manage vehicle speeds and reduce risk of crashes for all road users.

Benefits

- Lowers vehicle speeds.
- Reallocates roadway space for other needs such as bike lanes and pedestrian paths.
- Helps provide vehicular access for turning into and out of commercial and business driveways.

Constraints

- May increase travel time.
- Transit vehicles/mail trucks can block traffic when stopped.
- May create issues with snow storage.
- Possible decrease in roadway capacity.

Typical Applications

- Converting a four-lane undivided roadway to a three-lane cross section, with one lane in each direction and a two-way center left turn lane.

Design Considerations

- Road function and context – rural, urban, suburban neighborhood, etc.
- Design controls – design vehicles, drivers, non-motorized users, speed.
- Screening all upcoming resurfacing projects allows agencies to incorporate a road diet at no additional costs.
- For roads with fewer than 10,000 ADT, capacity will most likely not be affected.

ROAD SEGMENT EDGE LINES



This treatment involves installing/markings edge lines to define or delineates the edge of a roadway.

Benefits

- Provides a visual reference to guide motorists along the travel lane.
- Reduces drifting onto the shoulder and roadside areas.

Constraints

- Adds to striping costs.

Typical Applications

- Applicable when traveled way exceeds 20 feet in width.
- Apply just prior to and within a curved section of a road.

Design Considerations

- Recommended for rural arterials and collectors with an ADT of 3,000 per day.
- Edge lines should be considered on roadways that do not have center lines.



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