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3 Roadways

SICUT PATRIBUS SIT DEUS NOBIS. BOSTONIA. CONDITA A.D. 1630. CIVITATIS REGIMINE DONATA A.D. 1822.


PRUDENTIAL
BOSTON UNIV
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Education
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3

Roadways

Boston's network of roads has been built over centuries, with streets first designed for walking, horses, and carriages. Over time, as existing streets were re-purposed and new street grids were built to accommodate the city's growth, they became dominated by automobiles. This chapter covers roadway design in the space between curbs. It presents techniques to rebalance the travel-lane needs of different types of users—bicycles, automobiles, delivery trucks, and transit vehicles—within Boston's narrow rights-of-ways.

Roadway Design Principles

Multimodal

- Boston's roadways must be optimized to balance the needs of pedestrians, bicyclists, transit riders, and motorists, and will not be dominated by cars. Travel and parking lanes will be reduced to the minimum number and widths necessary to accommodate pedestrians, vehicular traffic including bicycles and transit vehicles, as well as on-street parking.
- Opportunities will be taken to reallocate excess roadway space once reserved for motor vehicle use to widen sidewalks, install bicycle facilities, and/or create plazas where possible.

Green

- Roadway designs must offer people viable transportation choices and should provide safe and convenient accommodations for all modes. Infrastructure for non-motorized transportation, high occupancy vehicles, and transit should be considered to help reduce single occupancy vehicles, congestion, and greenhouse gas (GHG) emissions.
- Roadway designs must aim to maximize sustainability to protect Boston's environment. Designs should reduce the amount of impervious surfaces to recharge groundwater levels, treat stormwater runoff on-site, and reduce erosion and water pollution.
- Roadway materials should be long-lasting, low maintenance, and sustainable. Materials should be locally-sourced, reused, or recycled whenever possible.

Smart

- Roadway elements such as sign and light poles, utility covers, hydrants, traffic control devices, etc, must be thoughtfully laid out to maximize accessibility and functionality; signs should be consolidated to reduce clutter and maximize visibility, and utilities should be accessible for maintenance without obstructing pedestrian crossings.
- Opportunities should be explored to install sensors to monitor and study operations, traffic conditions, modal counts, and air quality to improve the efficient and safe movement of people and goods on Boston's roadways. Roadway design, signage, and lane allocation will be coordinated with signal timing and intersection design to efficiently move all modes of transportation.
- Wayfinding should be provided for all users on Boston's roadways. Walking, bicycling, and motor vehicle routes should be clearly signed and incorporate smart technologies wherever feasible for real-time updates in delays, accident reports, and roadway construction. During construction, alternative routes should be signed for all modes.

The Boston Public Works Department (PWD) and the Boston Transportation Department (BTD) are responsible for approving all roadway designs on city-owned streets. As a division of PWD, the Public Improvement Commission (PIC) must approve all changes to city-owned right-of-ways. Roadway designs may also require coordination with the Boston Fire Department, Emergency Medical Services (EMS), and the Mayor's Commission for Persons with Disabilities.

For additional roadway design guidance, reference the Manual on Uniform Traffic Control Devices (MUTCD), the National Association of City Transportation Officials (NACTO) Urban Street and Bikeway Design Guides, and the American Association of State Highway and Transportation Officials (AASHTO) "Green Book" and "Bike Guide."

Safe Speeds

Streets should operate at speeds that create comfortable environments for pedestrians and bicyclists, as well as motor vehicles. Street designs will aim to limit excessive speeding, and design speeds must be appropriate for the Street Type and context of surrounding land uses. New streets will be designed to feel uncomfortable at speeds above the target design speed. On existing streets with excessive speeds, traffic calming measures will be considered to reduce speeds to improve safety and comfort for all users.

Pedestrians and bicyclists are particularly vulnerable in the event of a crash. Speed is of fundamental importance: the severity of a pedestrian injury in the event of a crash is directly related to the speed of the vehicle at the point of impact. For example, a pedestrian who is hit by a motor vehicle traveling at 20 mph has a 95% chance of survival, whereas a pedestrian hit by a motor vehicle traveling at 40 mph has a 15% chance of survival.† In addition, vehicles travelling at lower speeds also have more reaction time which helps prevents crashes.

Designing for reduced vehicles speeds is especially important in a historic city like Boston. Boston has the highest walking commute rate of any city in the US, due in large part to the city's historic compact form combined with its fine-grained network of streets and paths. The city's irregular street pattern and short, intensely developed blocks contribute to pedestrians constantly crossing the street. In addition, Boston's streets tend to have narrow sidewalks—often without a buffer or Greenscape/Furnishing Zone—positioning people walking in close proximity to moving traffic. Together, these conditions make reducing vehicle speeds an important strategy to improve safety and the quality of life in the city.

† Killing Speed and Saving Lives, UK Dept. of Transportation, 1987, London, England. See also Limpert, Rudolph. Motor Vehicle Accident Reconstruction and Cause Analysis. Fourth Edition. Charlottesville, VA. The Michie Company, 1994, p. 663.

25 MPH **Most city streets should be designed to produce an operating speed that does not exceed 25 mph.**

The following exceptions apply:

15 MPH **Shared Streets** should be designed to produce operating speeds that generally do not exceed 15 mph.

15 MPH **School Zones** should be designed to produce operating speeds that generally do not exceed 15 mph.

20 MPH **Neighborhood Residential Streets** should be designed to produce operating speeds that generally do not exceed 20 mph.

30 MPH **Parkways and Neighborhood Connectors** should be designed to produce operating speeds that generally do not exceed 30 mph.

Establishing speed regulations and posting speed limits requires conducting a comprehensive engineering study at locations where speed control is of concern. The purpose of the study is to establish a speed limit that is safe, reasonable, and self-enforcing.

As stipulated by Massachusetts State law, the statutory speed limit on most city streets is 30 mph. Lower speed limits may be posted by BTD in school and safety zones. The City of Boston supports new legislation to lower the State statutory speed limit to 25 mph.

Optimizing Use of Street Space

The configuration and width of travel lanes and parking lanes has a great impact on the availability of space on Boston's streets. Every foot of width between building faces is a precious commodity. Therefore, during road reconstruction and resurfacing projects, the City of Boston shall assess reallocating street space to accommodate pedestrians, bicyclists, and transit vehicles. Note that Massachusetts Law, under Chapter 90E, section 2A states that all reasonable provisions for the accommodation of bicycle and pedestrians shall be made in the planning, design, construction, reconstruction, or maintenance of any project. Street reconstruction should also incorporate green elements such as street trees and landscaped areas. While these projects should strive to minimize delay to motor vehicles, the safety and comfort of vulnerable roadway users will be an equal priority.

Design solutions during resurfacing projects are likely to be different than road reconstruction projects (e.g., projects in which curb location and subsurface elements are impacted).

Road reconstruction projects are an opportunity to reconsider all aspects of the cross section and to achieve a balance between all users. This may include relocating the curb, widening sidewalks, installing bicycle facilities, providing transit lanes, and incorporating green street elements.

Resurfacing and restriping projects, where the curb location is fixed, should consider design solutions that reallocate existing street space to accommodate bicycle and transit facilities. Resurfacing projects are usually lower in cost and quicker to implement than reconstruction projects.

Whether the project is a simple resurfacing or a more complex reconstruction, the following basic steps should be undertaken to optimize the use of street space.

The PWD and BTD must be consulted when street optimization projects are being designed.

Before Road Diet: Massachusetts Avenue with parking on both sides of the street and two travel lanes in each direction.

After Road Diet: Massachusetts Avenue with one parking lane, two travel lanes in each direction, and bicycle lanes in each direction, as well as transit prioritization at specific locations along the corridor.

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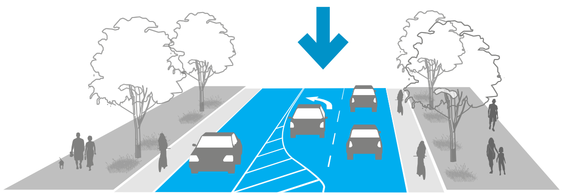
Determine if the street is a candidate for a:

1 Road Diet

A road diet is a reduction in overall roadway width.

Remove Lanes



An analysis should be done to determine if there is excess capacity that can be reallocated to other modes by removing one or more parking or travel lanes. To reduce excessive delay for motor vehicles, it may be necessary to retain turn lanes at intersections and/or adjust signal timing. A capacity analysis is often necessary to evaluate the impacts of the proposed design on the operation of the roadway or the adjacent road network.

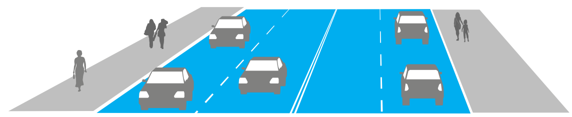
Example candidates: Four-lane undivided roadways, which can be converted to a three-lane cross section (one lane in each direction with a center turn lane or center median), and multi-lane streets with extra capacity where one or more lanes can be removed. See Three Lanes with a Center Turn Lane later in this chapter for more information.

Opportunities for reallocating space: During reconstruction projects, space can be reallocated to widen sidewalks, create curb extensions, plant street trees or greenscape elements, install street furniture, implement bicycle lanes or cycle tracks, or provide on-street parking lanes.

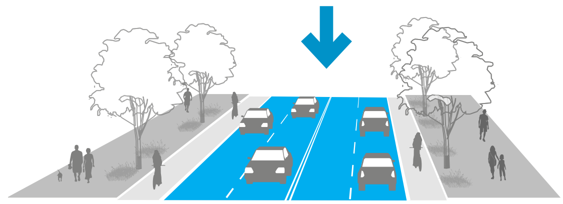
During resurfacing and restriping projects, removing travel or parking lanes can provide additional space to install bicycle lanes or cycle tracks. On roadways with on-street parking and bicycle lanes, it is advantageous to provide additional width to either the parking lane or the bicycle lane, particularly in areas with high parking turnover, to reduce the likelihood that a bicyclist will be struck by an opening car door.

2 Lane Diet

A lane diet is a reduction in travel lane width.



Reduce Lane Widths



Consider narrowing lane widths based on the guidance in the Minimum Lane Widths chart found on the next page. Reduced lane widths encourage slower vehicular speeds and can reduce crossing widths, further improving conditions for pedestrians and bicyclists.

Example candidates: Streets with travel lanes that are more than **10' wide**, streets with wide parking lanes, and streets with wide center turn lanes.

Opportunities for reallocating space: During reconstruction projects, space can be reallocated to widen sidewalks, create curb extensions, plant street trees or greenscape elements, install street furniture, implement bicycle lanes or cycle tracks, or provide on-street parking lanes.

During resurfacing and restriping projects, installing minimum lane widths can provide additional space to install bicycle lanes or cycle tracks. On roadways with on-street parking and bicycle lanes, it is advantageous to provide additional width to either the parking lane or the bicycle lane, particularly in areas with high parking turnover, to reduce the likelihood that a bicyclist will be struck by a motorist opening a car door.

Minimum Lane Widths in the City of Boston

The following chart presents guidelines for designating lane widths in the City of Boston. The lane widths should be considered minimums in design where available right-of-way is constrained and trade-offs are required to meet the needs of all users. They should be applied to major street reconstructions as well as projects where lane functionality is reallocated between existing curb lines.

A design exception may be required for some widths on federal or state-funded projects. Due to coordination with other jurisdictions, minimum lane width values are categorized by the traditional functional classification system. Decisions regarding lane widths in the city should support the desired characteristics of Boston's new Street Types.

The presence of heavy vehicles is a key consideration when using minimum lane widths. Wider lanes (**11' to 12'**) are appropriate in locations with high volumes of heavy vehicles (> 8%).

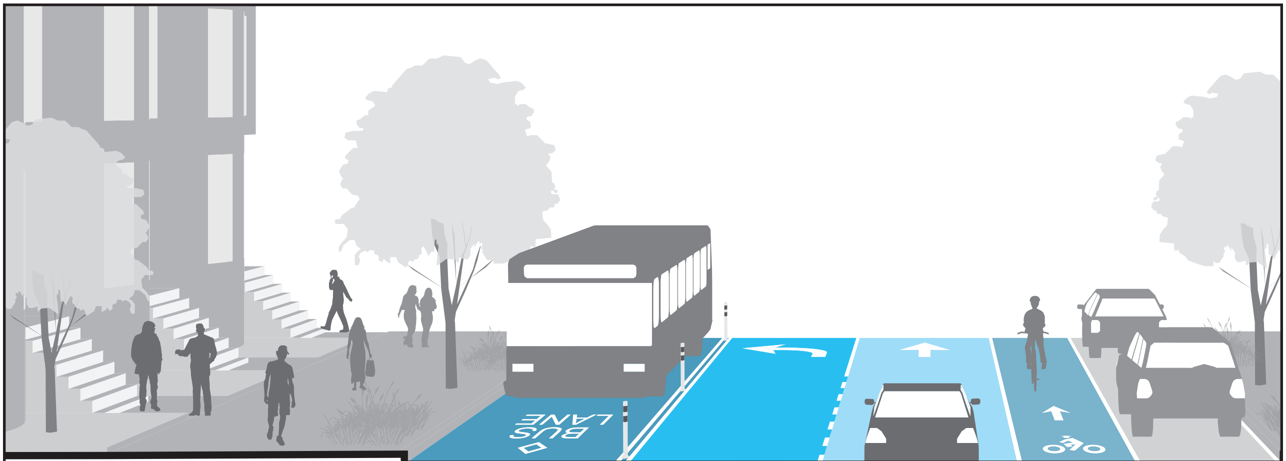
Because of the intricate history of Boston's streets, typical curb-to-curb widths vary along the length of a roadway, providing multiple cross section widths and lane configurations. Some of the most frequent curb-to-curb widths found in Boston are **26', 34', and 40'**; these cross sections highlight the narrow right-of-way the City must work within. In addition to narrow curb-to-curb widths, building setbacks provide a limited sidewalk realm, typically **7' in width.** The challenges of roadway design are emphasized when faced with trade-offs in trying to provide space for all modes.

Narrowing lane widths and reclaiming space once dedicated for automobile traffic is an important tool in equitably dividing roadway space. Studies‡ show that narrower lane widths have no measurable impact on capacity; however they may result in a reduction of average travel speeds by one to three mph. In response to specific conditions on a given roadway, lane widths different from those prescribed may be required.

All lane width dimensions must be approved by BTD.

‡ Potts, Ingrid B., Harwood, Douglas W., and Richard, Karen R. Relationship of Lane Width to Safety for Urban and Suburban Arterials. Washington, D.C.: Transportation Research Board, 2007.

Minimum Widths for Roadway Lanes



Street Type	FHWA Classification	Bus Lane	Turn Lane	Travel Lane	Bicycle Lane	Parking Lane
Downtown Commercial Downtown Mixed-Use Neighborhood Main Neighborhood Connector Neighborhood Residential Industrial Street Shared Street Parkway Boulevard						
	Arterial	11’	10’	10’	5’	7’
	Collector	N/A	10’	10’	5’	7’
	Local	Local roadways are typically one to two travel lanes, with or without parking, and do not have pavement markings.				

Notes

Bus Lane

- The minimum width of a shared bus and bicycle lane is 12’. Wider (13’ to 15’) shared bus and bicycle lanes are preferred to enable bicyclists and buses to pass each other.
- Flexposts are only required for contra-flow bus lanes.

Travel Lanes

- Wider travel lanes (11’ to 12’) are appropriate in locations with high volumes of heavy vehicles (> 8%).
- Travel lanes immediately adjacent to on-street parking should provide a minimum combined parking and travel lane width of 19’.
- Shared lane bicycle pavement markings are permitted on travel lanes of any width, in locations with and without parking. Bicycle lanes are preferred to wider shared travel lanes, as narrower travel lanes are associated with lower speeds.

Bicycle Lanes

- The preferred width for bicycle lanes is 6’ in areas with high volumes of bicyclists.
- Wider bicycle lanes (6’ to 7’) are preferred in locations with heavy parking turnover.
- Bicycle lanes 4’ in width may be considered on non-arterial roadways when not adjacent to on-street parking or at constrained intersections.

Parking Lanes

- Parking lanes with frequent loading zones may require wider parking lane widths.
- Decisions regarding parking lane width when adjacent to bicycle lanes should consider parking turnover rates and vehicle types.
- For lanes with peak hour parking restrictions, 12’ is the minimum width to accommodate shared use by parked vehicle and bicycles during off-peak times.


Cambridge St.
at Joy St.


NO
STOPPING
ANY
TIME

Design Features that Reduce Operating Speeds

Boston's roadways must be designed to operate at speeds appropriate for the context of the Street Type. Reconstruction, resurfacing, and restriping projects offer opportunities to redesign roadways and reduce operating speeds to desired values. As discussed earlier in this chapter, narrower lane widths have a traffic calming effect. Other speed-reduction strategies discussed in this section will be considered for roadway designs in Boston.

Traffic calming can be done without reconstruction or resurfacing through tactical, efficient, and cost-effective measures; these include the installation of pavement markings and/or flexposts, and the strategic placement of parking. In addition, enforcement and regulatory measures can be used to reduce speeding.

As the focus of this chapter is street design "between the curbs," other chapters should be referenced for additional traffic calming strategies including:

- Intersection treatments such as signal timing progression, raised intersections, and curb extensions can be used to reduce traffic speeds—these are discussed further in Chapter 4: Intersections.
- Street trees have a calming effect on traffic speeds—they are discussed in Chapter 2: Sidewalks.

Design features that reduce operating speeds must be approved by BTD and PWD. Designs may also require coordination with the Boston Fire Department, EMS, and the Mayor's Commission for Persons with Disabilities.

For additional design guidance, reference BTD's Pedestrian Safety Guidelines for Residential Streets.

Mid-block Neckdowns

Overview

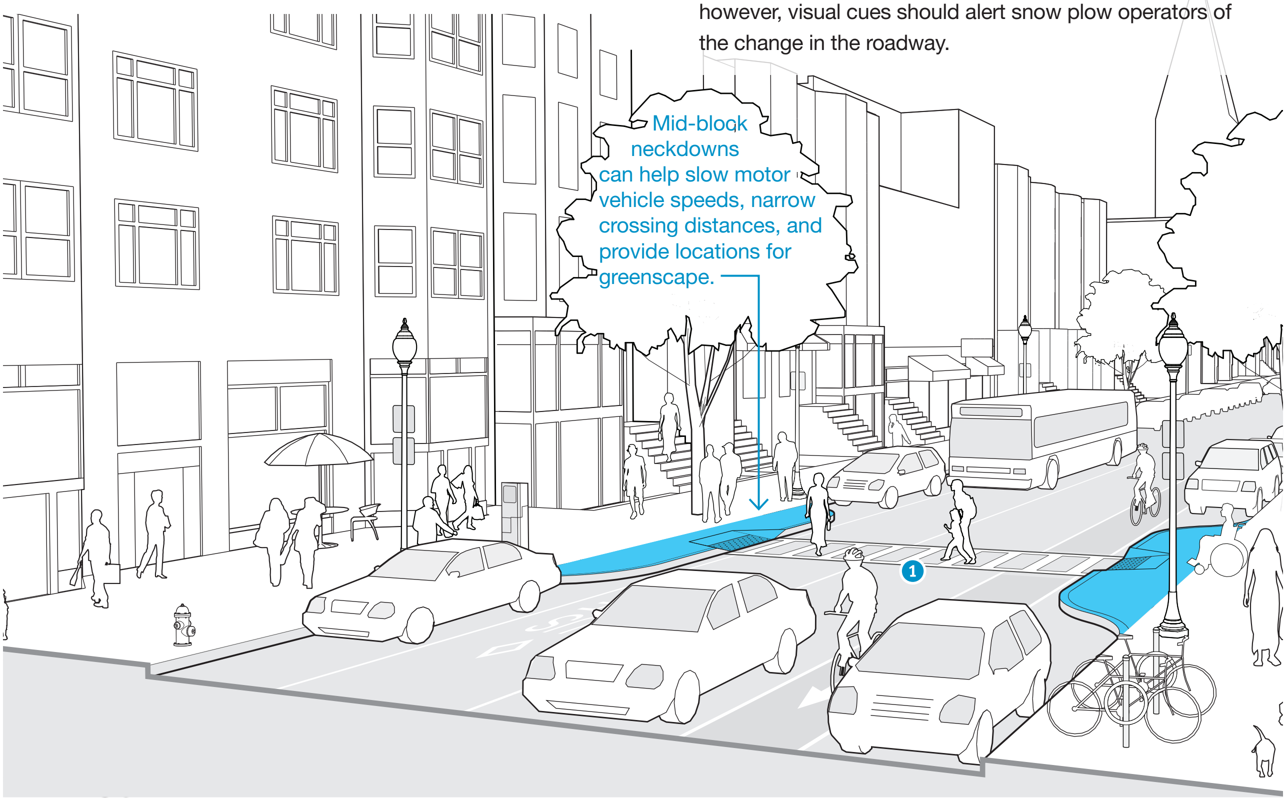
Roadway geometry can be altered at mid-block locations to reduce motor vehicle speeds by diverting the driver's path of travel. Neckdowns are curb extensions on opposite sides of the road which create a "pinch-point." They are particularly useful on streets with longer block lengths where motorists tend to pick up speed. They can be combined with mid-block pedestrian crossings (1) to further enhance pedestrian safety by reducing crossing distances and increasing visibility.

Use

- Mid-block neckdowns can be used on two-way streets with one lane in each direction, and one-way roads with no more than two lanes. They are sometimes combined with intermittent medians to reduce speeds along the length of a roadway.
- Vegetation used in the neckdown should generally be low-growing and low-maintenance.
- In locations with mid-block pedestrian crossings, sight distances should be maintained.

Considerations

- Where neckdowns provide pedestrian crossings, Americans with Disabilities Act (ADA) compliant curb ramps, tactile warning strips, and cross slopes must be provided; consider other traffic calming elements such as raised crossings. For more information, see Chapter 4: Intersections, Raised Crossings and Intersections.
- Mid-block neckdowns can serve as alternatives to speed tables. See Speed Tables later in this Chapter for more information.
- Care should be taken to avoid suddenly squeezing bicyclists into the traffic flow on streets with higher volumes of traffic, particularly in locations with steep uphill grades where bicyclists may be travelling considerably slower than motor vehicle traffic.
- On low-volume Residential Streets, neckdowns can reduce the street to one lane, requiring on-coming drivers to alternate passage through the neckdown, while keeping enough space for fire trucks and other large vehicles.
- Designs should consider snow removal operations. Mid-block neckdowns offer space to store snow in winter; however, visual cues should alert snow plow operators of the change in the roadway.



Chicanes

Overview

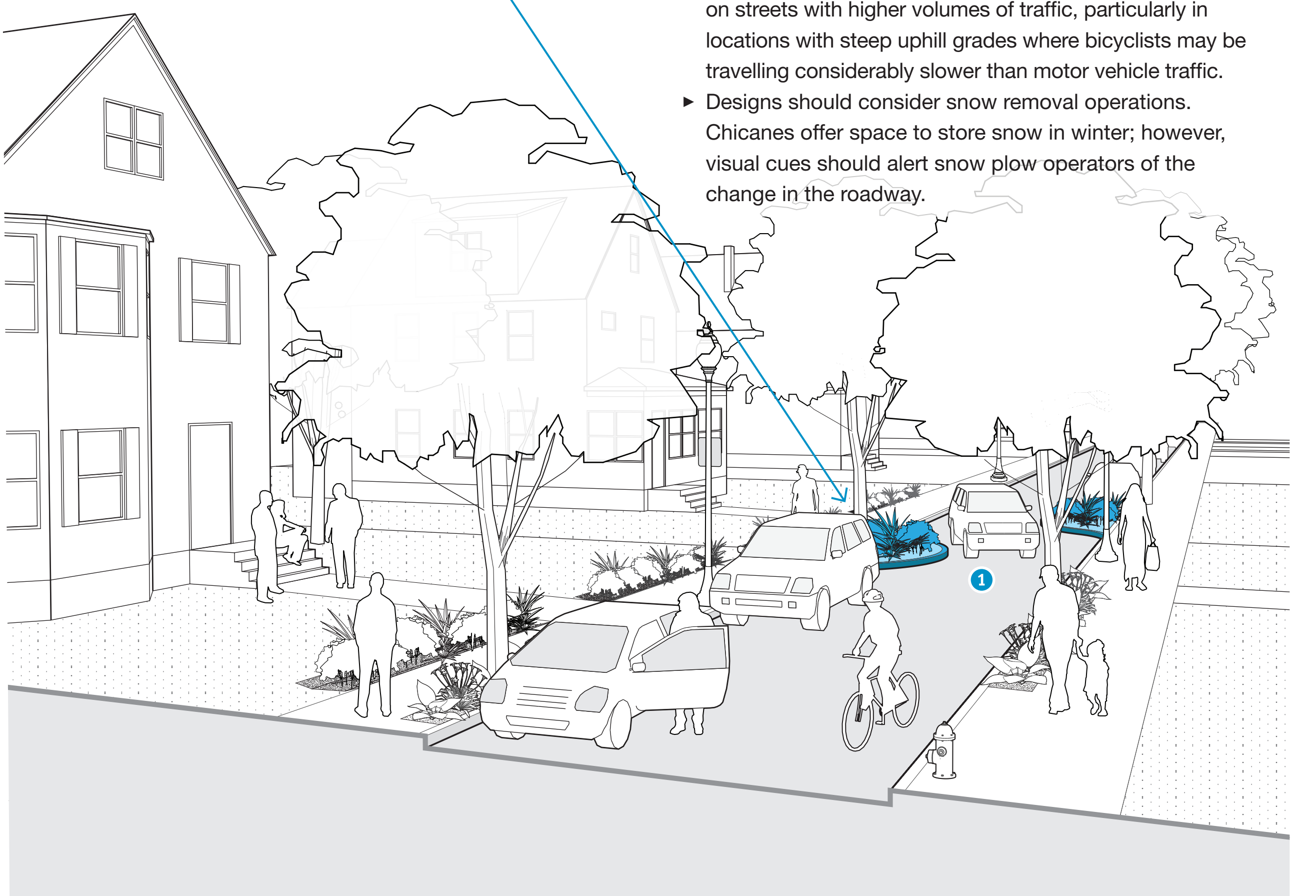
A chicanes is a design feature that creates an “S” curve in the roadway that drivers must weave through, with the effect of slowing speeds. Chicanes can be created by alternating parking from one side of the roadway to the other, as well as through curb extensions (1). Chicanes provide opportunities to increase sidewalk space and introduce green street elements in the right-of-way.

Use

- Chicanes can be used on two-way streets with one lane in each direction, and one-way roads with no more than two lanes.
- The amount of horizontal deflection should be based on the proposed design speed of the roadway.
- Vegetation used in chicanes should generally be low-growing and low-maintenance. In locations with mid-block pedestrian crossings, sight distances must be maintained.

Considerations

- Chicanes can serve as alternatives to speed tables. See Speed Tables later in this Chapter for more information.
- Care should be taken to maintain space for bicyclists, and to avoid suddenly squeezing bicyclists into the traffic flow on streets with higher volumes of traffic, particularly in locations with steep uphill grades where bicyclists may be travelling considerably slower than motor vehicle traffic.
- Designs should consider snow removal operations. Chicanes offer space to store snow in winter; however, visual cues should alert snow plow operators of the change in the roadway.



Center Islands

Overview

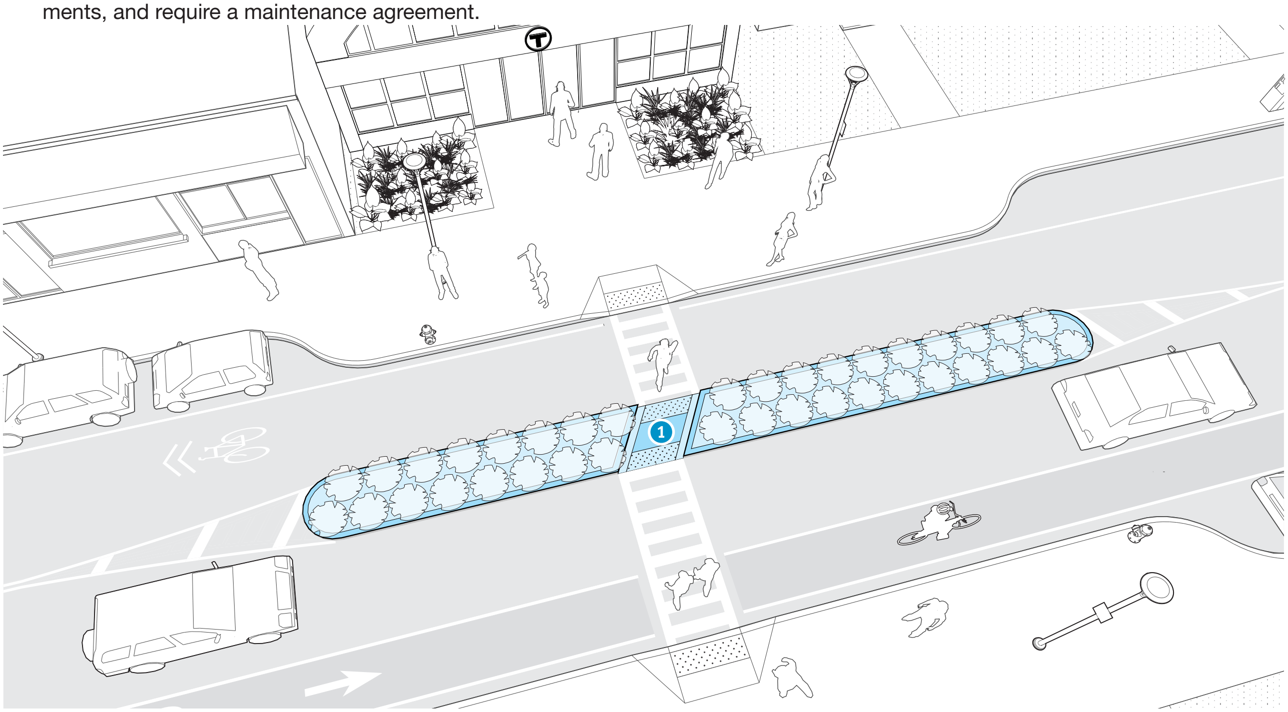
A center island can be used to narrow the roadway, reduce motor vehicle speeds, and improve pedestrian crossings. Center islands also provide opportunities to introduce green elements in the right-of-way, and can be used to absorb stormwater and reduce the heat island effect.

Use

- Center islands with crosswalks and pedestrian refuges improve pedestrian safety and access by reducing crossing distances and enabling pedestrians to cross roadways in two stages. Islands with crossings should be designed with a stagger, or a “z” pattern 1, forcing pedestrians to face oncoming traffic before progressing through the second phase of the crossing. Center islands with crosswalks should meet all accessibility requirements.
- Center islands can reduce the risk of head-on collisions and limit left turn opportunities to desirable locations (e.g., signalized intersections).
- Center islands should be carefully designed to ensure proper drainage and maximize the potential for on-site stormwater retention and infiltration.
- Landscaped center islands are considered enhanced treatments, and require a maintenance agreement.

Considerations

- Sidewalks should not be reduced in width and bicycle lanes should not be eliminated in order to provide space or additional width for islands.
- Center islands can be combined with mid-block pedestrian crossings to reduce crossing distances. For more information see the Intersections Chapter, Crosswalk Markings at Uncontrolled Locations.
- Permeable surfaces, street trees, and low-growing (**less than 3’** at mature height including the height of the curb and earthwork), drought-resistant plant materials should be used wherever safe and feasible.
- Plants should be located as far from the curb as possible to prevent exposure to salt and sand.
- Center islands should be at least **6’ wide** when used for low plantings, **10’ wide** for columnar trees and **18’ wide** for larger shade trees.
- Designs should consider snow removal operations. Center islands offer space to store snow in winter; however, visual cues should alert snow plow operators of the change in the roadway.



Speed Tables

Overview

Speed tables are raised pavement areas that are placed at mid-block locations to reduce vehicle speeds. Speed tables are elongated and have been shown to effectively reduce 85th percentile speeds. Well-designed speed tables enable vehicles to proceed comfortably over the device at the intended speed, but cause discomfort when traversed at inappropriately high speeds.

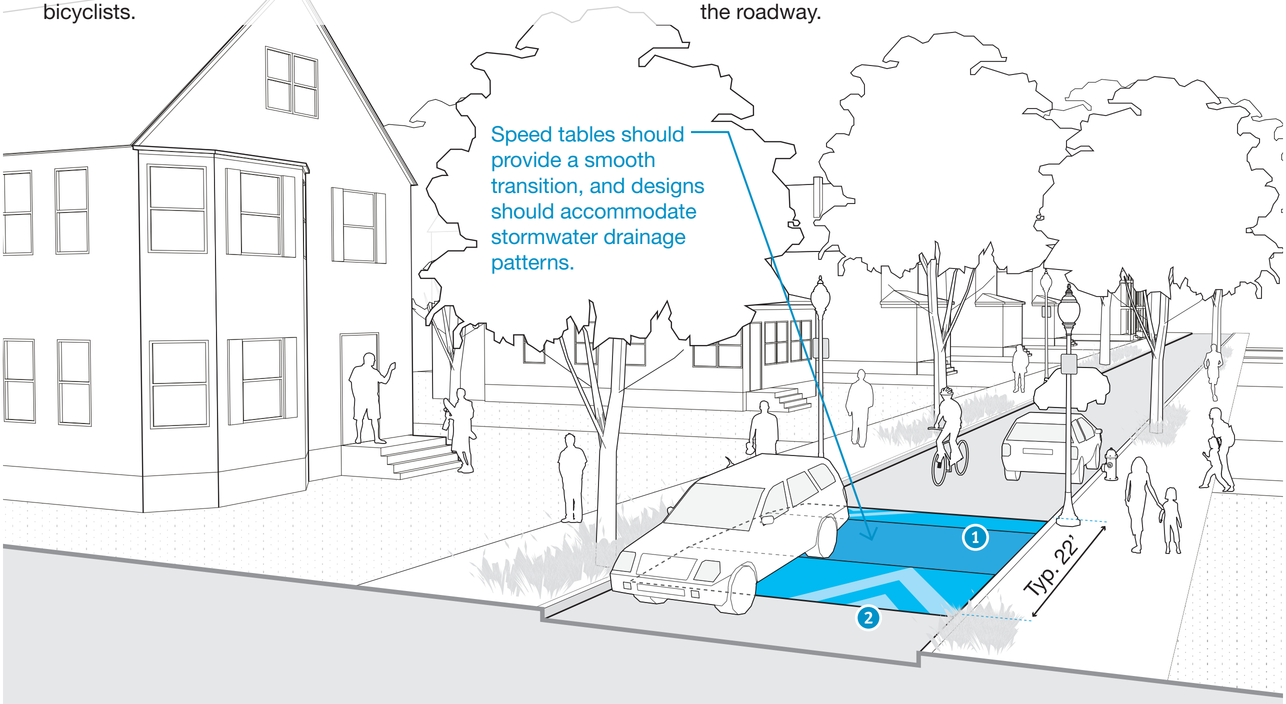
Speed table designs must be approved by BTD and PWD in consultation with the Boston Fire Department and EMS.

Use

- Speed tables are typically **3" higher** than the roadway surface and **3" below** the top of the curb, but can be fully raised **6"** to the height of the curb.
- Generally speed table design provides **22' of length, with 6' ramps and a 10' flat section along the top**. They normally extend the full width of the roadway, although sometimes they are tapered at the edges to accommodate drainage patterns.
- Speed tables should be designed with a parabolic profile or a flat top (1), with consideration for a smooth transition for bicyclists.
- Speed tables should be clearly marked with reflective pavement markings (2) per the MUTCD to alert motorists and bicyclists of their presence and they can adjust their speed accordingly.

Considerations

- Speed tables should not be confused with speed bumps. Speed bumps are used in parking lots and are **NOT** recommended for public streets.
- Speed tables **22' in length** have a design speed of 25 to 30 mph and are easier for large vehicles to negotiate.
- Avoid placing speed tables at the bottom of steep inclines where bicyclists travel at higher speeds and may be surprised by their presence.
- Speed tables should be utilized in series or supplemented with other traffic calming measures to effectively reduce travel speeds throughout a corridor or neighborhood. When used alone, speed tables may otherwise result in speed spiking, or when motorists travel at higher speeds between tables.
- Designs should consider snow removal operations. Visual cues should alert snow plow operators of the change in the roadway.



Paving Treatments

Overview

The choice of roadway materials can have significant impacts on traffic safety and speeds, user comfort, vehicle maintenance costs, stormwater management, roadway noise, and the heat island effect. Paving treatments include stamped concrete or asphalt, and colored pavements.

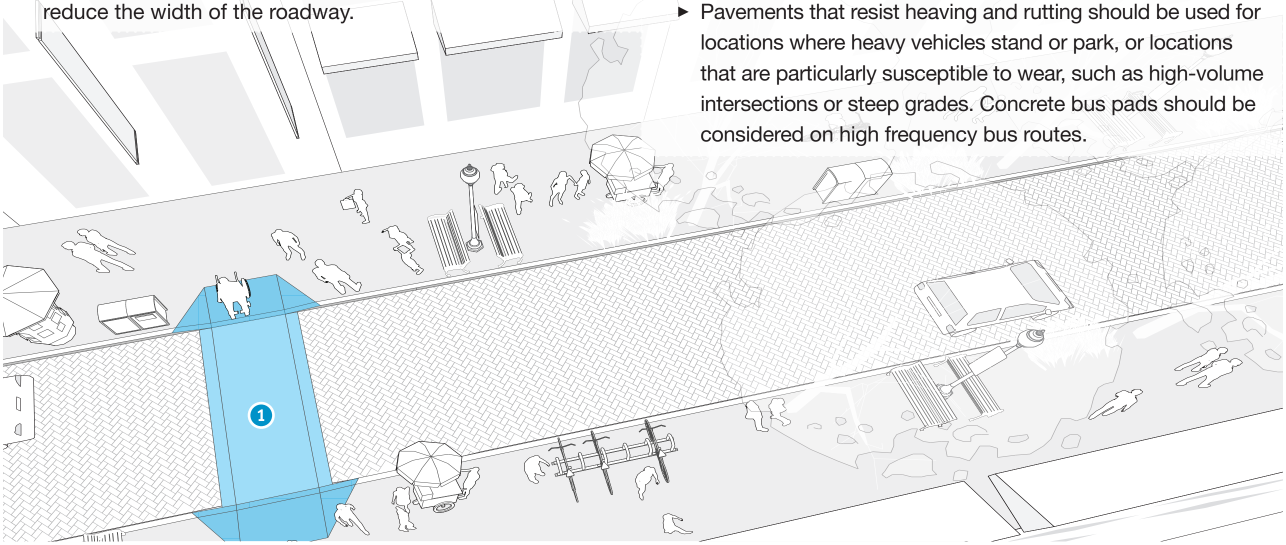
Paving treatments can help reduce speeds and are more commonly used on streets with high volumes of pedestrians and lower volumes of motor vehicle traffic, such as shopping districts and main streets. Boston's historic cobblestone streets are an example of the effects of textured pavements on vehicle speeds. Modern textured pavements are smoother than cobblestones which help accommodate bicyclists. Regardless of the material used on the roadway, an accessible, smooth travel path must be provided at crosswalks in order to accommodate people with disabilities.

Use

- Concrete is discouraged where frequent utility cuts are likely, and must have joints to allow for expansion.
- Pavers should generally not be used in roadway construction; however, they may be used in historic districts but require approval from the Historic Districts Commission and the Public Improvement Commission.
- Care should also be taken to ensure that materials do not settle to different heights.
- The use of paving treatments in parking lanes can visually reduce the width of the roadway.
- Pedestrian crossings must meet accessibility requirements by providing a smooth, stable, and slip-resistant accessible path, and should include the necessary reflective markings as required in the MUTCD (1). Pavers should not be used in crosswalks.
- The use of colored pavements for traffic control purposes (i.e., to communicate a regulatory, warning, guidance message) is narrowly circumscribed by the MUTCD, and may be required to follow Federal Highway Administration's (FHWA) experimentation process.

Considerations

- Key considerations for pavement materials selection include constructability, ease-of-maintenance, smoothness, durability, porosity, and color. Also, consideration should be given to the Street Type, the volumes and types of users (i.e., pedestrians, heavy vehicles, bicyclists, etc.), adjacent land uses, and stormwater management goals.
- Materials that are locally-sourced or recycled should be considered.
- Textured pavements are an expensive treatment and include long-term maintenance responsibilities.
- Consider the reflective characteristics of the pavement; high albedo pavements absorb less heat.
- Slippery surfaces such as smooth granite, tile, or brick should not be used as they create slippery conditions for bicyclists and pedestrians in wet weather.
- Pavements that resist heaving and rutting should be used for locations where heavy vehicles stand or park, or locations that are particularly susceptible to wear, such as high-volume intersections or steep grades. Concrete bus pads should be considered on high frequency bus routes.



Neighborways

Overview

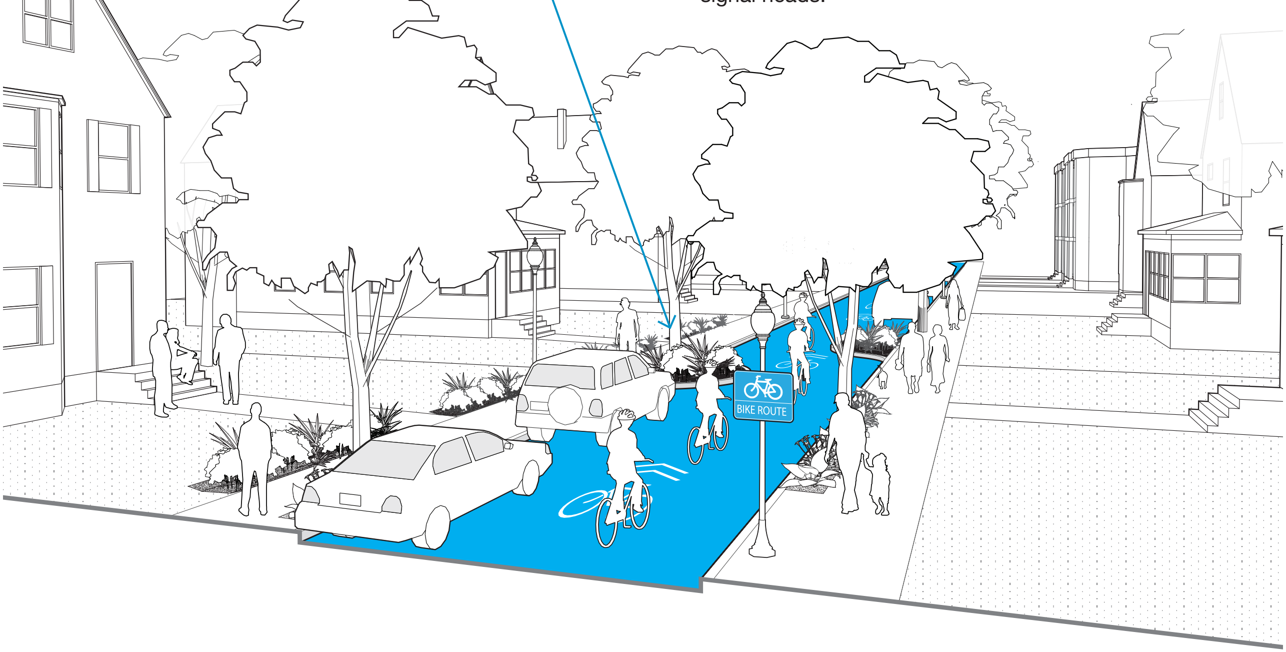
Neighborways, also known as “bicycle boulevards,” are quiet, often residential, streets that are designed for slower speeds, discourage unnecessary through-traffic by motor vehicles, and give priority to bicyclists and pedestrians. Neighborways are shared roadways where separate bicycle facilities (i.e., bicycle lanes, cycle tracks, etc.) are not necessary. Neighborways are pedestrian and bicycle friendly streets, typically designated by special wayfinding signs and pavement marking symbols. Also, for other design considerations on shared facilities, see Shared Streets, Chapter 1, Streets Types.

Use

- Design features that reduce operating speeds are used to maintain low speeds (20 mph or less) on neighborways.
- Neighborways are best accomplished in neighborhoods with a grid street network (where one street is chosen as the neighborway and through motor vehicle traffic is directed to parallel routes), but can also be accomplished by combining a series of road and trail segments to form one continuous route.
- Ideally, neighborways should not carry more than 1,000 motor vehicles per day to be compatible with bicycling. Traffic management devices are typically used to discourage motor vehicle through-traffic, while still enabling local traffic access to the street.
- Neighborways should be long enough to provide connectivity between neighborhoods and common destinations.

Considerations

- At major street crossings, neighborways may need additional treatments other than marked crosswalks for pedestrians and bicyclists. Treatments can include signage, median refuge islands, curb extensions, rapid flash beacons, bicycle-sensitive loop detectors, and/or bicycle signal heads.




WELCOME TO
MATTAPAN


INTRANSIT
CONTAINER

Travel Lanes

The design of travel lanes will depend on available right-of-way space, land use context, the mix of users, traffic volumes, and roadway design speeds. Travel lane designs should consider the impacts to all users, and the prevalence of each user on the roadway, including bicyclists, passenger vehicles, heavy trucks, buses, and emergency vehicles.

Accommodating all modes is challenging within Boston's constrained right-of-ways. Opportunities to move curblines are rare and expensive. Narrow right-of-way widths in conjunction with varying roadway widths along the length of the street create challenges to designing consistent facilities, especially for bicyclists. Sharing roadway space has been one tool to solve the narrow right-of-way problem. Strategies to share space include peak-hour parking restrictions and shared lane markings for bicyclists. Another design tool widely used across the country is shared center turn lanes, also known as two-way left turn lanes.

The number and width of motor vehicle lanes will be minimized to discourage speeding, provide space for pedestrian and bicycle facilities, and decrease impervious surfaces. Travel lane designs must also consider providing access for truck traffic to industrial areas, as it is necessary for economic development.

Travel lane designs must be approved by BTD and PWD. BTD is responsible for all lane markings and PWD for the reconstruction of city-owned roadways.

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TRAVEL LANES

Three Lanes with Center Turn Lane

Overview

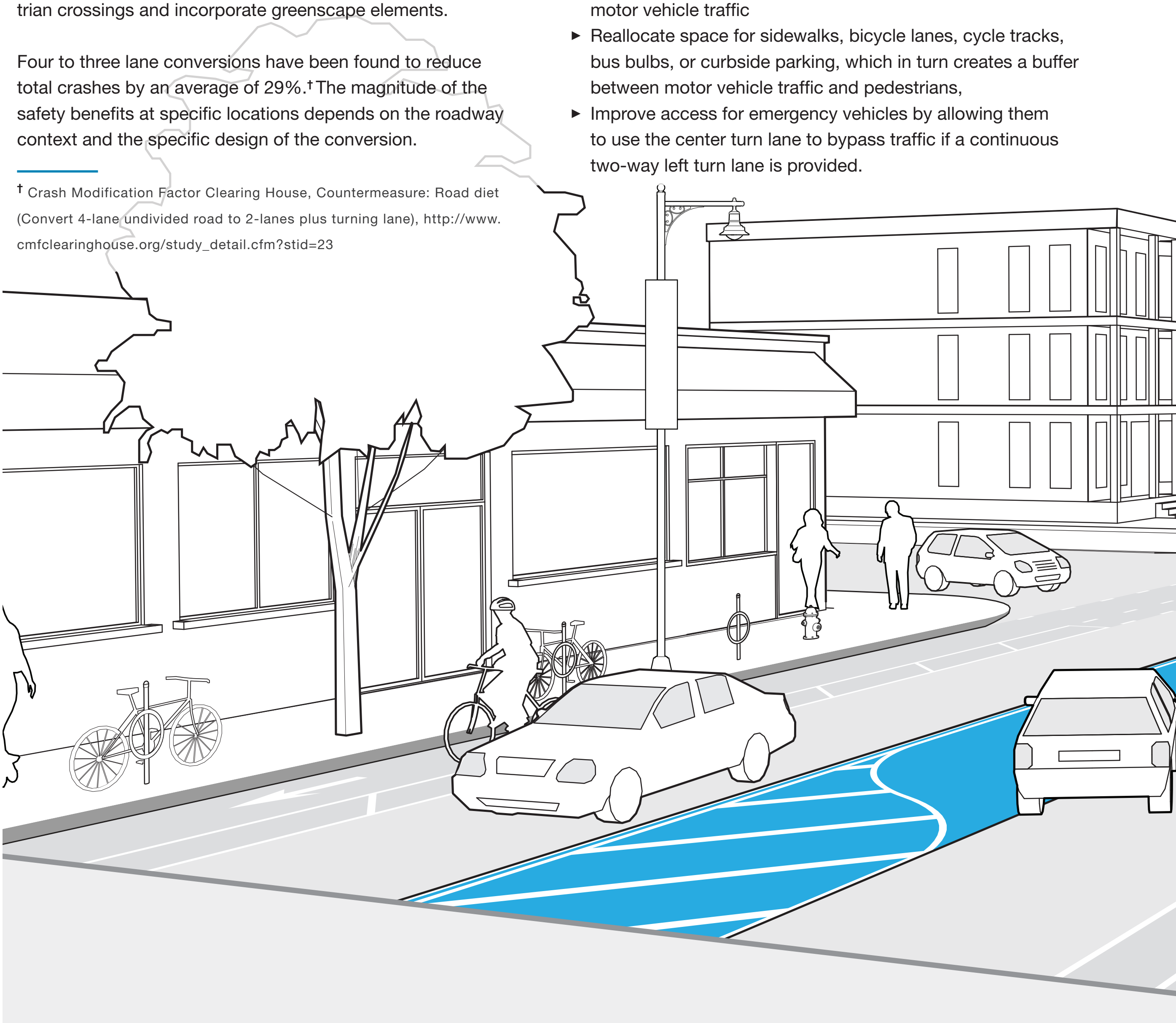
The most common road diet configuration involves converting a four lane road to three lanes: two travel lanes with a turn lane in the center of the roadway, often supplemented with painted, textured, or raised center islands 1. If considered during reconstruction, raised center islands may be incorporated in between intersections to provide improved pedestrian crossings and incorporate greenscape elements.

Four to three lane conversions have been found to reduce total crashes by an average of 29%.† The magnitude of the safety benefits at specific locations depends on the roadway context and the specific design of the conversion.

† Crash Modification Factor Clearing House, Countermeasure: Road diet (Convert 4-lane undivided road to 2-lanes plus turning lane), http://www.cmfclearinghouse.org/study_detail.cfm?stid=23

Roadway configurations with two travel lanes and a center turn lane can:

- Discourage speeding and weaving
- Reduce the potential for rear end and side swipe collisions
- Improve sight distances for left-turning vehicles
- Reduce pedestrian crossing distances and exposure to motor vehicle traffic
- Reallocate space for sidewalks, bicycle lanes, cycle tracks, bus bulbs, or curbside parking, which in turn creates a buffer between motor vehicle traffic and pedestrians,
- Improve access for emergency vehicles by allowing them to use the center turn lane to bypass traffic if a continuous two-way left turn lane is provided.

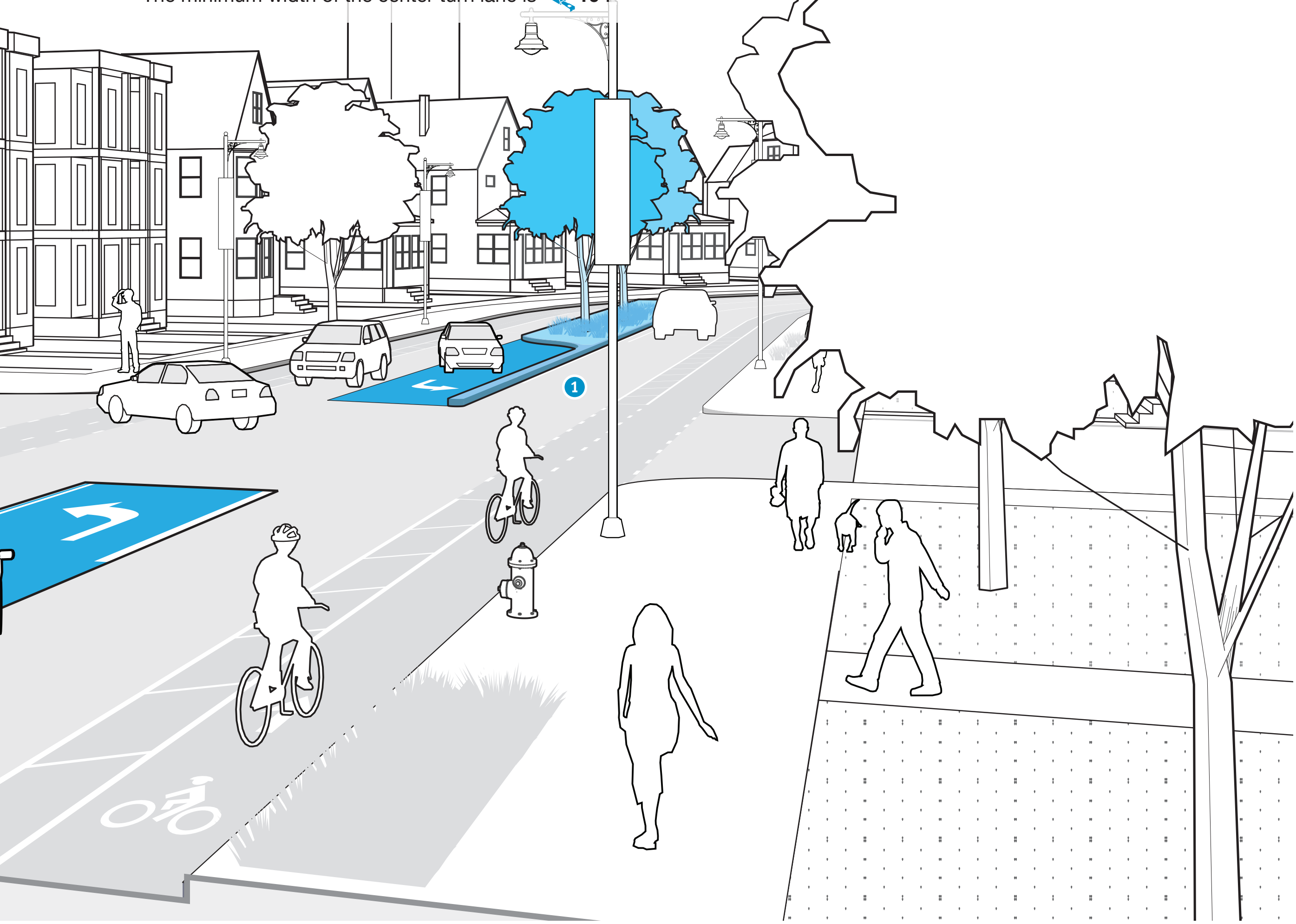


Use

- Four to three lane conversions should be considered for roadways with documented safety concerns, and along priority bicycle routes.
- Routes with volumes less than 15,000 average daily traffic (ADT) are generally good candidates for four to three lane conversions.
- Routes with volumes between 15,000 to 20,000 ADT may be good candidates for four to three lane conversions and should be evaluated for feasibility.
- Routes with volumes more than 20,000 ADT should be evaluated for feasibility and studied to ensure that traffic controls and access management are appropriate for larger volumes of vehicles.
- The minimum width of the center turn lane is **10'**.

Considerations

- Four to three lane conversions typically have minimal effects on the vehicular capacity of the roadway because left-turning vehicles are moved into a common two-way left turn lane.
- Four to three lane conversion designs may consider providing a continuous turn lane down the center of the roadway, called a two-way left turn lane.
- Consider documenting before-and-after studies of the conversion for safety and traffic flow improvements.



Peak Time Restricted Parking Lanes

Overview

Peak time restricted parking lanes are parking lanes that are converted to other uses during peak or rush hour times. The traditional application of this treatment involves converting parking lanes to general purpose travel lanes. However, peak time restricted parking lanes can also be converted to other purposes, including high-occupancy vehicle (HOV) lanes, bus lanes, and bicycle lanes.

Peak time restricted parking lanes can increase the capacity of the roadway for general purpose traffic. Depending on conditions, an additional travel lane can improve capacity by 600 to 1000 vehicles per hour. However, the capacity advantages of peak time restricted parking lanes for moving general purpose traffic assume universal compliance with the parking restriction; enforcement is required to deter illegally parked vehicles during peak hours.

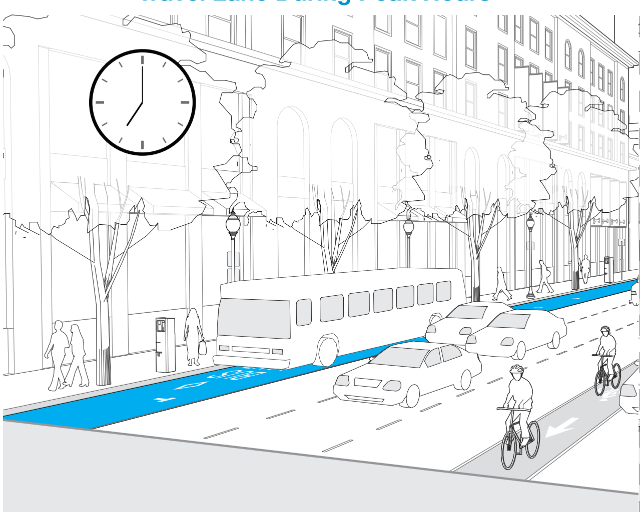
Use

- Peak time restricted parking lanes may be considered on roadways where additional capacity is needed during peak hours.
- The decision to install peak time restricted parking should be accompanied by a prompt and rigorous enforcement effort that involves ticketing and towing illegally parked vehicles.
- Peak hour restricted parking lanes should be a **minimum of 12' wide** to accommodate parked cars and bicycles in off-peak times. See the Minimum Lane Width Chart found earlier in this chapter for more information.
- Peak time restricted parking lanes are not compatible with curb extensions or neckdowns.

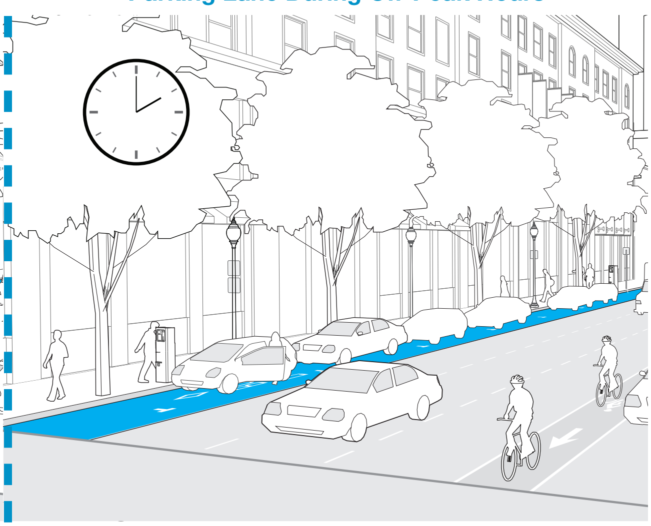
Considerations

- Converting parking lanes to general purpose travel lanes at peak times can make it difficult to install bicycles lanes due to safety concerns associated with having moving traffic on both sides of the bicycle lane. Potential solutions include off-street cycle tracks or shared travel lanes.
- In some situations, there may be benefits to removing peak time restricted parking lanes where they currently exist. The availability of parking during peak times may encourage motorists to visit roadside businesses. Also, parking improves pedestrian comfort and safety by providing a buffer between pedestrians and moving vehicles. Finally, full time parking spaces permit the installation of curb extensions for different purposes such as bus bulbs to improve transit efficiency.

Travel Lane During Peak Hours



Parking Lane During Off-Peak Hours



Routes with Frequent Heavy Vehicles

Overview

Many of Boston's busiest streets are also frequented by heavy vehicles, such as commercial vehicles, buses, and heavy trucks. Heavy vehicles have different performance characteristics than cars. For example, they require more space for turning and longer stopping distances. Therefore, it is important to ensure that roads frequented by heavy vehicles are designed to accommodate them safely alongside other roadway users.

Providing routes for heavy vehicles is essential to supporting Boston's economy. The transportation network should prioritize specific routes to accommodate freight, commercial vehicles, and transit vehicles.

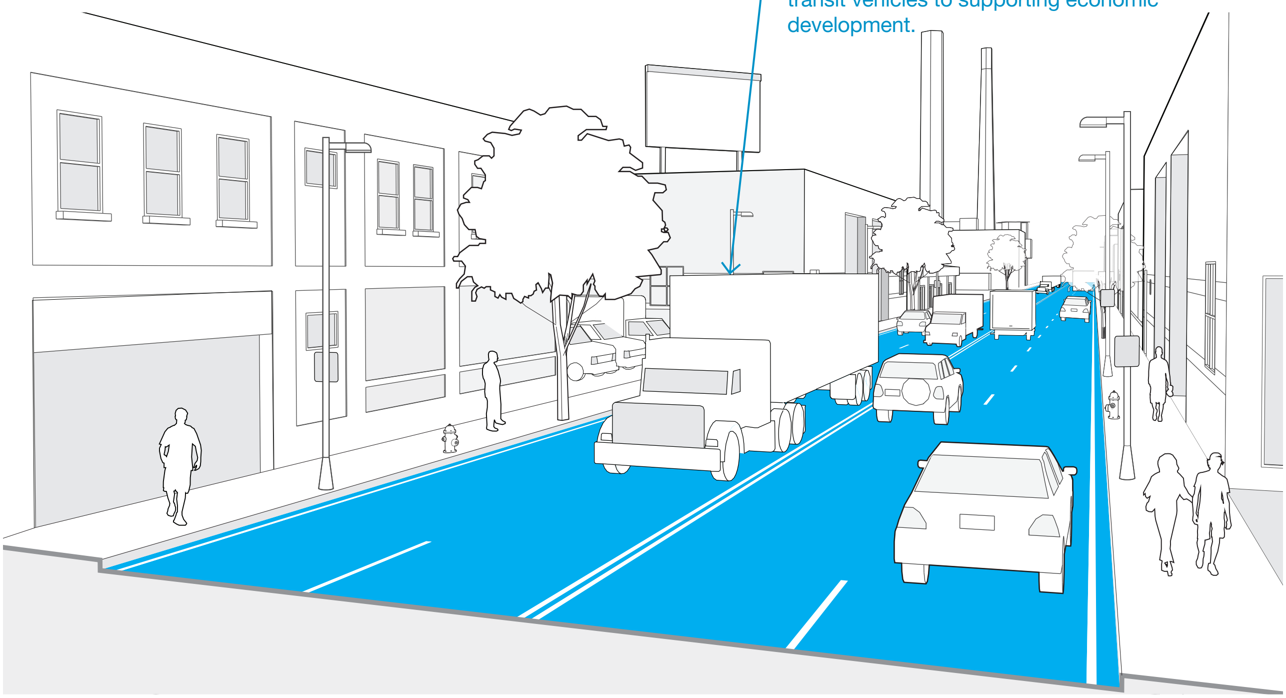
Use

- Roadways with more than 8% to 10% heavy vehicles should generally have **11'** outside lanes.
- Intersections with high volumes of large trucks, transit, and commercial vehicles should be designed to sufficiently accommodate turning radii and stacking space. For additional guidance on turning radii for heavy vehicles, refer to Chapter 4: Intersections, Corners and Curb Radii.
- Heavy vehicle braking characteristics should be considered when determining the placement of warning signs for intersections, curves, railroad crossings, mid-block pedestrian crossings, and shared use trail crossings.
- Separate cycle tracks or off-road paths should be provided on heavily used routes if insufficient space is available in the roadway to accommodate both heavy vehicles and bicyclists safely.
- Skid resistance and strength should be considered when choosing pavement surfaces for routes frequented by heavy vehicles. For routes with bus stops, consider installing concrete bus pads.

Considerations

- Flush medians or center turn lanes of sufficient width can help facilitate left-turn movements for heavy vehicles by providing a space to stop and wait for gaps.
- On sharply curving roads frequented by heavy vehicles, additional lane width may be necessary.

Boston's transportation network should prioritize specific routes to accommodate freight, commercial vehicles, and transit vehicles to supporting economic development.



Fire Department & EMS Accommodations

Overview

Roadway designs must consider the needs of emergency responders driving fire trucks and EMS vehicles. The goal of the Fire Department and EMS are to minimize response times to save lives—seconds can make the difference between life or death. The EMS department responds to an average of 300 emergencies per day and more than 100,000 per year, making Boston EMS one of the busiest services in the country. In fiscal year 2010, the Fire Department responded to over 70,000 incidents, and responded to 72% of all calls within 4 minutes.

Many of the treatments in these guidelines are designed to calm traffic and reclaim roadway space for a more equitable division of the public right-of-way. Pedestrian deaths and injuries significantly decrease as motor vehicle speeds decrease. Where speeding is of concern, traffic calming improves pedestrian and bicycle safety and access, reduces frequency and severity of vehicle crashes, adds parking lanes, and also provides opportunities to introduce greenscape elements to reduce stormwater runoff.

Designs with traffic calming features must be approved by PWD and BTD in consultation with the Boston Fire Department and EMS in order to minimize impacts to emergency response times.

Use

Listed below is the Code of Massachusetts Regulations (CMR) 527, which governs fire lanes in Massachusetts:

- Designation. The head of the fire department shall require and designate public or private fire lanes as deemed necessary for the efficient and effective use of fire apparatus. Fire lanes shall have a **minimum width of 18'.**
- Obstructions. Designated fire lanes shall be maintained free of obstructions and vehicles, and marked in an approved manner.
- Maintenance. All designated fire lane signs or markings shall be maintained in a clean and legible condition at all times and replaced when necessary to insure adequate visibility.

The City of Boston Fire Prevention Code states:

- Approved hard-surface, all-weather access fire lanes, **not less than 20' in width**, for use of Fire Department apparatus, shall be provided to **within 25'** of any building or other structure at the site.

New streets must be a **minimum of 18' to 20'**, and aim to improve connectivity; cul de sac developments are discouraged. Curb extensions at mid-block must not reduce the **overall street width to less than 14'.**

Parking within **20'** of intersections is prohibited in the City of Boston. Enforcement and design measures, including signage, pavement markings, and curb extensions should be considered to ensure intersections are free of parked motor vehicles.

Considerations

- Consider the maneuvering needs of fire trucks and emergency response vehicles. At corners, the design of curb radii must be balanced to accommodate fire trucks as well as pedestrians; see Chapter 4: Intersections, Corners and Curb Radii, for more information.
- The design of plazas and curb extensions must take into account the requirements for fire truck stabilization arms to provide ladder access to upper stories on buildings.

Reversible Lanes

Overview

Reversible lanes have been effectively used to manage congestion in numerous cities in the U.S., including Boston (Interstate 93). Reversible lanes allow one or more lanes on a roadway to switch the direction of travel at different times of day. Reversible lanes are intended to improve traffic flow and increase capacity during peak hours, roadway construction, planned special events, and for emergency management. Reversible lanes are typically found in tunnels, on bridges, and on highways.

There are generally two types of reversible lanes:
- The direction of the entire width of the road reverses (e.g., all lanes are one-way inbound in the morning, and outbound in the evening). This type of treatment is less common in the U.S.
- The road remains two-directional, however the direction of one or more lanes in the center reverse direction during rush hour. This is a more common type of reversible lane treatment in the U.S.

Reversible lane designs must be approved by BTD and PWD.

Use

Reversible lanes are appropriate for limited access freeways, longer bridges and parkways with heavy commuter volumes. Reversible lanes are not recommended for other Street Types as they are associated with increases in the number and severity of motor vehicle and pedestrian crashes on streets with frequent intersections and pedestrian activity. The reversible nature of the center of the street makes it impractical to provide either medians or left-turning lanes at intersections which results in higher speeds and sudden lane changes on the part of motorists, and long crossings with no median crossing island for pedestrians. The combination of higher speeds and unpredictable movements reduces safety for all modes.

Where appropriate, reversible lanes require signage, signalization, pavement markings, and/or physical separation to ensure drivers understand the operations of the roadway. All traffic control devices for reversible lanes must comply with the latest edition of the MUTCD. Changeable overhead lane-use control signals require constant monitoring and maintenance, since failure of a signal can have serious consequences in terms of driver safety.

Considerations

- Reversible lanes on parkways should be designed to ensure pedestrian and bicyclist safety and comfort at intersection crossings. At intersections where no pedestrian crossing island is possible, sufficient crossing time should be provided to ensure slower pedestrians can clear the intersection.
- Reversible lanes on freeways and bridges are often designed with movable barriers that separate opposing directions of traffic. This can be an important safety consideration, due to increased speeds and the potential for head-on crashes.
- In locations where the entire direction of the road reverses during certain hours of the day, entry and exit points must be carefully designed to guide vehicles towards the correct direction of travel. This sometimes requires the closure of certain entry and exit points where such movements can't be accommodated.
- Reversible lanes may not work well on roads with poor sight distances caused by hills and curves in the road.
- Reversible lane projects should undergo before and after studies to determine if they are achieving their purpose of easing congestion without increasing crashes.

Silver Spring, Maryland


BUS
LANE


SOUTH STATION


BUS
LANE


SILVER LINE DUDLEY
BUS
LANE


SL5 SILVER LINE

Transit Lanes

Efficient, cost-effective public transportation is essential for continued growth and quality of life in a dense, compact city like Boston. Compared with single occupancy vehicles, buses consume far less public space per passenger trip and can help relieve congestion, improve air quality, and reduce GHG emissions.

The Massachusetts Bay Transit Authority (MBTA) runs an extensive network of buses serving over 300,000 passengers and growing each day. Buses that travel in mixed traffic on congested streets are subject to delays. The City and MBTA are working together to make bus operations in Boston faster and more reliable. Setting aside street space for the exclusive use of transit vehicles is one way to improve efficiency in congested areas of the city.

Dedicated transit lanes (bus lanes and protected busways) make it possible to increase the frequency and reliability of bus service along a corridor and, where bus traffic is heavy, help reduce congestion in other travel lanes. When combined with signal priority strategies and bus stop improvements (shelters, seating, off-board fare collection, and real-time information displays), transit lanes can result in high quality, fast, comfortable, and cost effective public transportation.

While transit lanes are the preferred design, in constrained situations transit lanes may not be feasible, and enhancements such as bus bulbs, consolidation of bus stops, and queue jumps at intersections can be used to improve travel speeds by reducing boarding times and time spent at traffic lights.

These guidelines outline two basic types of transit lanes: **Bus Lanes**, which are demarcated with color but no physical separation, and **Busways**, which are physically separated from general traffic. Bus Stops and shelters are discussed in Chapter 2: Sidewalks. Designs for transit at intersections (i.e., queue jumping lanes, signals) are discussed in Chapter 4: Intersections.

General Design Considerations For Transit Lanes

- Improving the frequency, speed, comfort, and reliability of transit is critical to supporting growth and encouraging mode shift away from private automobile use.
- Transit lanes are well suited for arterial roads along corridors with high population densities, frequent headways (10 minute peak or less), a concentration of bus routes, and a concentration of major destinations.
- Curbside bus lanes are typically **11' wide.** They are less expensive and easier to install than median bus lanes or busways, but can be compromised by double parked vehicles, turning vehicles, and vehicles entering and exiting parking lanes. Effective enforcement is essential.
- Curbside bus lanes should always consider shared use with bicyclists when sufficient width is available; typically **13' to 15'** enable buses and bicyclists to pass one another. The **minimum width of shared bus/ bicycle lanes is 12'.**
- Combining bicycle use with physically protected busways typically is not feasible. These lanes are generally designed to carry buses at high speeds with few outlets. Separate bicycle facilities should be provided.

Transit lane designs must be approved by PWD, BTD, and the MBTA. For additional guidance for the design of Bus Rapid Transit (BRT), see the Institute for Transportation and Development Policy's Bus Rapid Transit Planning Guide.

Curbside Bus Lanes

Overview

Curbside bus lanes in the roadway are reserved primarily for buses and are distinguished by colored pavement, bus-only pavement markings, and signage 1. They are generally open to private vehicles at intersections as turning lanes. Where bus lanes are adjacent to curbside parking, vehicles can cross the bus lane to access parking but may not continuously travel in them. In general, bus lanes should operate as shared bus/bicycle lanes 2 where space permits.

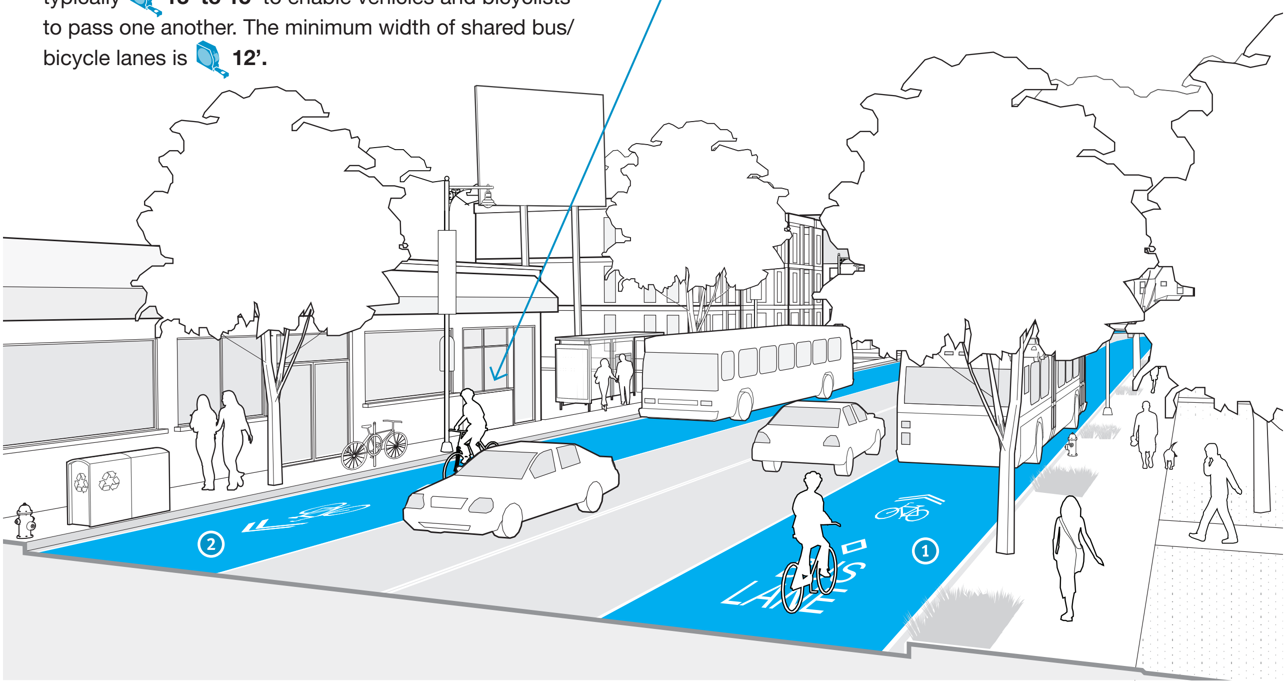
Use

- Curbside bus lanes provide fast, efficient service on one-way or two-way multi-lane streets where there is adequate width to accommodate them.
- Curbside bus lanes are placed on the right hand side of the road, adjacent to the curb or curbside parking. They work best in locations with no curbside parking.
- To deter encroachment by private vehicles, curbside bus lanes are marked with colored pavement and bus-only pavement markings.
- The minimum width of a bus lane is **11'.**
- Curbside bus lanes can be shared with bicyclists when sufficient width is provided for dual bicycle/transit use, typically **13' to 15'** to enable vehicles and bicyclists to pass one another. The minimum width of shared bus/bicycle lanes is **12'.**

Considerations

- Space for a curbside bus lane is typically created by removing a travel lane, parking lane, or median.
- Curbside parking adjacent to bus lanes should be avoided when feasible, as vehicles performing parking maneuvers in the bus lane will delay buses and decrease the efficiency of service.
- Measures to reduce conflicts with right-turning vehicles and opposing left-turning vehicles through signalization and signage should be considered.
- Curbside bus lanes can complicate access to adjacent commercial buildings particularly if parking is removed for installation.

Where space permits, curbside bus lanes should allow for shared bus/bicycle use. A minimum width of 12' is required for shared bus/bicycle lanes, but preferably 13' to 15' wide lanes should be provided to allow for passing.



Median Bus Lanes

Overview

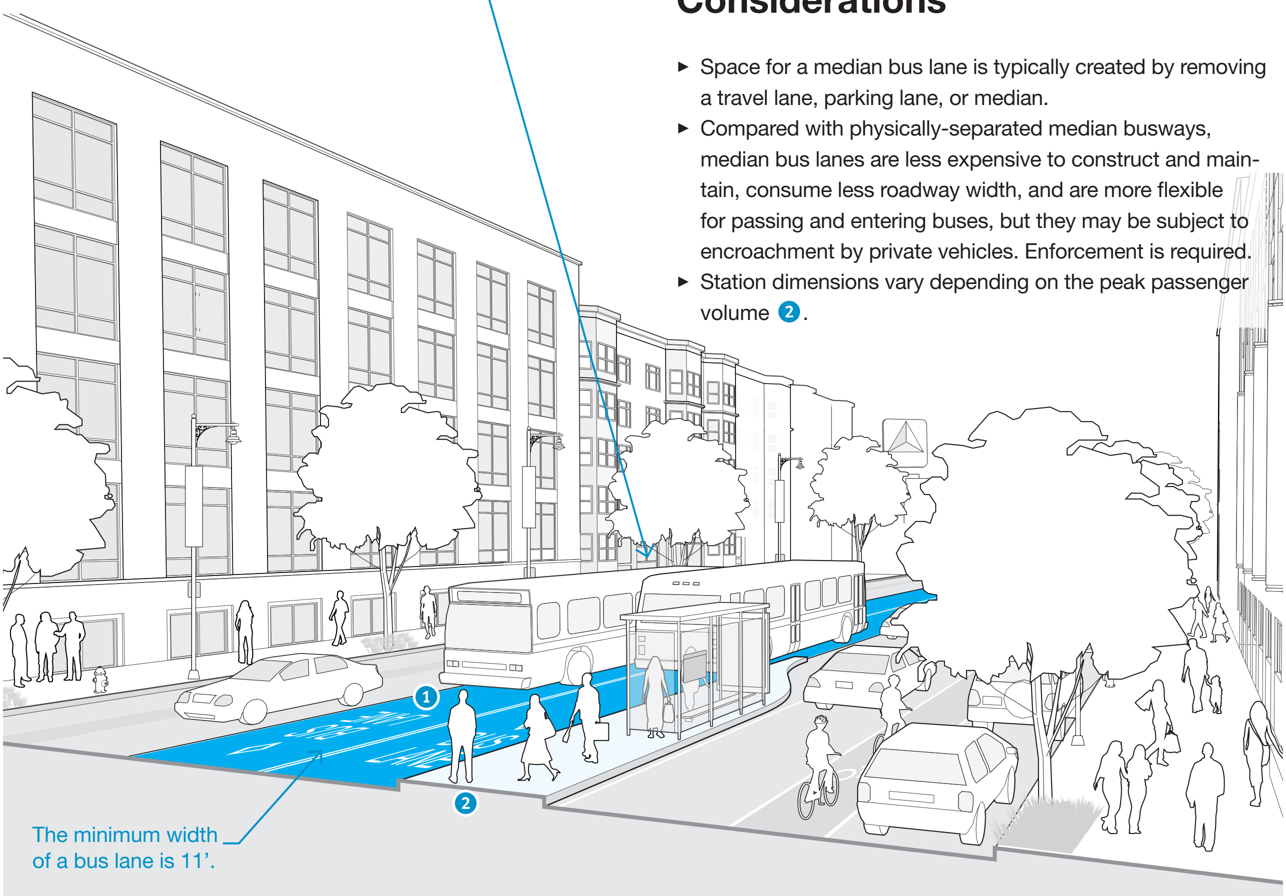
Median bus lanes run in the center of multi-lane streets with station stops located on center islands. Compared with curbside bus lanes, median bus lanes provide better service and have fewer conflicts with parking, stopping, and turning vehicles. However the cost is typically higher because of the need for island station stops. Generally stops are spaced farther apart than curbside bus stops. With fewer conflicts and more widely spaced stops, median bus lanes provide high quality service that approaches BRT. Also see Median Protected Busways later in this chapter for more information.

Use

- Median bus lanes provide fast, efficient, and reliable service on two-way, multi-lane streets with adequate width for bus lanes and stations. They are preferable to curbside bus lanes on streets with high-turnover parking and heavy right-turn volumes.
- Bus stops along median bus lanes are generally spaced further apart, (**1/3 to 1/2 mile**) than curbside bus stops (**1/5 to 1/4 mile**) to permit greater speeds and reduce trip times for buses. For more information on bus stop spacing distances, see Chapter 4: Intersections, Bus Stop Location.
- To deter encroachment by private vehicles, bus lanes are marked with colored pavement and bus-only pavement markings 1.
- The **minimum width of a bus lane is** **11'.**

Considerations

- Space for a median bus lane is typically created by removing a travel lane, parking lane, or median.
- Compared with physically-separated median busways, median bus lanes are less expensive to construct and maintain, consume less roadway width, and are more flexible for passing and entering buses, but they may be subject to encroachment by private vehicles. Enforcement is required.
- Station dimensions vary depending on the peak passenger volume 2.



Contra-Flow Bus Lanes

Overview

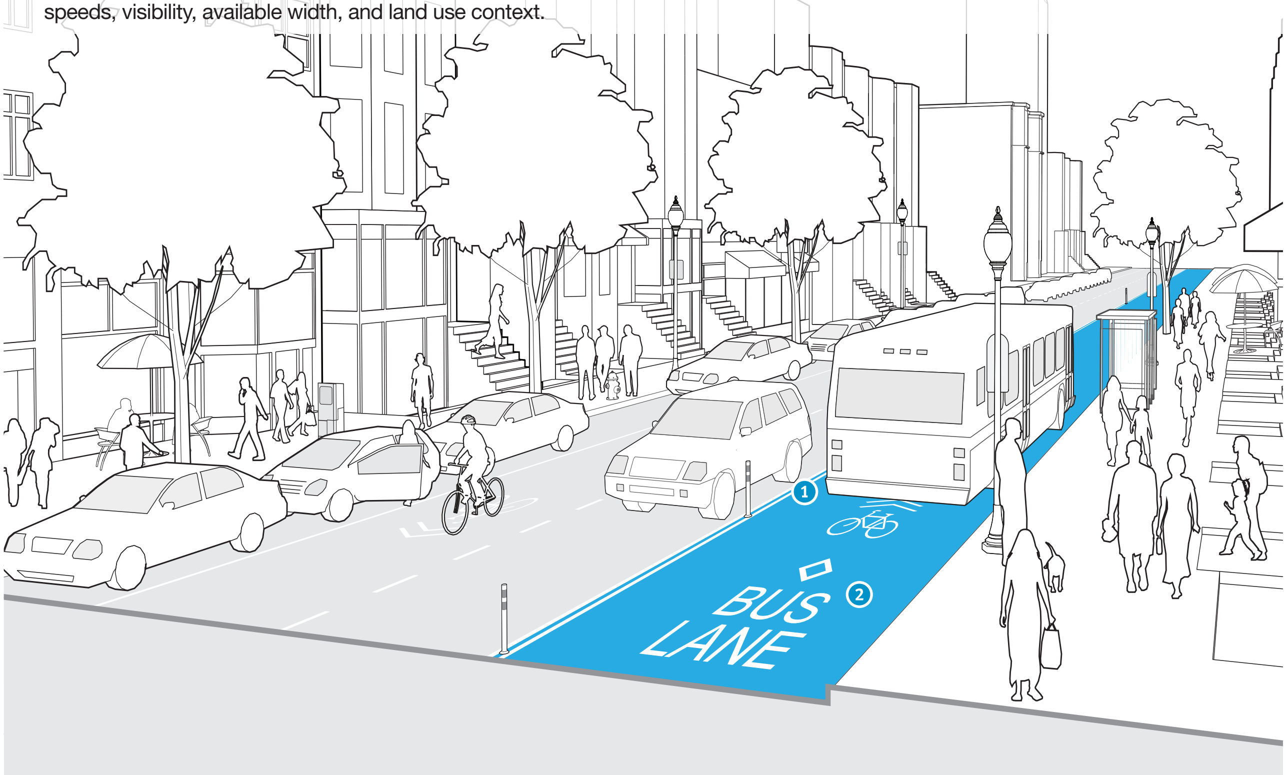
Contra-flow bus lanes run counter to the flow of general traffic on one-way streets, essentially rendering the street two-way (1). They are generally used on short segments of connector streets to provide a continuous transit network, such as the contra-flow bus lane on Washington Street in the South End. Because pedestrians, bicyclists, and drivers may be unaccustomed to looking both ways on these streets, contra-flow lanes should be well marked and separated from opposing traffic lanes.

Use

- Contra-flow bus lanes provide fast, efficient, and reliable service on streets that are one-way for general traffic with no parking on the contra-flow side.
- The **minimum width for a contra-flow bus lane is 11'**, and may require additional width for separation depending on the context of the roadway.
- Separation from opposing traffic can be achieved with double yellow lines supplemented by flexposts depending on traffic speeds, visibility, available width, and land use context.
- To deter encroachment by private vehicles, bus lanes are marked with colored pavement and bus-only pavement markings and flexposts where feasible (2).
- Arrow pavement markings are used to highlight the direction of travel.

Considerations

- Space for a contra-flow bus lane is typically created by removing a travel lane, parking lane, or median.
- Contra-flow bus lanes are less likely to be encroached on by private vehicles than other bus lanes, as offenders would be trapped and easily apprehended.
- Signal progression should take into consideration bus headways riding against regular traffic flow.
- Measurements to reduce conflicts with opposing left turning vehicles through signalization and signage should be considered.
- Contra-flow bus lanes may require modifications be made to existing signal timing.



Median Protected Busways

Overview

Median protected busways are transit lanes in the center of multi-lane streets that are separated from general traffic by means of a physical barrier (1). Only transit and emergency vehicles are permitted in these lanes. Combined with comfortable stations and off-board fare collection, median protected busways can form the framework of a BRT system. They can also serve as a precursor to light rail.

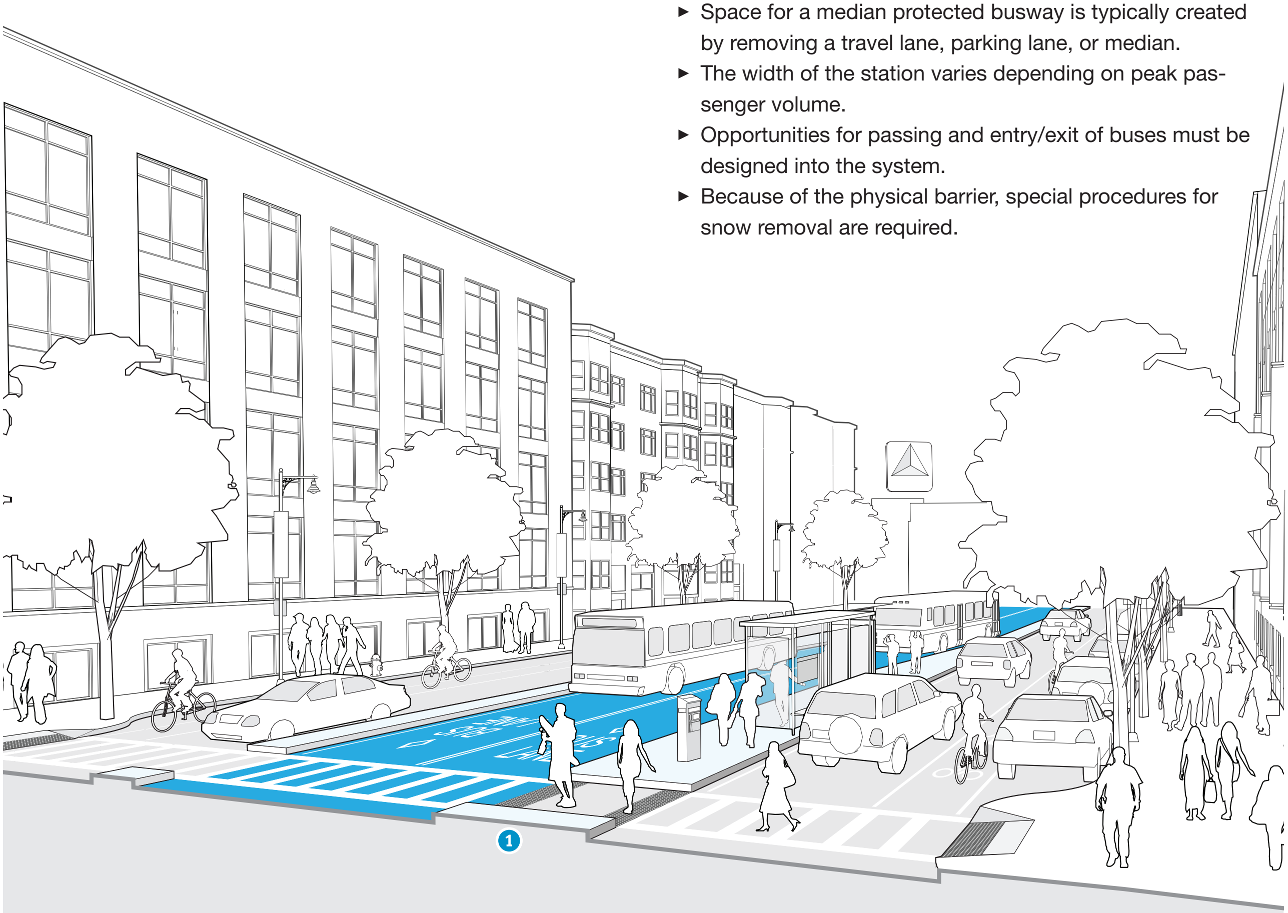
Median protected busways are less flexible than median bus lanes as they do not generally allow passing and buses can only enter and exit at specific locations. They are also more expensive to construct and maintain than median bus lanes; however, they allow for more consistent speeds and require less enforcement.

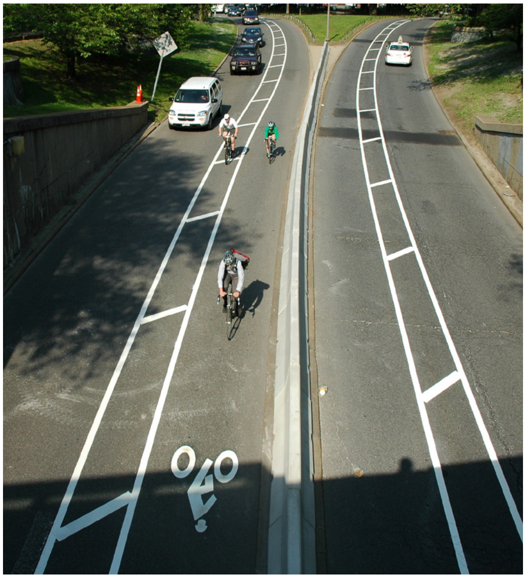
Use

- Median protected busways provide fast, efficient, and reliable service on multi-lane streets with adequate width for the lane, barrier, and stations.
- Separation from general traffic is achieved by means of a curb, island, fence, or other well-defined structural feature.
- Bus stations on median protected busways are generally spaced further apart (**1/3 to 1/2 mile**) than curbside bus stops (**1/5 to 1/4 mile**) to permit greater speeds and to reduce trip times for buses. For more information on bus stop spacing distances, see Chapter 4: Intersections, Bus Stop Location.
- The **minimum width for a busway is 11' for the bus lane plus 1' shy distance** from the median barrier.

Considerations

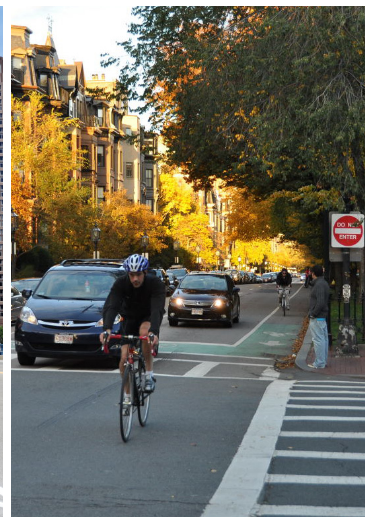
- Space for a median protected busway is typically created by removing a travel lane, parking lane, or median.
- The width of the station varies depending on peak passenger volume.
- Opportunities for passing and entry/exit of buses must be designed into the system.
- Because of the physical barrier, special procedures for snow removal are required.






Centre Street Cafe
George's Shoes


39 VIA COPLEY SQ



Bicycle Facilities

Since Mayor Menino launched Boston Bikes in 2007, Boston has made considerable progress in becoming a bicycle friendly city, incorporating bicycling into transportation projects, retrofitting existing streets with new bicycle lanes, and establishing new programs that support and encourage bicycling. Ridership in the City has more than doubled, increasing 122% from 2007 to 2009. To date, more than 50 miles of on-road bicycle facilities and 1,500 bicycle parking spaces have been installed, with more facilities to be installed in the upcoming years.

These guidelines outline two basic types of cross sections: exclusive facilities where roadway space is designated for bicycle use, and shared facilities where bicycles and other vehicles share roadway space. Like pedestrians, bicyclists are vulnerable road users and can be seriously injured in a minor collision. For many people, bicycling in close proximity to fast moving traffic can be uncomfortable. On streets without bicycle facilities, the competition for space can result in unsafe behavior by both motorists and bicyclists. In addition, the lack of on- or off-street bicycle accommodations can increase the number of bicyclists riding on the sidewalk, conflicting with pedestrian traffic. Well-designed bicycle facilities reduce conflicts and help facilitate predictable movements.

Exclusive bicycle facilities are the preferred facility type in Boston; however, in general, exclusive facilities are not appropriate on Neighborhood Residential and Shared Streets where traffic conditions support bicycling without needing separation, and neighborway treatments should be considered. See Neighborways found earlier in this chapter for more information. On streets where an exclusive facility is not feasible, the appropriate shared facility design should be determined by an engineer and approved by BTD.

Guidance on intersection treatments for bicycles is provided in Chapter 4: Intersections, Bicycle Accommodations at Intersections. Bicycle parking is covered in Chapter 2: Sidewalks, Bicycle Parking and Bicycle Racks.

General Design Considerations for Bicycle Facilities

- Road diets, lane diets, and the consolidation or removal of on-street parking should be considered in order to provide adequate space for bicycle facilities. More guidance on optimizing street capacity and Boston's minimum lane widths is provided earlier in this chapter.
- While Massachusetts State Law maintains it is illegal for motorists to open car doors into oncoming traffic until it is safe to do so without interfering with other traffic, including bicyclists and pedestrians, the potential hazard of opening car doors should still be considered when developing appropriate designs for bicycle facilities. Design options on the following pages have been provided to help reduce conflicts between bicycles and the opening of car doors.
- Colored pavement should be considered to increase awareness of bicycle facilities at:
  - Curbside locations where there are conflicts with parking or stopping in the bicycle lane
  - The beginning of the block for a short distance to highlight a bicycle lane
  - Intersections to increase awareness of conflicts areas and increase visibility
- Roadways should be designed to provide the most direct and appropriate bicycle route, and minimize convoluted or out-of-the-way routing. Where roadway widths change along the length of the street, designs should aim to provide continuous facility types to the maximum extent feasible.
- Bicyclists are more vulnerable to broken or uneven pavement, drainage structures, and utility access covers, which can cause a loss of balance or swerving. Drainage inlets should be safe for bicycle wheels. Where possible, the installation of bicycling facilities should be coupled with an evaluation of pavement conditions and improvements to ensure smooth riding surfaces.
- Angled parking adjacent to on-street bicycle facilities should require reverse-angle parking to increase visibility of bicyclists when exiting spaces.

Bicycle facility designs must be approved by BTD, PWD, and Boston Bikes. Additional guidance for the design of bicycle facilities can be found in the MUTCD, the NACTO Urban Street and Bikeway Design Guides, and the AASHTO "Bike Guide."

Cycle Tracks

Overview

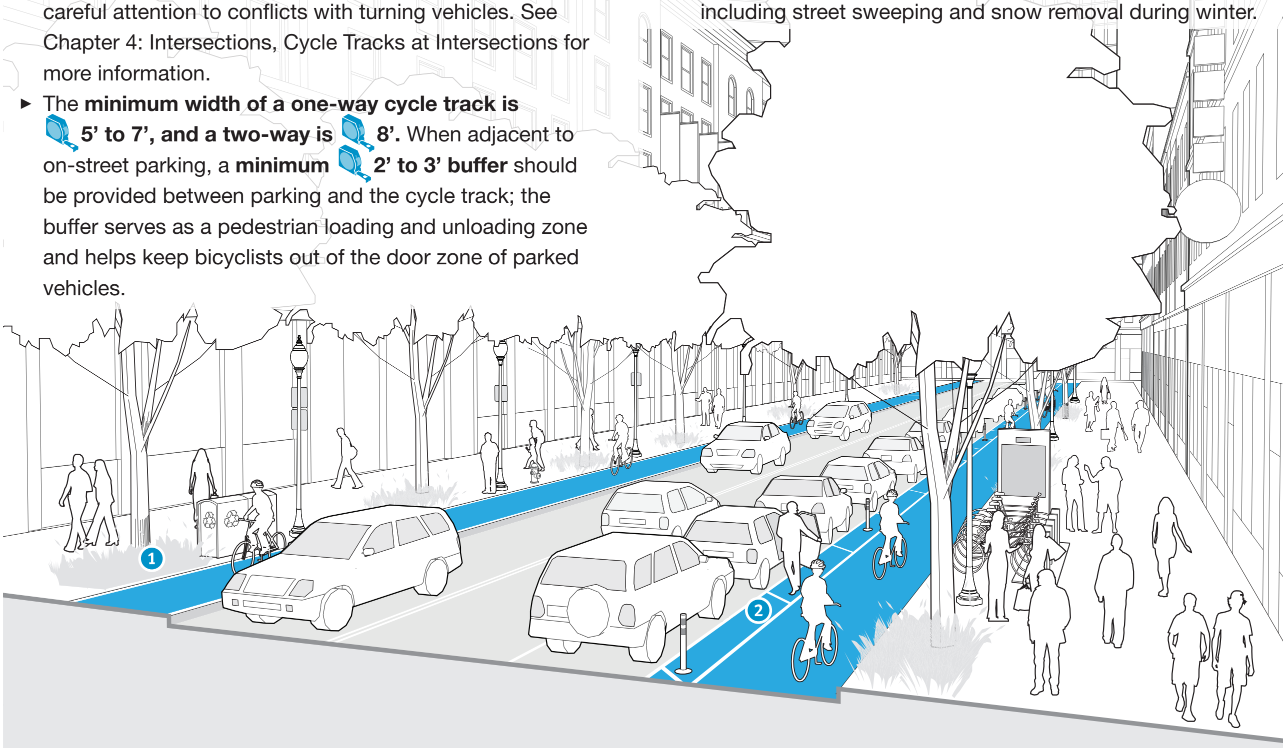
Cycle tracks are bicycle facilities physically separated from adjacent travel lanes. They can be designed at the same level of the sidewalk separate from pedestrian travel (1), or on the roadway separated through the use of a raised median or on-street parking (2). Cycle tracks are for the exclusive use of bicyclists and provide added separation that enhances the experience of bicycling on urban streets. Cycle tracks can either be one-directional or two-directional, and can be provided on both sides of two-way streets or on one side of one-way streets.

Use

- Cycle tracks are typically installed on streets with higher traffic volumes and/or speeds, with long blocks and therefore fewer intersections.
- Cycle tracks can be useful on streets that provide connections to off-street trails, since bicyclists on these streets may be more accustomed to riding in an area separated from traffic.
- Intersection design for cycle tracks is complex and requires careful attention to conflicts with turning vehicles. See Chapter 4: Intersections, Cycle Tracks at Intersections for more information.
- The **minimum width of a one-way cycle track is 5' to 7', and a two-way is 8'.** When adjacent to on-street parking, a **minimum 2' to 3' buffer** should be provided between parking and the cycle track; the buffer serves as a pedestrian loading and unloading zone and helps keep bicyclists out of the door zone of parked vehicles.

Considerations

- Cycle tracks should be designed to allow bicyclists to pass one another.
- Cycle tracks require increased parking restrictions compared to bicycle lanes to provide for visibility at intersection transitions.
- Vertical curb separation should be considered where on-street parking is not present. Snow clearance will need to be considered with this option. Parking protected cycle tracks may be combined with islands at corners and crossings.
- When a cycle track is provided on the same side of the road as transit operations, transit stops and waiting areas should be provided between the cycle track and the roadway to reduce conflicts between pedestrians loading and unloading, and bicyclists.
- On streets with high volumes of pedestrians and constrained sidewalks, cycle tracks may not be appropriate due to the strong likelihood that pedestrians will use the cycle track as an extension of the sidewalk.
- The presence of drainage and utility structures along the curb may reduce the effective width of the cycle track.
- Maintenance should be considered during all seasons, including street sweeping and snow removal during winter.



Bicycle Lanes

Overview

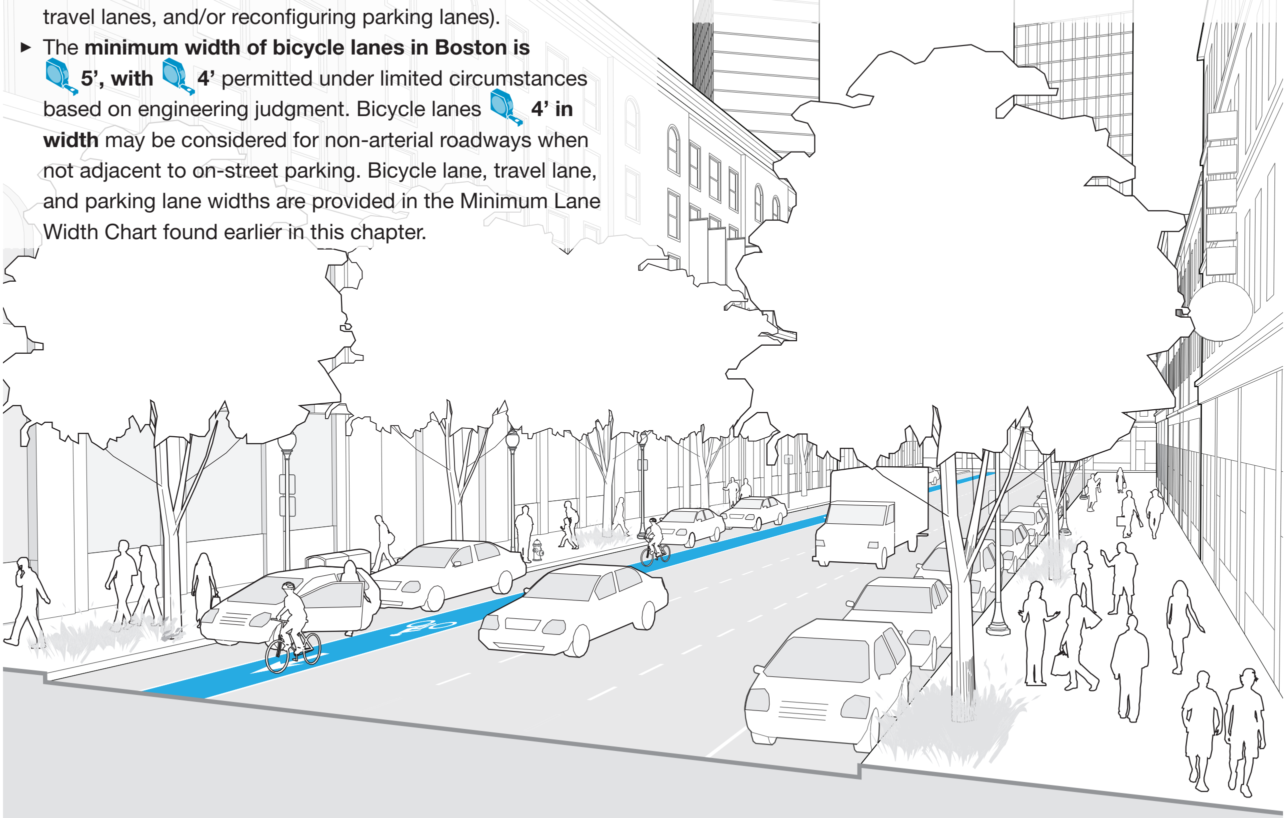
Bicycle lanes provide an exclusive space for bicyclists through the use of lines and symbols on the roadway surface. Bicycle lanes are for one-way travel and are normally provided in both directions on two-way streets and/or on one side of a one-way street. Bicyclists are not required to remain in a bicycle lane when traveling on a street, and may leave the bicycle lane as necessary to make turns, pass other bicyclists, or to properly position themselves for other necessary movements. Bicycle lanes may only be used temporarily by vehicles accessing parking spaces and entering and exiting driveways and alleys.

Use

- Bicycle lanes can be used on one-way or two-way streets, and on single or multi-lane roads.
- Bicycle lanes may be placed adjacent to a parking lane or against the curb if there is no parking.
- Bicycle lanes are typically installed by reallocating existing street space (i.e., narrowing other travel lanes, removing travel lanes, and/or reconfiguring parking lanes).
- The **minimum width of bicycle lanes in Boston is 5', with 4'** permitted under limited circumstances based on engineering judgment. Bicycle lanes **4' in width** may be considered for non-arterial roadways when not adjacent to on-street parking. Bicycle lane, travel lane, and parking lane widths are provided in the Minimum Lane Width Chart found earlier in this chapter.

Considerations

- When deciding which side of the roadway to place bicycle lanes, consider parking configurations and turnover, the presence of medians, the continuity of the facility, and the configuration and complexity of turning movements at intersections. Left-side bicycle lanes are discussed on the next page.
- Wider bicycle lanes (**6' to 7'**) enable bicyclists to pass one another on heavily traveled corridors and increase separation from faster traffic.
- Where additional space is available, consider providing a buffered bicycle lane, discussed later in this section.
- On constrained corridors with high parking turnover, consider designing pavement markings to guide bicyclists outside of the door zone of parked vehicles. Treatments include installing a buffer on the parking side of the bicycle lane, door zone, hatch marks, or using parking T's instead of a longitudinal parking line.
- Consider using colored pavements to highlight areas where conflicts might occur, such as at intersection and driveway crossings.



Left-Side Bicycle Lanes

Overview

In some locations, bicycle lanes placed on the left-side of the roadway can result in fewer conflicts between bicyclists and motor vehicles, particularly on streets with heavy right-turn volumes, or frequent bus headways where buses commonly operate in the right-side curb lane. Left-side bicycle lanes can increase visibility between motorists and bicyclists at intersections due to the location of the rider on the left-side of the vehicle.

Use

- On one-way streets where parking is only provided on the right-hand side, left-side bicycle lanes are often a better option than right-side bicycle lanes because there are fewer conflicts with parked cars. The same is true for two-way streets with continuous, raised center medians where on-street parking is not provided adjacent to the median.
- Left-side bicycle lanes have the same design requirements as right-side bicycle lanes.

Considerations

- On one-way streets with parking on both sides, bicyclists riding on the left will have fewer conflicts with car doors opening on the passenger side.
- Colored pavement should be considered in curbside locations to increase awareness of the restriction against parking or stopping in the bicycle lane.
- Left-side placement may not be appropriate in locations where the street switches from one-way to two-way operation.
- Left-side bicycle lanes may not be appropriate near the center or left-side of free flow ramps, or along medians with street car operations, unless appropriate physical separation can be provided including signal protection where appropriate. See Chapter 4: Intersections, Bicycle Lanes at Intersections for more information.

Buffered Bicycle Lanes

Overview

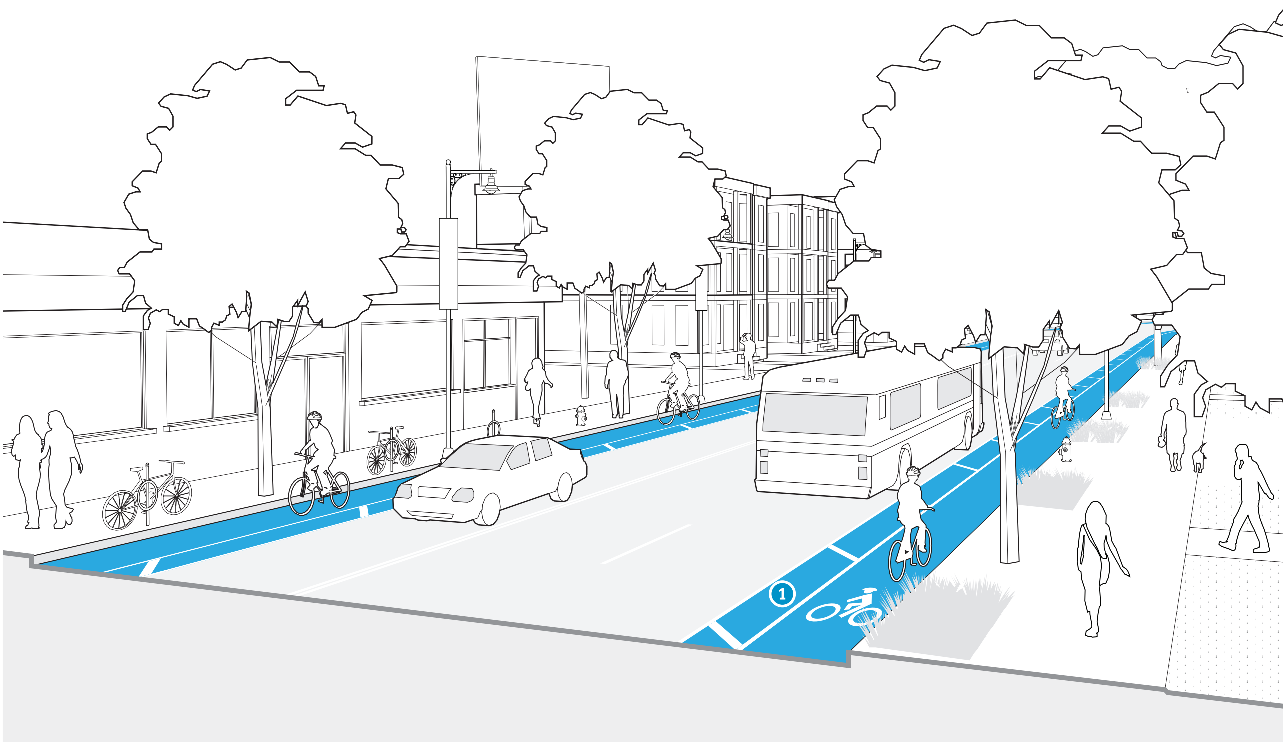
Buffered bicycle lanes are created by painting a flush buffer zone between a bicycle lane and the adjacent travel lane. While buffers are typically used between bicycle lanes and motor vehicle travel lanes to increase bicyclists' comfort, they can also be provided between bicycle lanes and parking lanes in locations with high parking turnover to discourage bicyclists from riding too close to parked vehicles.

Use

- The recommended **minimum width of a buffer is 3'**; however width may vary depending upon the available space and need for separation. Buffers should be painted with solid white lines and channelization markings 1.
- Buffers can be useful on multi-lane streets with higher speeds, but are not required in these locations.

Considerations

- Where only one buffer can be installed on a constrained corridor with on-street parking, the buffer should typically be placed between the bicycle lane and parking lane, depending upon roadway speeds and parking turnover.



Contra-Flow Bicycle Lanes

Overview

The current pattern of street directions in Boston (i.e., two-way or one-way in one of two directions) has been developed primarily to facilitate efficient movement of automobile traffic and has led to significant number of one-way streets. This, combined with the organic, non-grid nature of much of the city's layout, often make bicycling to specific destinations within short distances difficult.

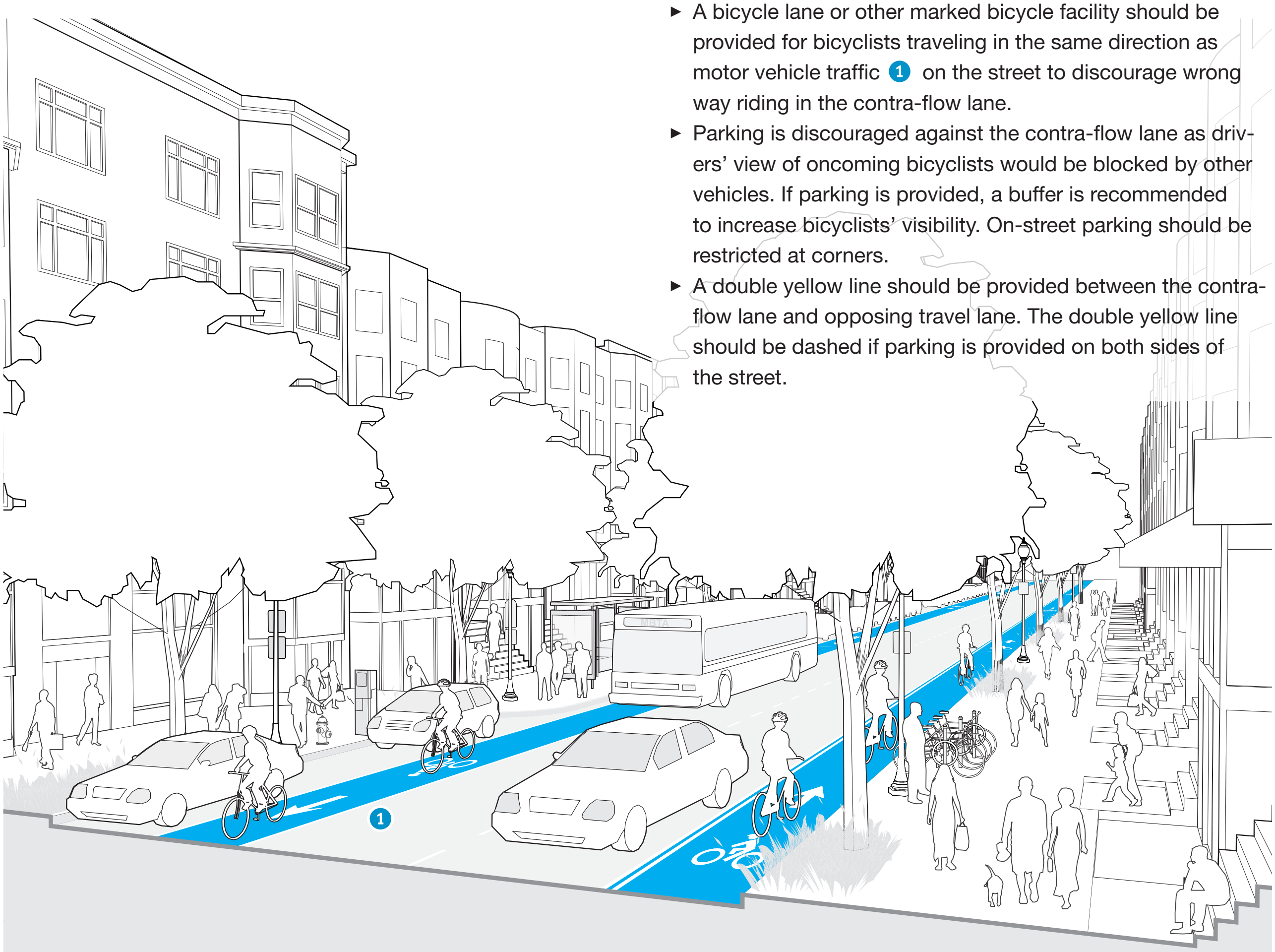
A contra-flow bicycle lane can help to solve this problem, by enabling only bicyclists to operate in two directions on one-way streets. Contra-flow lanes are useful to reduce distances bicyclists must travel and can make bicycling safer by creating facilities to help other roadways users understand where to expect bicyclists.

Use

- Contra-flow bicycle lanes are used on one-way streets that provide more convenient connections for bicyclists where other alternative routes are less desirable or inconvenient.
- Contra-flow lanes are less desirable on streets with frequent and/or high-volume driveways or alley entrances on the side with the proposed contra-flow lane.
- Care should be taken in the design of contra-flow lane termini. Bicyclists should be directed to the proper location on the receiving roadway.

Considerations

- Observations of wrong way riding may indicate the need to consider a contra-flow lane.
- A bicycle lane or other marked bicycle facility should be provided for bicyclists traveling in the same direction as motor vehicle traffic (1) on the street to discourage wrong way riding in the contra-flow lane.
- Parking is discouraged against the contra-flow lane as drivers' view of oncoming bicyclists would be blocked by other vehicles. If parking is provided, a buffer is recommended to increase bicyclists' visibility. On-street parking should be restricted at corners.
- A double yellow line should be provided between the contra-flow lane and opposing travel lane. The double yellow line should be dashed if parking is provided on both sides of the street.



Climbing Lanes

Overview

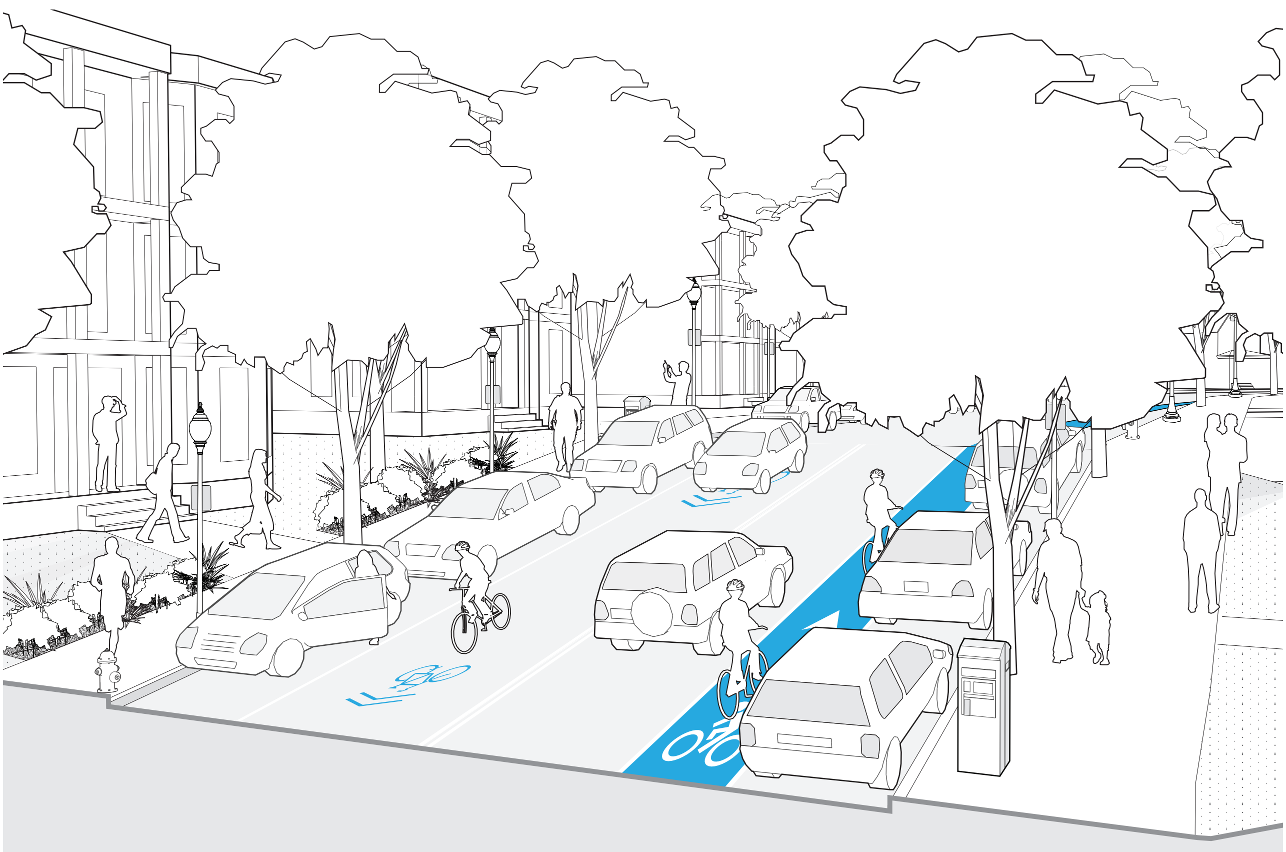
On roadways with steep and/or sustained grades where there is not enough space to install **standard 5' wide bicycle lanes** on both sides of the street, climbing lanes are provided on the uphill side of roadway while shared lane markings are provided in the downhill direction. Bicyclists traveling in an uphill direction move at significantly slower speeds than adjacent traffic, and therefore benefit from the presence of a bicycle lane. When travelling downhill, bicyclists gain momentum and can travel at similar speeds as motor vehicles; therefore, shared lane markings are provided in the downhill direction.

Use

- Climbing lanes should be used in the uphill direction on roadways with steep grades to provide a dedicated space for bicyclists.
- Climbing lanes have the same **minimum width as standard bicycle lanes, 5'.**

Considerations

- In general, designs should aim to provide bicycle lanes on both sides of the street where space permits. Wider outside travel lanes with shared lane markings should be provided if standard bicycle lanes do not fit within the provided right-of-way.
- If on-street parking is provided in the downhill direction, it is particularly important to ensure that bicyclists are directed to ride in a location outside of the door zone.



Marked Shared Lanes

Overview

Where it is not feasible or appropriate, dependent upon the Street Type and surrounding context of the roadway, to provide separate bicycle facilities such as lanes or cycle tracks, bicyclists, motorists, and transit vehicles share travel lanes. Marked shared lanes are indicated by specific bicycle symbols called shared lane markings (1) or "sharrows."

Shared lane markings help direct bicyclists to ride in the most appropriate location on the roadway, provide motorists visual cues of where to expect bicyclists, and help encourage safer passing behaviors. They may also be used in multiple lanes for positioning bicyclists for turning movements.

Use

Marked shared lanes are typically provided on streets where space constraints make it impossible to provide bicycle lanes. Shared lane markings should not be used on streets with speed limits higher than 35 mph, or on streets where speeds and volumes are low enough that it is desired for bicyclists to ride in traffic. For detailed dimensions on placement of shared lane markings, see the latest edition of the MUTCD.

- On narrow travel lanes adjacent to on-street parking, shared lane markings should be placed in a location that is outside of the door zone (2) of parked vehicles.
- Shared lane markings should be supplemented by **SHARE THE ROAD** signs, and **MAY USE FULL LANE** signs where appropriate.

Considerations

- Marked shared lanes should be provided after considering narrowing or removing travel lanes, parking lanes, and medians as necessary to provide an exclusive bicycle facility.
- Shared lane markings may be placed on both sides of the road where there are multiple routes along a corridor.
- For multi-lane applications, shared lane markings should generally be provided in the outside travel lane, but symbols can be marked in multiple lanes to indicate travel patterns by bicyclists. Shared lane markings may be supplemented by additional treatments; see the following section, Priority Shared Lanes, for more information.
- Shared lanes can be used to complete connections between bicycle lanes and other facilities.

Priority Shared Lanes

Overview

On multi-lane streets, marked shared lane symbols, or "sharrows," can be enhanced with dashed longitudinal lines and colored pavements (1). This marked lane within the lane can reduce conflicts by encouraging (though not requiring) vehicles to use inside lanes and reserve the outside lane for bicyclists. On streets with narrow travel lanes, priority shared lanes direct the bicyclist to the correct and most conspicuous position on the road—the middle of the travel lane.

Use

- Priority shared lanes are appropriate on multi-lane one-way and two-way streets with higher traffic volumes and speeds, where roadway space is not available for separate bicycle facilities.
- Shared lane markings should be supplemented by **SHARE THE ROAD** signs, and **BICYCLE MAY USE FULL LANE** signs where appropriate.

Considerations

- Priority shared lanes should be provided after considering narrowing or removing travel lanes, parking lanes, or medians as necessary to provide an exclusive facility.
- Dashed longitudinal lines and/or colorized pavement may be provided along the length of the corridor, or be location specific.
- The City of Boston is currently conducting an FHWA approved experiment along Brighton Avenue for design variations in dashing styles, colored pavements, and signage for priority shared lanes.