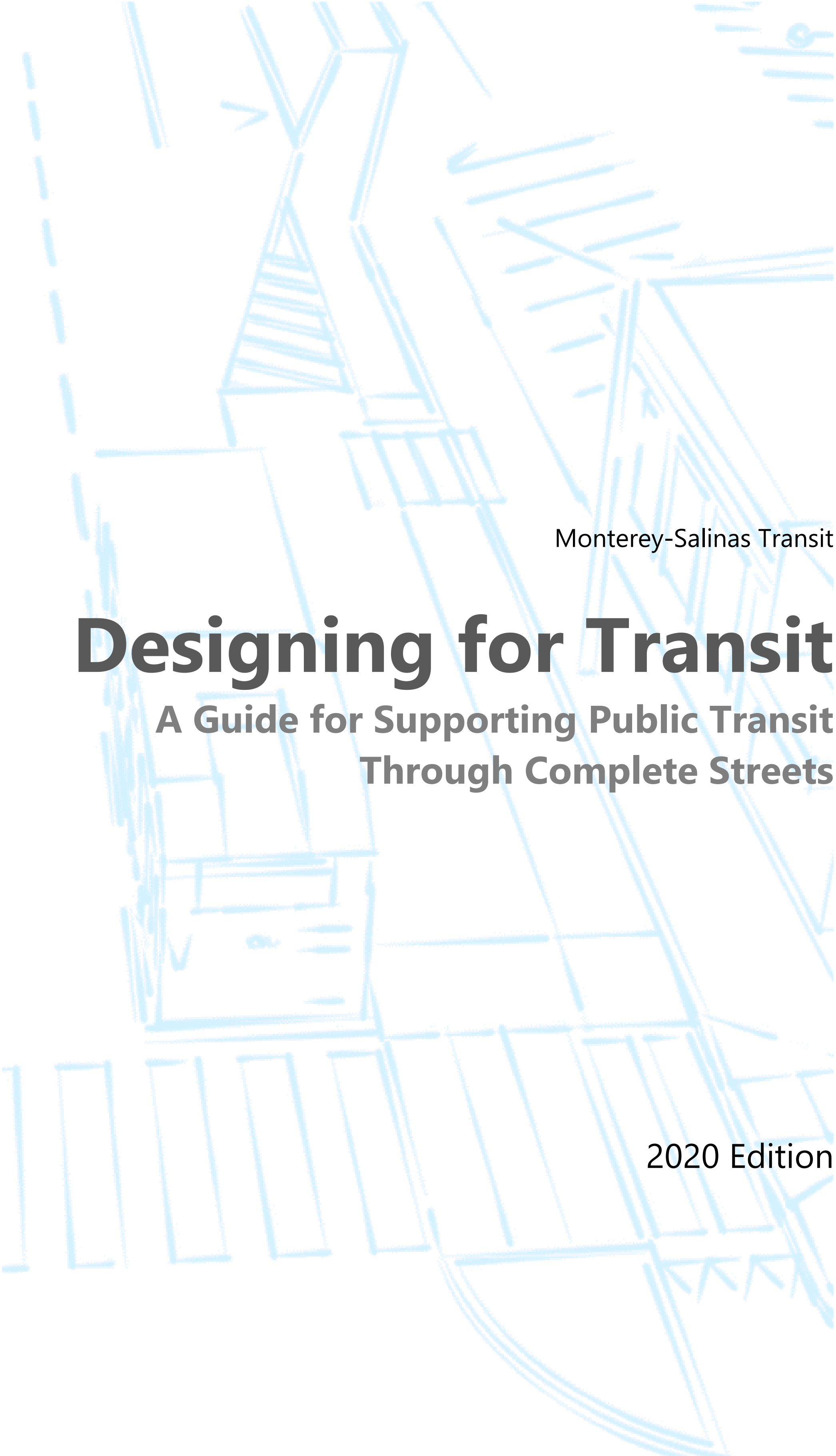

Monterey-Salinas Transit

Designing for Transit

A Guide for Supporting Public Transit Through Complete Streets

2020 Edition

Acknowledgments

Monterey-Salinas Transit

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Table of Contents

INTRODUCTION

Designing for Transit is a guide for developers, planners, city or other public agency staff, and transit agency staff to meet complete street objectives (providing safe access for everyone using the street including bus riders, pedestrians, drivers, and bicyclists) while providing the best possible experience for bus riders, bus drivers and others around bus stops and along bus routes. Well-designed and thoughtfully located bus stops are a key component of a high-quality transportation system. With the guidance provided in this manual and coordination with Monterey-Salinas Transit (MST) staff, we can collectively improve the quality, efficiency, customer experience, and safety of our transit system

As much as possible, this guide is written for anyone to use and understand. It provides a high-level overview of bus stop planning and design considerations, as well as integrating transit service on streets. The guide may not always provide an exact answer for questions like "What do I need to build in front of my development?" Every stop and street is unique and will require context-appropriate solutions. Any proposed developments, alterations, or renovations that could affect transit service should be conducted both by consulting this guide and coordinating with MST staff.

The guide first addresses bus stops, which are the most fundamental infrastructure element of transit service. The bus stops section covers the minimum required dimensions for a bus to stop and for the sidewalk and curb space at the bus stop to provide Americans with Disabilities Act (ADA)-compliant access to the bus. Next, the guide addresses where and how bus stops interact with the street network to inform where around an intersection to place a stop, or what choices to make when placing a stop away from an intersection (including in suburban and rural areas). This section also addresses minimum street dimensions for accommodating buses and providing other transit-supportive or priority treatments along roadways. The following chapter addresses access between bus stops and the places people want to go, for pedestrians, including people with disabilities, and bicyclists. Each section is simple to read with diagrams and illustrations, and minimal text or jargon. Besides minimum required dimensions, technical specifications and details are generally limited to the reference section at the end of the document.

We look forward to working together to develop a world-class transportation system!

USING THIS GUIDE

The guide is organized by the idea that the most common work on transit infrastructure is the bus stop – a clearly defined place where a transit vehicle stops to pick up (board) or drop off (alight) passengers. Next, bus stops must be placed somewhere along a street, typically near an intersection although sometimes between intersections or along a long stretch of road without any controlled intersections. Stops are sometimes placed off-street either in a special transit facility or occasionally on private property (such as a shopping center). Finally, people need to access these stops to safely board or alight the bus and reach their destination, meaning that designing for transit continues beyond the bus stop.

This guide includes graphically oriented information on prototypical stop layout and dimensions or placement of elements along the street. Every situation is unique, so the diagrams try to represent the most common or basic elements pertaining to transit.

> Most importantly, plans for work on and around any bus stop, whether modifying an existing stop or building a new one, should be made in consultation with MST Staff. This will ensure that minimum standards are met and reduce the risk of needing to revise plans.

Critical minimum standards are underlined. These are often driven by federal regulations, such as the Americans with Disabilities Act, or are set by MST and must be adhered to when upgrading streets or designing new stops. Other guidance such as desired dimensions or configurations may have flexibility depending on the situation, and as always, in consultation with MST staff.

The guide provides specific callouts when appropriate for the three main audiences: **Developers, City Staff** (including planners and engineers), and **MST Staff**. These will be highlighted in **Bold** as above.

Some design choices require more information from another subject area – for example, the bus stops section discusses the "bus bulb" design, but to know when it is appropriate to use this design, it *refers to Chapter 2* for further detail on stop placement in streets.

1 | BUS STOPS

Besides the bus itself, bus stops are the most visible and important components of providing high-quality public transit. The bus stop is the physical transition point on a customer's journey from point A to point B – and not just the transition in and out of the bus, but also along their path between home, work, stores, and other destinations.

Every stop is unique based on the existing street, available right-of-way and easements, the built environment and density of development, the type of road, and more. There is no single "standard bus stop" design; each stop begins with basic requirements, after which the designer(s) may make choices and trade-offs about which elements to include and how to arrange them. This chapter is organized by the layers of these choices, beginning with the basic requirements that all stops must meet for safety and accessibility. Following that are guidelines for amenities such as benches and shelters that are not always required or necessary, and how to place them appropriately in relation to the basic elements. Finally, stops served by high-quality, fast, efficient, and frequent bus service, or Bus Rapid Transit (BRT), have additional design features and minimum standards that add to or replace basic stop requirements.

Developers can provide high-quality bus stops to create a safe and comfortable experience for their residents, workers, and patrons to reach their adjacent development and to wait for the bus. This section informs developers of the design requirements when planning for a new or updated bus stop at their site and the choices for amenities that can improve the quality of a bus stop.

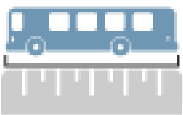
City Staff can provide high-quality bus stops that demonstrate the community character and the value and importance of public transit in safely connecting people and place. This section informs local planners and decision-makers of the requirements for bus stops as they interact with other elements of the street like sidewalks and intersections, and how bus stops can be customized within a 'toolkit' to reflect the local community character.

MST Staff will use this section to direct planners, designers, and engineers to select appropriate dimensions and design features based on the transit service provided or planned at a given stop. Staff will find reference information for typical thresholds for including certain stop amenities.

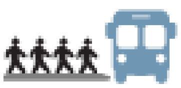
FUNDAMENTALS OF BUS STOP DIMENSIONS

The required length of a bus stop and level of amenities to place is a function of:

1. **How many buses serve the stop?** For many MST bus stops outside of downtown areas, only one route serves a stop between one and four times an hour. At some stops, particularly in downtown areas, multiple routes may serve the same stop with buses arriving within minutes of each other or simultaneously. Typically, only at these busier stops does the length of the stop area need to accommodate more than a single bus.



2. **What is the longest bus that might serve the stop?** A stop must be long enough to accommodate the longest bus (or buses, if multiple routes are present) that could operate on that route. Additionally, stop length must accommodate the bus's turning movements on approach to and while departing the stop. Most routes are served by 40-foot buses. The longest buses in the MST fleet are 45 feet, but these buses are typically only used on the long commute routes connecting Monterey County to Santa Clara County, Santa Cruz County, San Luis Obispo County and other neighboring regions.



3. **How many riders use the stop at peak times?** The bus stop environment should provide adequate space for people to wait and passengers to safely circulate off and on the bus at the busiest periods of the day. For example, a stop at a school might be quiet most hours of the day, but could have 40 or more passengers waiting at the same time when classes let out. The sidewalk and boarding area for this stop must comfortably and safely accommodate at least this number of people and allow passengers to exit the bus as well. Stops that do not have adequately sized and designed waiting areas could be dangerous and could block access to individuals using mobility devices, the flow of other pedestrians passing by, or encroach upon private property. If wider sidewalks are not possible, a longer sidewalk area at the stop may be necessary instead.

Developers and **City Staff** should contact MST early in the design process to determine the answers to these questions, understanding that MST may have future service plans that could differ from what is observed on a street today. Do not rely on existing observations and data alone when determining the minimum dimensions for a stop. Bus stops are periodically relocated or removed based on changing demands for service, and ridership demand changes over time in response to numerous factors that are not necessarily in MST's control.

BUS STOP DIMENSIONS AND LAYOUTS

Bus stop design begins where the front door of the bus is expected to be. This section covers the clear-distance along (parallel to) the curb and perpendicular to the roadway required at any bus stop in order to provide adequate space for passengers to enter and exit the bus, including passengers using a wheelchair or other mobility device. These dimensions are required minimums based on the Americans with Disabilities Act (ADA) first passed in 1990 and most recently updated in 2010. In most respects, additional space is preferred where possible, especially in busy pedestrian environments.

<u>At a minimum, a bus stop consists of:</u>

1. A length of curb long enough for a bus to pull alongside, open both the front and rear doors to allow passengers to board or exit to the sidewalk.
2. A smooth and unobstructed sidewalk area that meets the minimum dimensions and slope requirements in the following subsection, to allow passengers including individuals using mobility devices to circulate while boarding or exiting the bus.
3. A bus stop sign on a post, which indicates to the public the existence of the stop, and is typically placed approximately in-line with where the front of the bus should stop.

Most importantly, <u>a stop must have a minimum of eight feet clear and smooth sidewalk width perpendicular to the curb, for at least five feet in length along the curb</u> in order to meet ADA requirements for passenger circulation, in addition to meeting ADA requirements for sidewalks leading to this landing area. <u>When placing a new stop or relocating an existing stop, these standards must be met.</u> The following diagrams model the dimensions, angles, and radii for a 40-foot bus, which is the most common design for MST bus stops. Bus stops must accommodate a 40-foot bus at a minimum, unless special circumstances apply, but are sometimes required to be longer. *The minimum curb dimensions based on the bus size can be found in the Technical Reference chapter.* Please consult with MST Staff to determine the appropriate selection when designing for a stop.

Passenger Landing Pad

A stop must have a minimum of eight feet clear and smooth sidewalk width perpendicular to the curb, for at least five feet in length along the curb. This passenger landing pad provides ADA-required circulation space for passengers using mobility devices such as wheelchairs.

Generally, bus stops fall into a few basic categories: a stop that is parallel to the sidewalk and travel lanes, a ‘turnout’ where the bus stop cuts into the curb and allows the bus to fully exit the travel (and bike) lanes, and a ‘bus bulb’, where the bus stop actually extends out from the sidewalk so that the bus can stay completely in the travel lane.

Parallel (In-Lane or Partially In-Lane) Stops

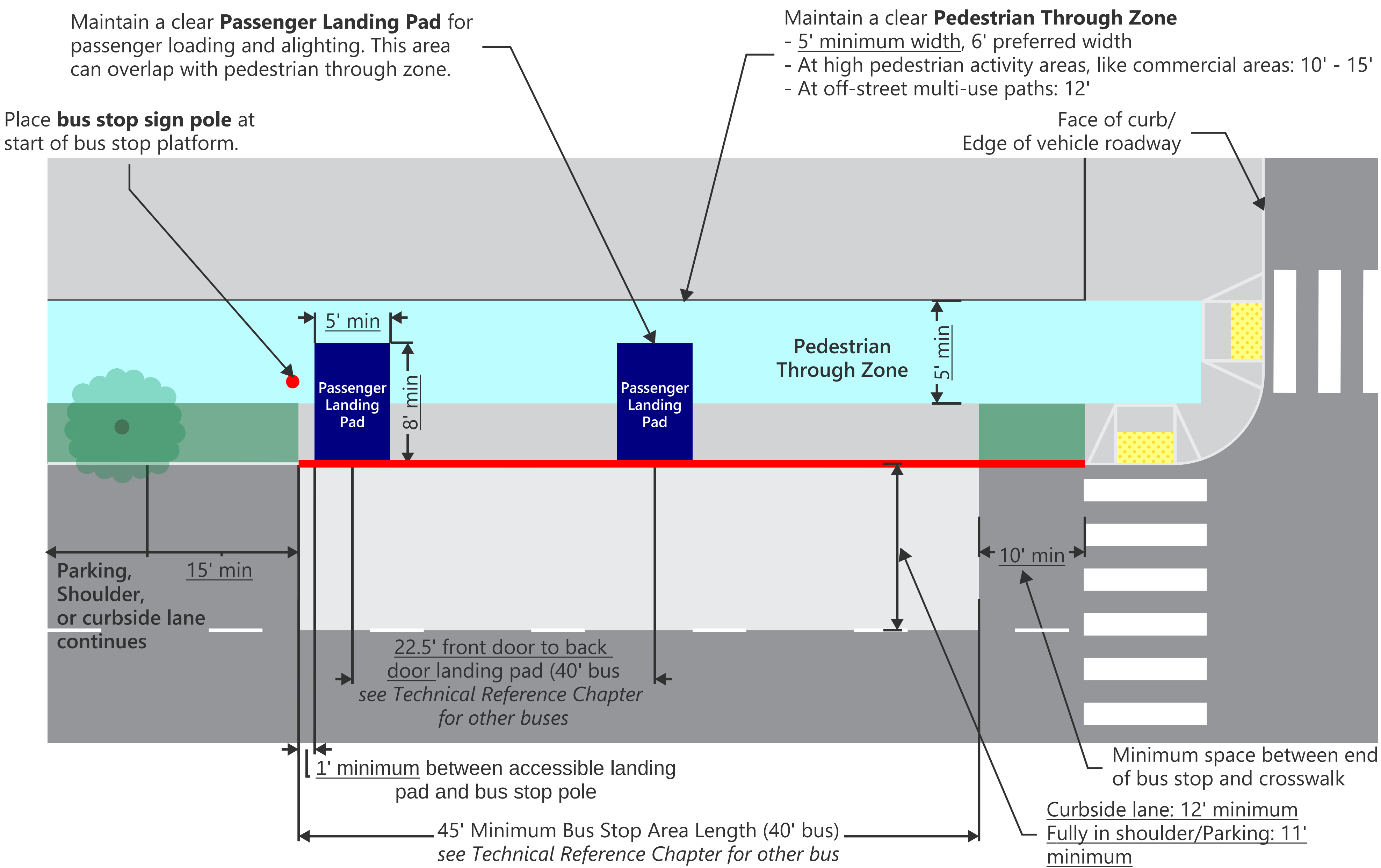
The most common stop arrangement is a bus pulling alongside the existing curb line, requiring minimal maneuvering for the bus to serve the stop. Depending on the roadway, this might mean the bus is stopping in a travel lane. When there is a paved shoulder (or bike lane), the bus may pull partially or fully out of the travel lane, depending on the shoulder width. *See Chapter 4 for guidance on how bus stops and bike lanes can best work together.* In areas where there is on-street parking, space can be allocated for the bus and should be posted as ‘no parking’ with a red curb.

The parallel in-lane or pull-over type stop is preferred because of its flexibility for transit operations, and typically requires minimal construction, if any, where sidewalks are present.

> **Prioritizing Transit**
>
> Minimizing transit delay makes the service more appealing for riders. Reduce the maneuvering needed to enter and exit stops.
>
> Parallel, in-lane stops are generally the most efficient to serve. According to the Transit Capacity and Quality of Service Manual, buses can require at least 15 additional seconds per stop when the bus must pull out of the travel lane.

Figure 1 shows the general layout and required minimum dimensions for a parallel stop.

Figure 1: Bus Stop in Lane, Partially in Lane on Paved Shoulder, or Out of Travel Lane on the Shoulder



Bus Turnout

A bus turnout cuts into the adjacent curb space to allow a bus to pull completely out of the travel lane when there might not otherwise be a continuous paved lane for the bus to stop in. When placed at an intersection (as shown in Figure 2), there is typically no taper on entry, but the curb tapers at the head-end of the stop. When a turnout is located away from an intersection *(such as a mid-block stop, shown on Figure 9 in Chapter 2, or after a roundabout)*, it will typically taper at both ends. Bus turnouts are nearly always designated only for buses and posted for no parking or loading for all other vehicles.

Turnout Vs. In-Lane Stops

A turnout may be more appropriate than an in-lane stop at locations where:

- A bus would be dwelling for more than 30 seconds on average
- where combined bus volumes serving the stop are greater than 10 per hour
- and/or on single-lane roads,

so that traffic can pass the stopped bus and minimize queuing into the intersection.

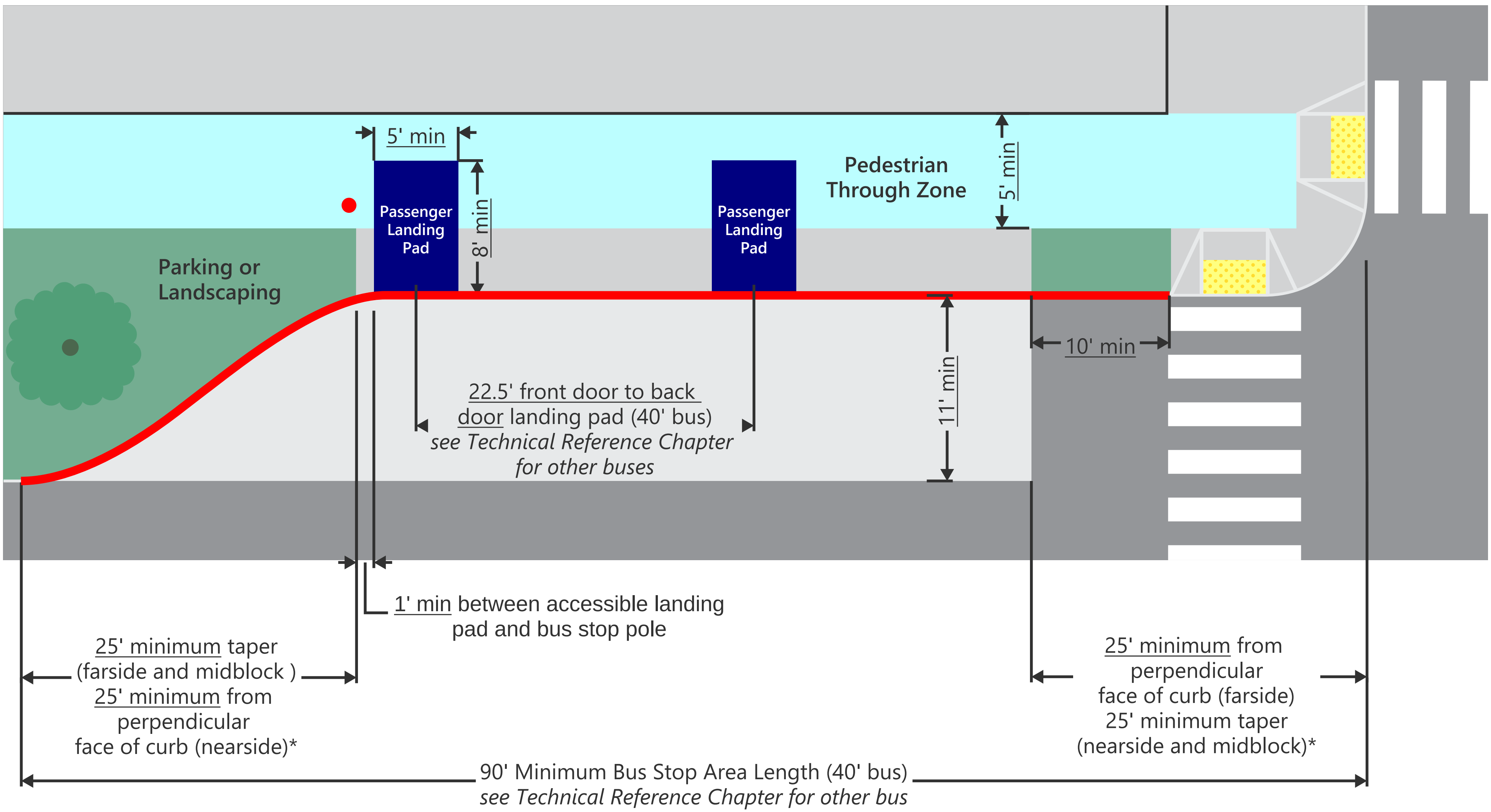
At most stops, buses dwell for less than a minute, and most stops are only served by buses a few times per hour.

Turnouts are used only in special cases where having a bus block the travel lane for any length of time is undesirable, as described in the inset. They can be beneficial on single-lane roads where there is no shoulder for the bus to stop in, and/or at locations where buses might be stopped for long periods of time, either because of passenger demands (including regular loading and unloading of people using mobility devices such as a wheelchair), or because transit operations include some layover time.

On heavily congested roadways, turnouts are discouraged because bus operators can sometimes have difficulty getting back into the flow of traffic after serving the stop.

As road speed increases, turnout length must increase to allow the bus space to safely decelerate when approaching and accelerate to reenter the travel lane. This becomes most important above 35mph when buses need more time and distance to decelerate. Designers should also consider the context of the road curvature and other conditions that would reduce visibility for oncoming traffic or for the bus operator looking for an opportunity to safely depart the stop.

Figure 2: Bus Stop Turnout (bus stops pulls out of travel lane)



**Length of tapers into and out of bus stop depend on site conditions.*

Bus Bulbs

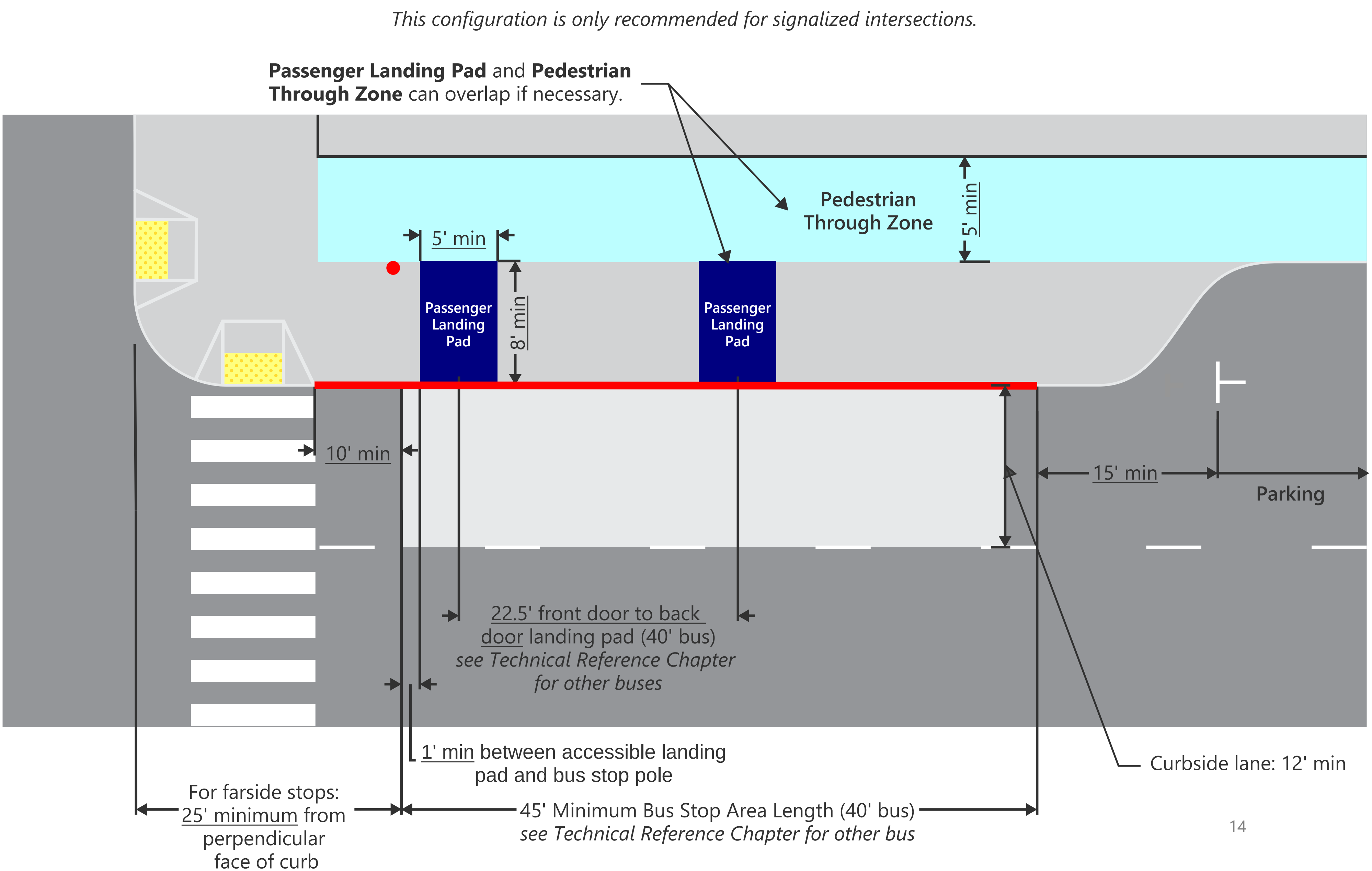
A bus bulb (sometimes called a curb extension) is the inverse of a turnout. Bus bulbs are used where it is preferable for the bus to stop in the travel lane without any maneuvering to reach the curb. The bulb extends the curb out to the edge of the travel lane, creating extra space for passenger loading and unloading. They are used where there is a parking lane or other wide shoulder, to prioritize transit access and minimize operational delays if the bus would otherwise have to exit and reenter the travel lane when serving a stop. They are best suited for busy urban areas with high pedestrian activity and can support 'complete streets' objectives by improving the pedestrian environment, narrowing the street to encourage slower driving, and provide better visibility for all users around intersections. *Bus bulbs can also be designed to accommodate a bike lane by diverting the bike lane between the stop and the sidewalk, which is covered in Chapter 4 (see Figure 16).*

Chapter 2 describes when to choose from these various bus stop types and where to place them (on the near-side or far-side of the intersection). While far-side stops are the preferred configuration, bus bulbs provide the most improvement to near-side stops, which are the least efficient for bus operations and safety. Figure 3 shows a bus bulb configuration applied to the near side of a signalized intersection. Bus bulbs can be used for far-side stops and should include additional length to provide space behind the bus to minimize cars queuing back into an intersection when the bus is stopped. Bus bulbs are less desirable on 35+ mph roadways where other motorists may not be expecting a vehicle to stop in the travel lane.

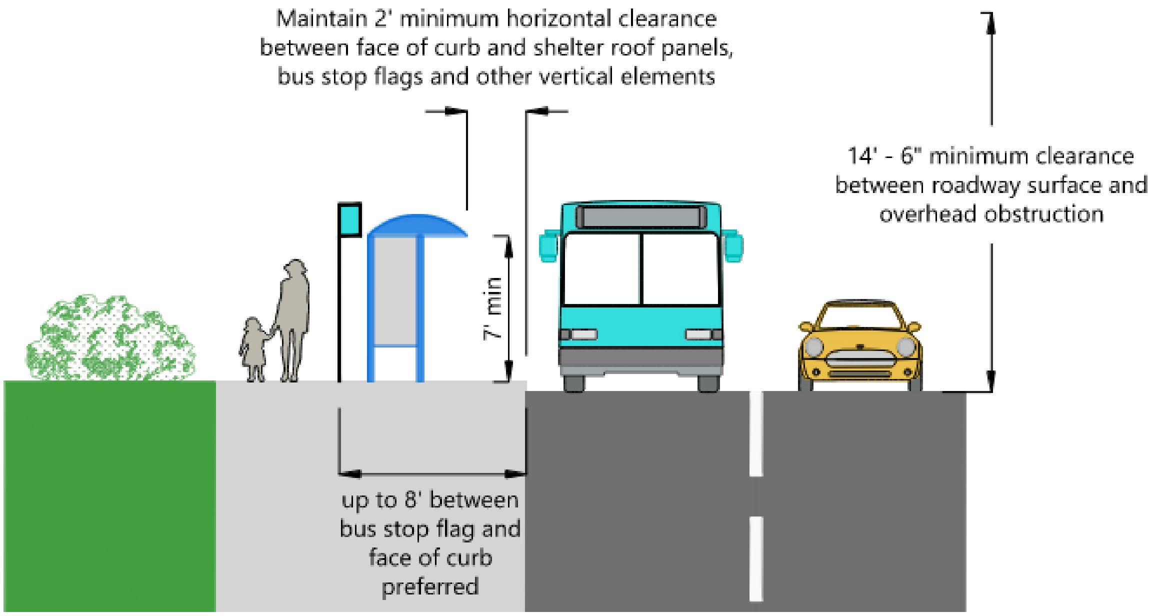
Use Bus Bulbs:

- In urban settings on 30mph or lower streets
- At signalized intersections on the far-side, or as an upgrade to a near-side stop that cannot be relocated to the far side
- At unsignalized intersections <u>on the far side only</u>

Figure 3: Bus Stop Bulb Out (bus stops in lane)



VERTICAL CLEARANCES FOR ALL STOP DESIGNS



Any potential vertical elements, including planters, structures, trees, and posts must be set back from the curb a minimum of 2 feet. Any element that overhangs the roadway must meet the minimum clearance of 14'6".

STOP DESIGN QUICK REFERENCE

Sidewalk Width
Total width at bus stops
- 10' preferred
- 15' preferred in commercial areas

ADA-required clear boarding and alighting areas (Passenger Landing Pad):
- 8' minimum perpendicular to curb/roadway
- 5' minimum parallel to curb/roadway
- Maximum slope of 1:48 (~2%) perpendicular to roadway
- Same roadway slope parallel to the roadway

Sign Placement
Preferred placement between 2' to 8' from face of curb.
No closer than 2' from face of curb.
Stop sign flag typically 10' tall. Minimum of 7' above ground

Length of Bus Zone
No parking, stopping or standing
Minimum 45' for 40' bus – may be longer

Curbside Lane Width
12' minimum

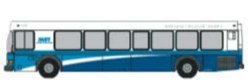
Non-Curbside Lane Width
11' minimum*

*Lane widths narrower than 11' will result in encroachment in adjacent lanes.

Sources:

2010 ADA Standards Chapter 810 Transportation Facilities Section 810.2 Bus Boarding and Alighting Areas

Easter Seals Project Action's Toolkit for the Assessment of Bus Stop Accessibility and Safety (2014)



SIDEWALKS IN THE BUS STOP ZONE

The sidewalk in the area of a bus stop must meet certain dimensions (width, length, and slope) required by the ADA to provide safe access and circulation for all people. Sidewalks are also often home to several other elements, such as mailboxes, utility poles, traffic signage, and more. Sidewalks around bus stops also often need to accommodate passenger amenities such as benches and shelters or information kiosks. All other 'vertical' elements must defer to the following minimum requirements for clear and level circulation space around the bus stop.

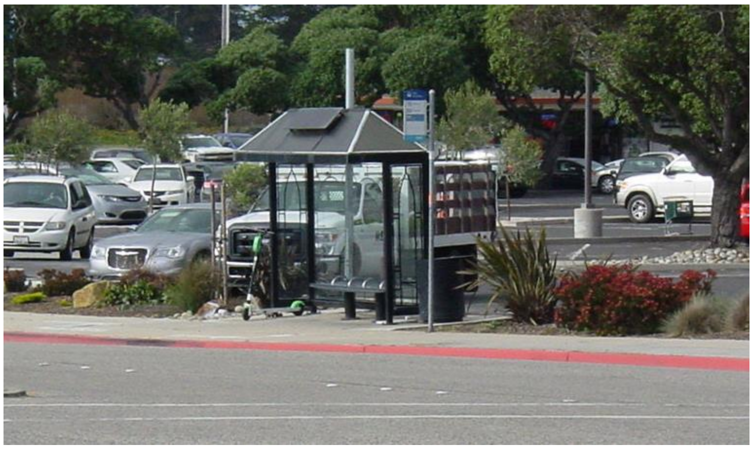
Follow the guidance in the prior subsection for providing clear sidewalks, noting that it is important to minimize and remove unnecessary vertical elements along the curb at bus stops, such as newspaper stands. Infrastructure that is difficult or impossible to relocate, such as fire hydrants, should be considered when determining where the bus doors should fall at a stop to ensure clear pathways.

Furthermore, sidewalks provide the connection for passengers between the bus and their ultimate destination. A sidewalk must connect to nearby intersections, crosswalks, businesses and homes. *Chapter 4 provides guidance on ensuring the sidewalk beyond the bus stop provides this important connection for passengers.*

The example above shows a stop with a clear and smooth sidewalk connecting to the nearest intersection and extending away from the stop in both directions. Potential obstructions to the path of travel are minimized: the bus shelter is inset on the 'backside' of the sidewalk, as are the bus stop signpost and additional bench.

BUS STOP AMENITIES AND STREETSCAPE

After providing an adequate length of curb for the bus to stop, and a clear sidewalk area for passengers to circulate into and out of the bus, amenities such as benches, shelters, and information can make the bus stop environment safer, more comfortable and more attractive to customers. Some elements are recommended for all stops, while others become requirements when certain thresholds such as passenger activity are achieved. Bus stop amenities must be selected and oriented in relation to the requirements of the previous sections; a shelter cannot be placed in a way that reduces circulation space on the sidewalk below the ADA requirements, for example. If placing a bus shelter is desired or required, but the geometric limitations of the stop preclude placement, other options must be considered.



The example stop shown at left includes a shelter and bench for waiting passengers, with landscaping set back from the sidewalk to ensure the whole length of the bus stop zone has a clear and smooth path of travel.

At the end of this section, Table 1 summarizes the bus stop features that are required or recommended.

Passenger Seating (Benches)

Seating is ideally provided at all stops so that riders can wait comfortably for their bus and is required at stops with an average of 10 or more passenger boardings per day. Seating may not be necessary at stops that are limited to drop-off only based on routing and operations.

Passenger Shelters

Likewise, shelters are ideally provided to provide comfort and safety for riders, which encourages people to use transit. Shelters are required at stops with an average of 25 or more passenger boardings per day. Shelters may not be necessary at stops that are limited to drop-off only based on routing and operations. *Specifications for bus shelters can be found in the Technical Reference chapter.*

Passenger Information

Providing passenger information at stops can range from printed timetables and maps to modern touch-screen kiosks and real-time information displays. There are variations on printed timetables developed by MST for all stops, and maps for major stops or the intersection of multiple routes or operators. Real-time information and more elaborate technology are provided on a case-by-case basis, typically at the most heavily used and centrally located stops, especially where multiple routes connect.

Lighting

Providing adequate lighting can improve a rider's comfort and sense of security while waiting at a bus stop and improve the visibility of people waiting for the bus operator. Stops should be placed in areas that have existing lighting and/or designed to include pedestrian scale lighting for the length of the bus stop, and ideally along pedestrian pathways to nearby destinations. In suburban and rural settings, traditional street lighting with a lamp 20 or more feet above the ground is often insufficient to illuminate people waiting at a stop and provide a sense of safety for passengers. It's generally recommended that lighting at a bus stop area should provide at an average illumination level between 2 to 3 foot-candles and uniformity of 3.[1]

There are many options for improving the lighting at a stop. Lighting can be included as an option in bus shelters and can be solar powered or connected to the grid. These products typically illuminate the interior of a shelter and may provide some additional light around the area, depending on the shelter configuration, but might not sufficiently light the sidewalk leading to the stop. There are passenger-activated LED lights available for mounting on the bus stop sign post which provide downlighting to the sidewalk. Coordinate with MST to select products appropriate for the bus stop and surrounding area. Along the path to the stop, lighting should be provided with pedestrian-scale street lamps at regular intervals to minimize dark zones.

Stop Layout with Amenities

Figure 4 shows the transit passenger amenities with considerations and minimum requirements as they apply to the bus stop area. Transit passenger amenities are typically located in the public right-of-way, but MST maintains the amenities or develops agreements with the local jurisdiction for maintenance.

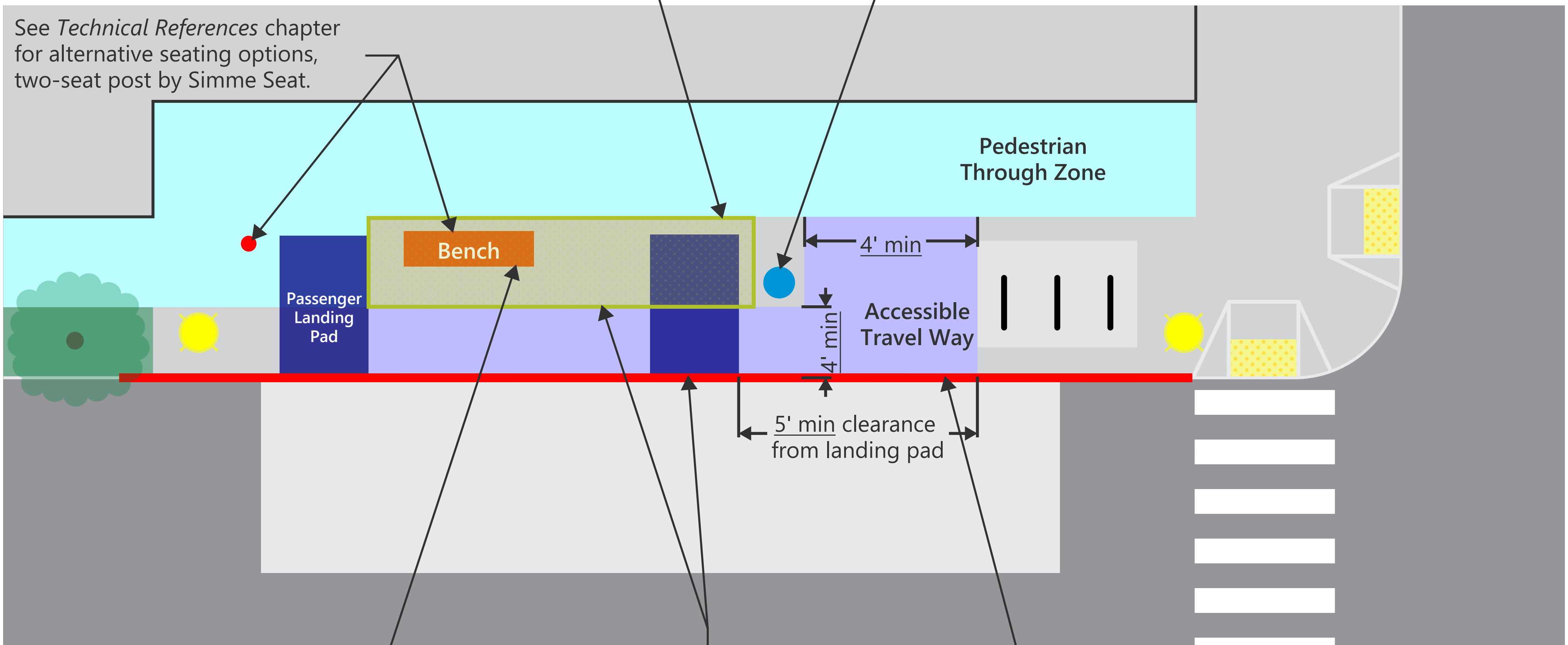
Figure 5 shows other common street features that might be found around a bus stop, such as landscaping, water retention swales, or other street furniture that is not related to the bus service. When adding a new stop, moving or renovating an existing stop, consideration should be made of these other features to ensure they meet the standards in this chapter and support transit riders. For example, some existing stops may have landscaping in the stop area where the bus rear door would be, and given the opportunity to perform stop upgrades, should be removed or relocated.

[1] See Illuminating Engineering Society (IES) RP-33-14 and G-1-16 for additional criteria for lighting in exterior environments and guidelines for security lighting for people and infrastructure. See City of Los Angeles Bureau of Street Lighting *Design Standards and Guidelines* (May 2007).

Figure 4: Bus Stop Amenities – Transit Agency Level

Shelter adjacent to buildings: Maintain 1' horizontal clear space between back of shelter and building to permit trash removal.

Furniture such as **benches** and **trash receptacles** should be placed outside of Pedestrian Through Zones and Accessible Travel Ways.



Benches can be placed with and without shelters.

Passenger Landing Pad can over lap with **Bus Shelter**, ensure minimum clearance is provided for landing pad

Maintain a clear **Accessible Travel Way** from the **Pedestrian Through Zone** to the **Passenger Landing Pad.** Pedestrian Through Zone can overlap with Accessible Travel way.

Notes:
See Bus Shelter standards on page 19.
See *Technical References* chapter for ADA requirements.

Figure 5: Bus Stop Amenities – Local Agency or Developer Level

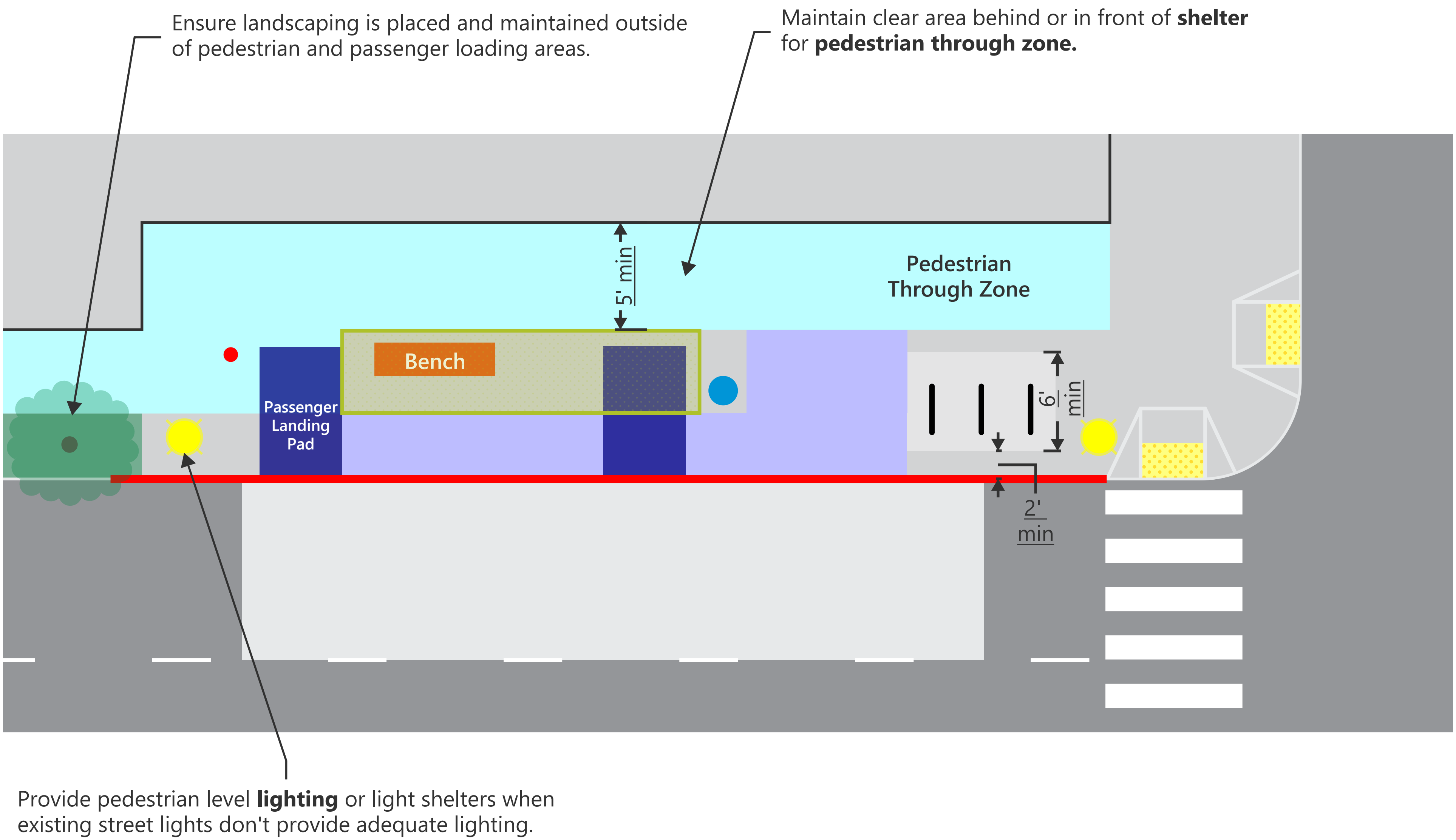


Table 1: Summary of Bus Stop Features			
Elements	**Required**	**Recommended**	Park & Ride Requirements
MST Bus Stop Sign and Pole – 2′ min from curb (preferred at back of sidewalk, up to 8′ from curb) and 8′ vertical min between bottom of sign to finished grade	✔		
Public Roadway	✔		
Minimum Red Curbs / No Parking[1]	✔		✔
10′ minimum spacing between end/front of bus stop and crosswalk	✔		
8′ (from curb) x 5′ (along curb) Passenger Landing Pad	✔		
Sidewalk width: 5′ min, 6′ preferred	✔		
Sidewalk width at high pedestrian areas: 10′ – 15′		✔	
Available width at multi-use paths: 12′		✔	
Curb Ramps at Crosswalks	✔		✔
Seating		✔	
when # of passenger boardings is 10 or more per day[2]	✔		
Shelter		✔	
when # of passenger boardings is 25 or more per day[2]	✔		
Lighting		✔	
Trash Receptacle			✔
Route Designations	✔		
Timetable		✔	
Route Map		✔	
Real-Time Information Infrastructure		✔	
Individual Bus Bays			✔
System Map			✔
Landscaping			✔

Notes:
1. See Figure 1, Figure 2, and Figure 3 and Technical Reference for length
2. Gather ridership data from MST to determine need for seating and shelters at a stop

BUS RAPID TRANSIT

Bus Rapid Transit (BRT) is a high-quality bus service that provides high-frequency, high-capacity public transit typically along an exclusive right-of-way for part or all of its route. BRT achieves higher average speeds than traditional bus routes using a combination of exclusive right-of-way, specially designed bus stops, and other infrastructure to minimize delay at traffic signals and bus stops. Typically, BRT is implemented as a comprehensive project by the agency, in coordination with local jurisdictions, and is used where passenger demand is highest and/or the need to improve transit speeds is greatest. Because of this, **MST Staff** and **City Staff** should closely collaborate on BRT-related design.

BRT Station Elements

BRT Stations are high-quality transit stops which can be located along the BRT exclusive right-of-way or on public roadways. Key features of BRT Stations are intended to both enhance the rider experience and transit operations. At the end of this section, Table 2 summarizes the required or recommended features of a BRT station.

- Curb heights at BRT stations should be level with the floor of the bus *(see the Reference Section for entry door heights by bus type)*, to eliminate the need for passengers to step up or down and in some cases eliminate the need to use the ramp for people using wheelchairs or walkers. This reduces bus dwell times. An example is shown at right.
- BRT stations should include lighting around the boarding platform.
- BRT stations should include more advanced information kiosks, including real-time information.
- Fare payment kiosks (ticket machines or farecard readers) at stations allow passengers to board the bus having already paid for their trip, reducing dwell times.
- The curb length at stations should be completely free of obstructions for at least 5′ from the curb to improve passenger circulation, reducing dwell times.
- After providing clear space along the curb, BRT stations should provide seating and shelter for passengers, with the quantity and style determined by the expected boardings per hour.

The examples below of BRT stations on the Metro Orange Line in Los Angeles feature real-time departure information, extensive canopies, off-board automated fare collection (required to ride), and unobstructed platforms for optimal passenger circulation. Passengers may board from any door as a result of the off-board fare collection.

Table 2: Summary of BRT Features		
Elements	**Required**	**Recommended**
MST Bus Stop Sign and Pole – 2′ min from curb (preferred at back of sidewalk, up to 8′ from curb) and 8′ vertical min between bottom of sign to finished grade	✔	
Separated, Transit-Exclusive Roadway		✔
Minimum Red Curbs / No Parking[1]	✔	
10′ minimum spacing between end/front of bus stop and crosswalk	✔	
Level boarding platform (1′3″ from pavement)	✔	
8′ (from curb) x 5′ (along curb) Passenger Landing Pad	✔	
Sidewalk width: 5′ min, 6′ preferred	✔	
Sidewalk width at high pedestrian areas: 10′ – 15′		✔
Available width at multi-use paths: 12′		✔
Curb Ramps at Crosswalks	✔	
Seating	✔	
Shelter – BRT Design including Information Kiosks	✔	
Lighting	✔	
Trash Receptacle	✔	
Route Designations	✔	
Timetable	✔	
Route Map	✔	
Real-Time Information Infrastructure	✔	
System Map	✔	

Notes:
1. See Figure 1, Figure 2, and Figure 3 and Technical Reference for length

2 | STOP PLACEMENT AND STREET DESIGN

Bus stops are typically located at intersections, which leads to the choice of placing the stop on the intersection approach, known as a near-side stop, or on the far-side after the bus has crossed the intersection. Bus stops can also be located away from intersections; this is known as a mid-block stop in urban environments, and in rural environments it may simply be a long stretch of road between intersecting streets where a stop needs to be located.

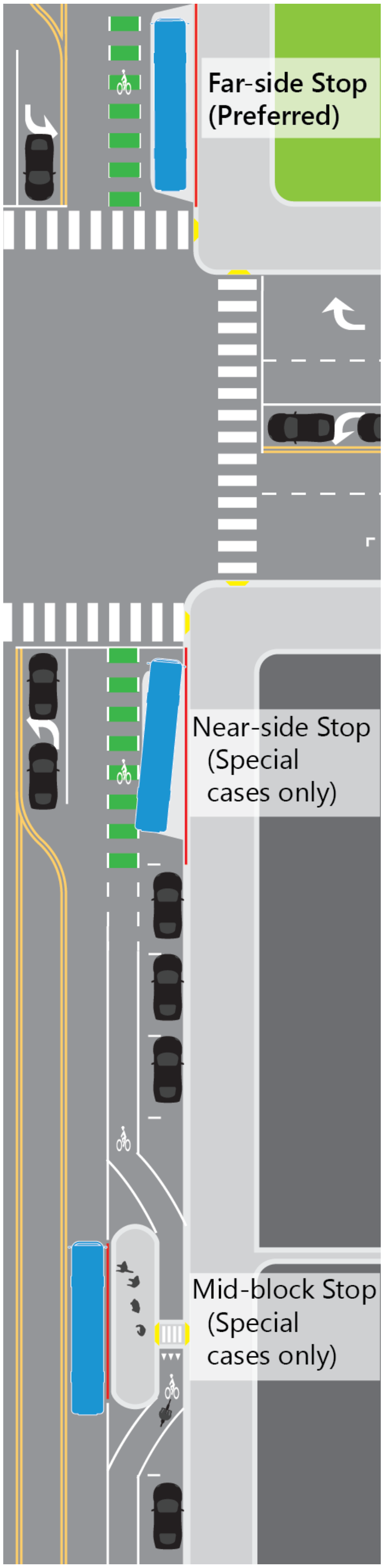
This chapter addresses the considerations for placement of stops at intersections, then discusses mid-block stops in urban settings and then the considerations in suburban and rural contexts where there may not be an intersection near to a needed stop. Finally, this chapter covers other considerations for incorporating transit into street design beyond just the stop area, such as the width and weight rating of the travel lane where buses will operate.

Developers need to understand bus stops in context with street design when developing site plans to properly accommodate bus stops with development access and the surrounding transportation network.

City Staff will consider how bus transit interacts with the many other elements of public roadways – parking, driveways, intersections, bicycles and pedestrians. This chapter also addresses critical minimum roadway standards that city planners and engineers must consider. This chapter also identifies solutions, such as bus bulbs, that support complete streets programs without further impacting transit speeds and can also benefit the pedestrian environment.

> The placement of a bus stop is an important factor in determining whether MST can provide transit service to an area. Early coordination with MST can ensure successful design of stops and service.

MST Staff will refer to this chapter when working with developers to ensure that stop placement addresses the agency's policies and the route(s) operational needs.



WHERE TO LOCATE STOPS

In general, there are three categories of stop placement: on the far-side of an intersection (in the direction of travel), on the near-side approach to an intersection, or 'mid-block' far from an intersection. Far-side stops are the preferred design in most cases. Placing stops at intersections is ideal to maximize people's ability to reach destinations in any direction from the stop.

Near-side stops are not to be used at unsignalized intersections because they pose safety risks, described later in this chapter. Whenever possible, MST seeks to relocate existing near-side stops to the far-side.

Mid-block stops are used where the nearest intersection geometry precludes a safe bus stop, where there is a major destination for riders between two intersections, or where there is no nearby intersection (usually in suburban and rural contexts).

Figure 6 illustrates the relative placement of far-side, near-side and mid-block stop.

Figure 6: Far-side, Near-side and Mid-block stops compared

Far-side Stop

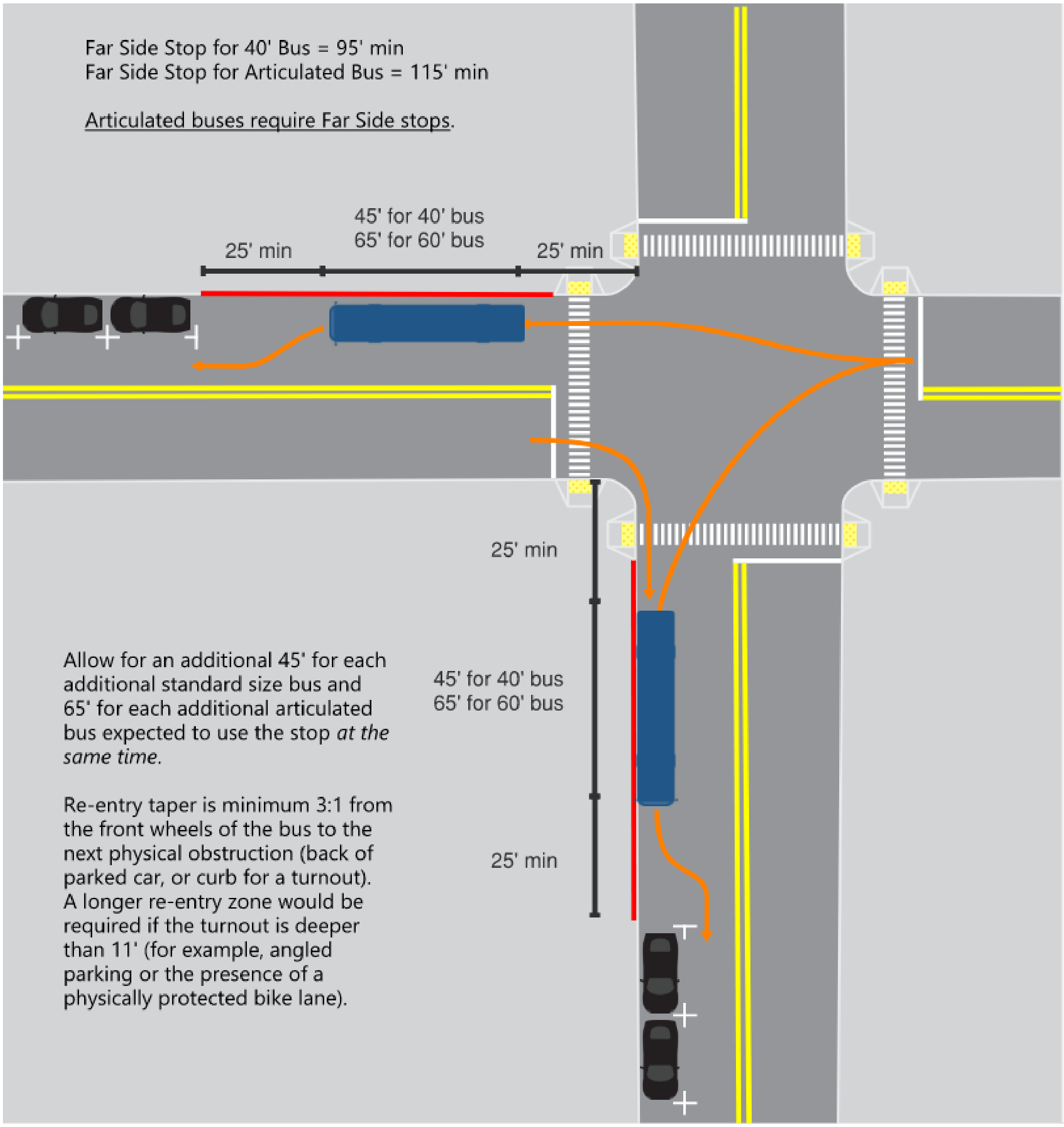
In most cases, the preferred location for bus stops is on the far-side of an intersection, whether signalized or unsignalized. Far-side stops are the safest and most efficient arrangement for buses in most circumstances. Buses coming straight through an intersection can enter a far-side stop at a shallow angle and have wide visibility. Buses turning left at an intersection nearly always require a far-side stop. Far-side stops use less curb space than other stop types because the bus approach angle is through the intersection. Placing a stop on the far side makes better use of traffic signals, especially with Transit Signal Priority *(see Chapter 3 for details)*, because the bus can pass through the intersection on a green, serve a stop if necessary and continue on without having to additionally wait for a red light. Additionally, far-side stops avoid the safety conflict of a passenger using a crosswalk in front of a bus while the driver is looking over his/her shoulder to re-enter the travel lane.

Far-side stops must be long enough to fully accommodate the longest bus that would serve it without the bus extending into the crosswalk or intersection itself. There should be at least 10' of clear space behind a stopped bus so that vehicles turning right from the side street have a clear view and are less likely to turn into the stopped bus.

When there is a parking lane present, far side stops should reserve adequate space for the bus to stop and maneuver around the first parking space when exiting the stop. If there is no parking lane or paved shoulder adjacent to the travel lane, *a turnout-style bus stop (see Chapter 1)* should be considered so that the bus can exit the travel lane. On high-speed roads, accommodations should be made so the bus can fully exit the travel lane to serve the stop and have adequate clear space ahead to accelerate before re-entering the lane.

Figure 7 illustrates the basics of far-side stop placement in relation to the intersection and parking.

Figure 7: Far-Side Stop Requirements



Near-side Stop

Use only where a far-side stop is not possible, or in special cases approved by MST. New near-side stops should never be placed at unsignalized intersections, to reduce the risks associated with a stopped bus blocking the view of people attempting to cross the street and on-coming motorists.

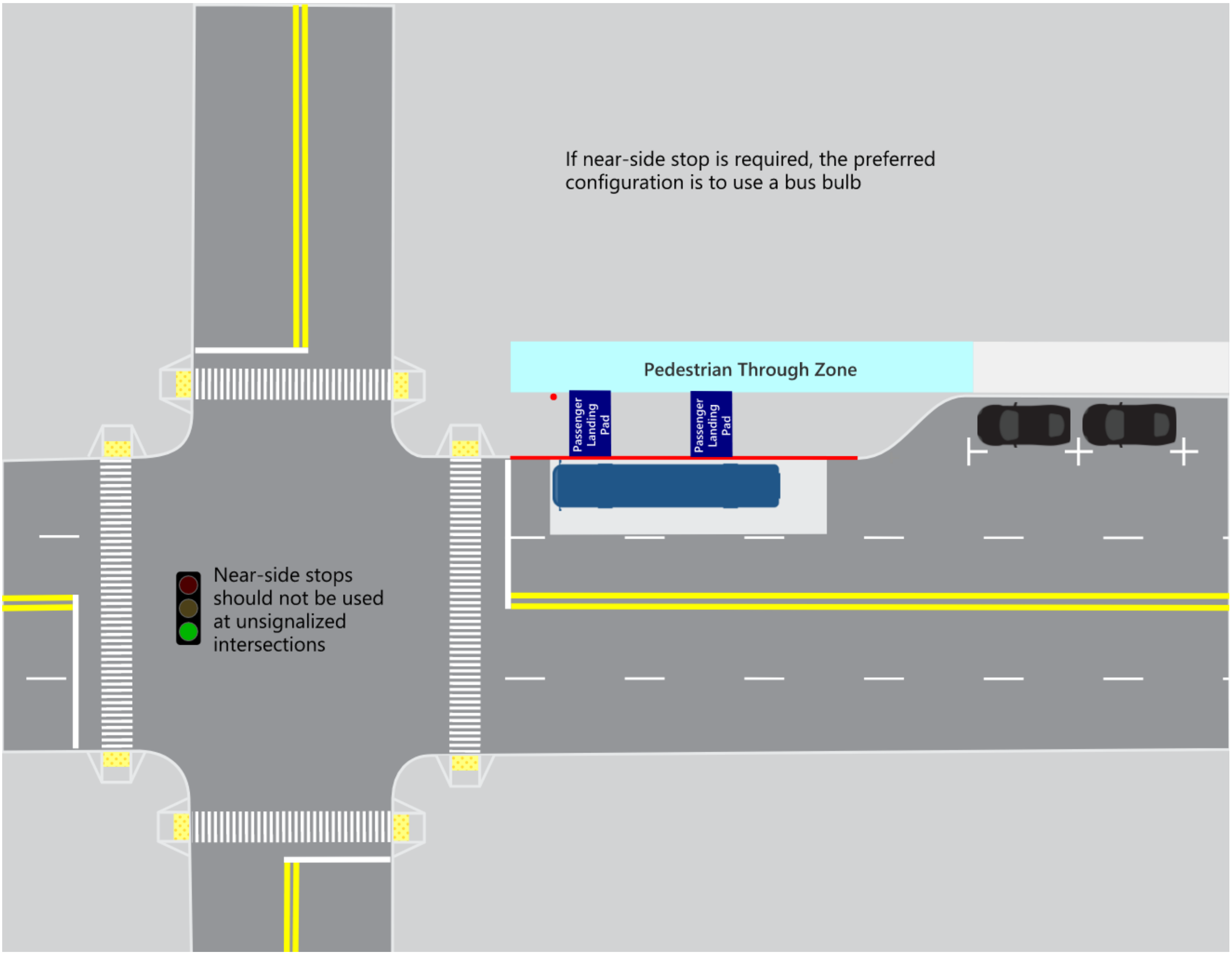
Near-side stops are usually less efficient for transit compared with far-side stops. Near-side stops in the turnout (pull-over) configuration require a slower and sharper entry angle, slowing the bus and traffic behind it. At signalized intersections, the bus may also have to wait for a red light after serving the stop. Near-side stops can increase the risk of collisions with vehicles making right turns in front of the bus as it departs the stop.

At all-way stop intersections, near-side stop configurations can be more efficient than far-side, because the bus does not have to stop twice; however, the configuration must allow the bus to stay in the travel lane (possibly with the addition of a bus bulb, as described below) when serving the stop, and it should be a single travel lane. Additional safety measures to discourage traffic from passing around the stopped bus can include placing flexible bollards or traffic delineators along the centerline for about 50’ back from the intersection.

Using a bus bulb at a signalized or stop-controlled near-side stop significantly improves the safety and efficiency of this type. The bulb eliminates the need for the bus to maneuver out of the travel lane and reduces the risk of other drivers attempting to make a right turn in front of the bus. When considering a bus bulb to improve a near-side stop, ensure there is adequate distance for traffic to queue behind a stopped bus, or pass in an adjacent lane. Figure 8 illustrates the basic considerations for applying a bus bulb to the near-side of a signalized intersection. *See Chapter 1 for guidance on bus bulb designs*.

When intersection improvements are being considered, every effort should be made to relocate near-side stops to the far-side, which is safer and more efficient in almost any case.

Figure 8: Near-Side Stop Requirements



STOPS FAR FROM AN INTERSECTION ("MID-BLOCK")

While most stops should be provided at intersections, there may be certain reasons to place a bus stop far from an intersection. In urban areas, a mid-block stop might be best if the nearby intersection cannot accommodate a stop safely, or where there is some significant destination between intersections (especially widely spaced intersections).

In suburban or rural areas, "mid-block" may simply be needed where there is a destination but no intersection, as cross-streets tend to be further apart outside of urban centers.

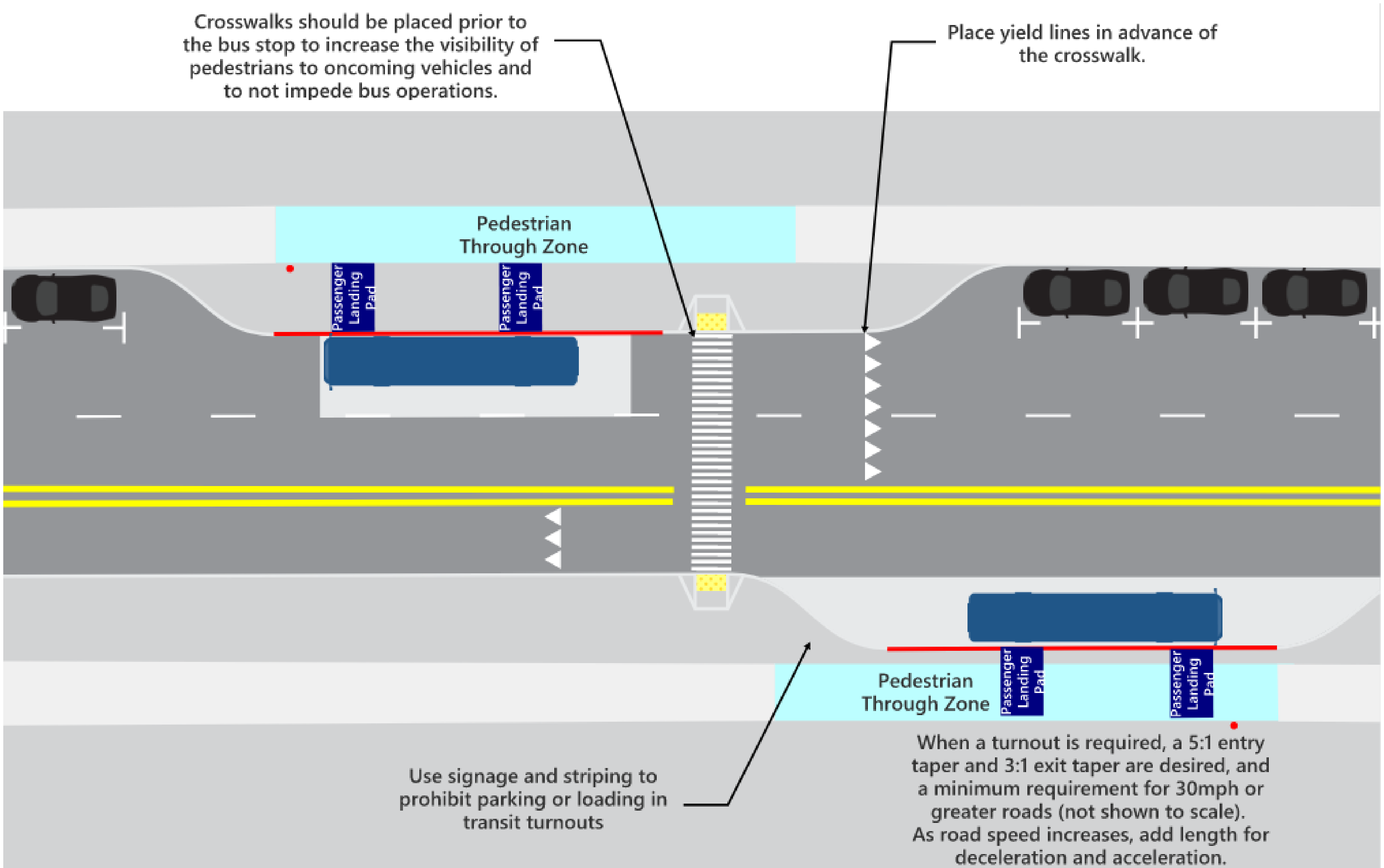
Stops and Crosswalks

Stops that are very far from a nearby intersection or other marked crosswalk should be carefully considered. By nature, people boarding or alighting a bus will want to take the most direct path to their destination, and if it is across the road, a mid-block stop may result in people making dangerous crossing attempts. Always stripe the crosswalk behind the bus at a mid-block stop so that passengers have visibility of traffic coming in the same direction as they attempt to cross. Every situation is different and there are many factors to consider when designing a crosswalk that this guide cannot address with a simple rule-of-thumb. Consult the latest best practices guidance from the Federal Highways Administration (FHWA), the National Association of City Transportation Officials (NACTO), and local standards on design and placement of crosswalks in relation to bus stops.

Bus Bulbs at Urban Mid-Block Stops

In dense urban areas, mid-block stops might be used if the nearest intersections are simply not appropriate for a stop. In some cases, this is a good opportunity for a bus bulb, particularly if there is a parking and/or bike lane at the curb. The bulb in this context not only eliminates slow maneuvers in and out of the stop but could even save space that would be needed to safely make those maneuvers around parking spaces. Figure 9 illustrates an urban mid-block stop using a bus bulb, and the appropriate placement of a crosswalk (if necessary) behind the stopped bus. *See Chapter 1 for guidance on bus bulb designs, and Chapter 4 for accommodating a bike lane with a bus bulb.*

Figure 9: Mid-block Stop Examples



Suburban and Rural Context

In suburban and rural environments where roads tend to have higher speed limits, the built environment is less dense, and intersections are farther apart, some stops are “mid-block” by nature of needing a stop near a destination with no controlled intersection. In these cases, it is even more critical to consider the opportunities to safely cross the road, because typically the rider will need to cross the road in order to make their return trip by bus. Proposed stops should consider high-visibility crosswalks, such as the pedestrian-activated ‘HAWK’ style crossing shown here, particularly on 35mph or greater roads. These treatments should be used where appropriate and consistent with local crosswalk and street design guidelines.

Suburban and rural stops may also require the addition of ADA-compliant sidewalks to connect to nearby destinations. **MST Staff, City Staff and Developers** may need to work together to address areas where sidewalks are sparse, non-existent, or not compliant with regulations.

TCRP Report 19, *Guidelines for Location and Design of Bus Stops* chapter 3 provides suggested lengths of deceleration and acceleration lanes based on the posted speed limit and assumptions of the bus entry speeds, although the report is somewhat dated.

The actual length and configuration for a new suburban or rural out-of-lane stop should be determined on a site-specific basis by a licensed engineer.

Regarding the travel lanes and shoulders where the bus will be decelerating, stopping, and accelerating, the lane widths and approach/departure lengths and angles for the bus should be carefully considered. Key factors include the prevailing speed of traffic, available paved width and right-of-way, and the visibility, including around curves and over hills. Sometimes the geometry of the road may preclude a safe bus stop if other motorists at speed would not have enough time to see a bus pulling out of a stop, or if the bus operator cannot clearly see oncoming traffic behind them. **City Staff and MST Staff** should coordinate closely when locating mid-block bus stops on high-speed roads, including site visits and road testing with the design vehicle.

QUICK REFERENCE: CHOOSING STOP CONFIGURATIONS

The preferred stop configuration is far-side:

- **Bus fully out of travel lane in most conditions** except heavily congested roadways or
- **Bus fully in-lane** when the curb is adjacent to the travel lane, road speeds are low, and/or where curvature of the road would reduce visibility of the bus for approaching traffic or reduce the bus operator's ability to see approaching traffic in their mirror when exiting
- **Use a bus bulb**, at either signalized or unsignalized intersections, **in low-speed urban settings**

or

A near-side stop may be used, at signalized intersections only:

- When the far-side **cannot safely accommodate** a stopped bus
- When far side **cannot accommodate required passenger** facilities (sidewalk width, slope, etc.)
- **Use a bus bulb** or temporary curb extension to improve safety and efficiency

or

A mid-block stop may be used in urban environments:

- When neighboring intersections **cannot safely accommodate** a stopped bus
- When nearby intersections **cannot accommodate the required platform dimensions** at the bus stop
- When there is a **major destination** between intersections, especially on long blocks
- When a mid-block bus bulb would provide an **advantage for transit operations** and passenger experience over nearby intersections

if

In rural environments, bus stops must:

- **Consider road speed, geometry and sight lines,** typically requiring a long distance for the bus to safely slow approaching the stop, stop fully outside the travel lane, and accelerate before reentering the travel lane
- Provide **ADA-compliant landing** and circulating area for passengers at the stop
- Provide ADA-compliant **connections to nearby developments**

CURB LANE ON STREETS WHERE TRANSIT OPERATES

City Staff can refer to this guidance when improving, reconstructing, or planning new streets. Buses are heavy and operate dozens of times a day or more over the same roads, creating considerable wear and tear. The curb lane where buses typically travel should be designed with bus transit in mind to provide safe streets in good repair.

For safety and clarity for all drivers, travel lanes should be clearly marked. Around bus stops, it is particularly important to clearly delineate the bus zone from parking and bike lanes.

Pavement materials and design should support the weight of the bus along the roadway, and particularly at bus stops where buses may be stopped or lay over for long periods of time. Pavement design is site-specific and must be evaluated by a licensed engineer. Bus stops should be constructed using reinforced concrete, such as in the example photo below. The concrete pad is designed to support the weight of buses for prolonged periods of time.

> The curb lane should be a minimum of 12' to meet minimum safe operating requirements for buses, which are 127 inches (10'7") wide including the mirrors.

*The Reference Chapter provides AutoCAD turning template examples for 40' and 45' buses around typical intersections and roundabouts as reference for **City Staff** to consider for providing adequate maneuvering space for transit.*

TRANSIT AND COMPLETE STREETS TREATMENTS

Public transit is an important part of a complete street, and most traffic calming and active transportation enhancements are compatible with transit. For example, transit bus bulbs can be used to improve the stop environment for passengers, which in turn enhances the area available for pedestrians and narrows the roadway to potentially slow other traffic. Here are some additional considerations for coordinating transit and Complete Streets strategies.

Bus Bulbs and Pedestrian Bulb-Outs

Transit bus bulbs extend the passenger boarding and alighting zone at the stop, but the bus bulb can also integrate seamlessly with pedestrian bulb-outs designed to reduce traffic lane width and the crossing distance for pedestrians. Keep in mind the guidance in this chapter on crosswalks in relation to transit stops: at signalized or stop-controlled intersections, crosswalks and pedestrian bulb-outs can be placed ahead of the stop, but the bus stop should be set back far enough that a vehicle approaching the stop can see around the front of the bus. For any unsignalized stops, the crosswalk and pedestrian bulb-out should be at least 10′ behind the end of the bus stop.

Where pedestrian bulb-outs are used independently of bus stops, keep in mind that they must not narrow the lane width to less than 11 feet without risking the bus encroaching on the adjacent (or opposing) lane or the mirror overhanging the sidewalk.

Traffic Speed Tables (Speed Bumps/Humps)

Speed tables can generally be used on streets where transit is operating. A speed table is a method of slowing traffic by raising the profile of the road 3-3.5 inches for a length of 22 feet, according to the *NACTO Urban Street Design Guide*[2]. Speed humps or bumps, which are much narrower, can sometimes cause buses to "bottom out" depending on the road geometry, and are a traffic calming treatment more suited for neighborhood streets where transit is not typically operating. Alternatively, the NACTO guide offers the "speed cushion", which is similar to the speed hump and table but includes wheel cutouts at the width of large (102-inch-wide) vehicles like buses. *See the Technical Reference chapter for specific dimensions.*

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[2] The NACTO guide is available online at https://nacto.org/publication/urban-street-design-guide/street-design-elements/vertical-speed-control-elements/speed-table/ and provides specific critical and recommended design considerations.

Lane Narrowing, Chicanes

A common traffic calming strategy is to narrow travel lanes to reduce travel speeds and improve safety. Transit buses at their widest (inclusive of the side mirrors) are about 10 feet 7 inches wide. While most Complete Street guidance, including the NACTO guide, encourages communities to consider 10 foot lanes for improved multimodal safety, if only 10 foot lanes are provided, a transit bus must encroach on other lanes, which increases the risk of collision. Therefore, on streets where transit is operating, a minimum lane width of 11' is required even in low operating speed environments.

A chicane treatment uses offset curb extensions to slow traffic by forcing some weaving, while expanding space for other uses like pedestrians and bicyclists. Chicane treatments are best suited for neighborhood streets and may not be the most appropriate treatment on streets where transit is operating. Use the *Technical Reference* chapter for the dimensions and turning radii of buses to determine in the planning stage if a chicane would be navigable.

Street Trees

Street trees can improve the aesthetic and comfort of a street as well as visually narrow the road, which can also slow traffic. It is important to ensure that the minimum lane widths where the bus is traveling in relation to trees are observed for the full vertical clearance of the bus (see *Chapter 1 Stop Design Quick Reference)*. Trees must be maintained and trimmed regularly so that buses do not clip branches as they pass by. Trees are generally discouraged from the bus stop area or should be located behind the sidewalk, in order to avoid vertical clearance conflicts as the bus is approaching the stop and to maximize visibility of people waiting at the stop for bus operators and more "eyes on the street" visibility to make customers feel safe.

OTHER STOP PLACEMENT TOPICS

Roundabouts

Cities are increasingly using traffic roundabouts as an intersection control system. Roundabouts must be designed to meet bus turning radius requirements *(see the Technical Reference Chapter)*. A bus stop to be located at a roundabout intersection should follow the same principles presented throughout this manual.

1. The preferred location is after the bus has passed through the roundabout ("far side"), to maximize visibility of pedestrians crossing any leg of the roundabout.
2. The back of stop should be a minimum of 10 feet beyond the crosswalk or curb return of the roundabout, or further as site conditions dictate.
3. The stop configuration is a function of the number of lanes, the frequency of buses serving the stop, and the peak passenger loads; if the road is only a single lane, and/or buses stop very frequently (more than ten in an hour), and/or buses will dwell for more than 30 seconds on average, the best configuration is a turnout.
4. At complex and/or multi-lane roundabouts, consider placing the stop further beyond the intersection (potentially 200 feet or more) to reduce conflicts.

Temporary/Construction Conditions

For planned construction in the road and/or at bus stops, **City Staff** should notify MST as part of the approvals process, just like any stakeholder or affected property owner, to allow the agency adequate time to plan alternate operations and notify passengers. MST may evaluate the situation and apply case-specific changes, such as temporary stop relocation following the design principles of this guide, or if necessary close the stop entirely. An alternate stop must meet the same ADA requirements and should include signage to direct passengers for the appropriate location to wait. Depending on the duration and complexity of the construction project, there could be impacts to the route or safety concerns with a bus proceeding through a constrained area safely. It is imperative for City Staff to coordinate with MST as early as possible in construction planning and provide direct lines of communication between the project manager and MST operations to ensure buses are able to pass the construction zone safely or are rerouted to minimize impacts on riders and service quality.

Often, construction can be unexpected (a water main break), or a moving target (paving) with little time to notify the transit agency. In these cases, **MST Staff** should make the best alternative that balances alerting bus operators, passengers, and avoiding pass-ups. In some cases, this might mean special accommodations for passengers needing to use the ramp to board or alight the bus, depending on site conditions.

BRT TRAVELWAYS

BRT is typically implemented as a project by **MST Staff** in collaboration with **City Staff**. BRT works best when buses operate on an exclusive right-of-way for as much of the route as possible. Providing an exclusive transitway usually consists of repurposing right-of-way such as an abandoned railroad line or reallocating some travel lanes on an existing roadway. The photo below shows an example, the Metro Orange Line in Los Angeles. When space is not available to dedicate exclusively to transit, BRT can operate in regular traffic conditions, and it becomes even more imperative to consider enhanced station design and traffic operational priorities such as bus lanes *(see Chapter 3)*.

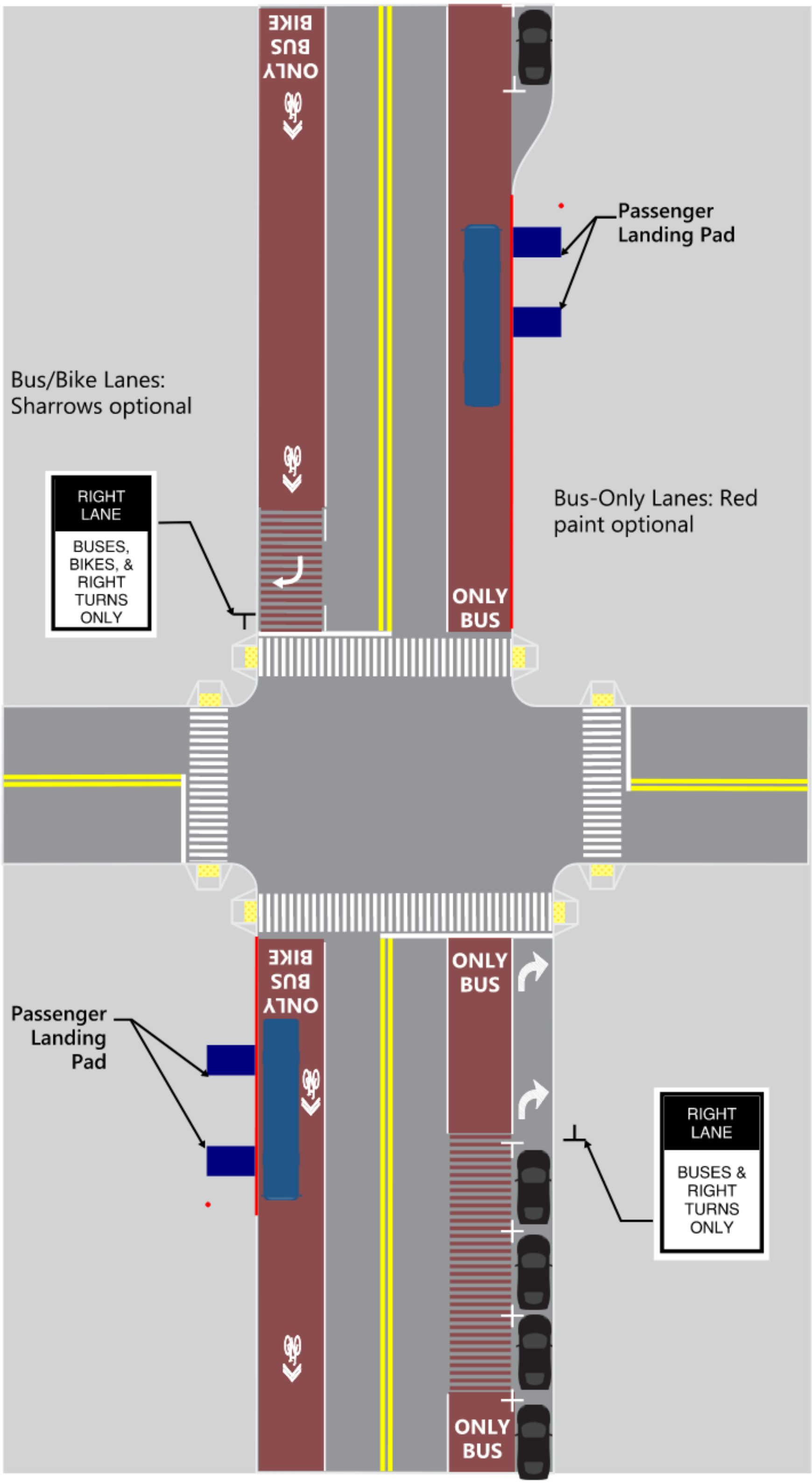
BRT in Mixed-Traffic

When a BRT or bus priority lane is provided in general traffic, consider the available lane width. If there is sufficient room to provide separate bus lanes (12') and bike lanes (minimum 5'), or a fully separated bike path is available, bicycles should be explicitly prohibited from the bus lane, for safety. If there is not sufficient width to provide both a designated bus and bike lane, a shared bus-bike lane should be provided with clearly-marked stenciling and signage. This is only permissible if the speed limit is 25mph or less in the shared zone.

Bus-only lanes can be painted red, per the Manual of Uniform Traffic Control Devices (MUTCD) Interim Approval 22 (IA-22), to improve motorist adherence. At intersections, bus-only lanes are typically shared with right-turning vehicles and skip-striping and signage should make this clear. Figure 10 shows an example of a red-painted bus only or bus-bike only treatment including the travel corridor and stop areas.

Bus-only or shared-bus-bike lanes can be provided curbside, or can "float" inside of a parking/loading lane, as shown in Figure 10. For more guidance on specific implementation, refer to the *NACTO Transit Streets Design Guide*.

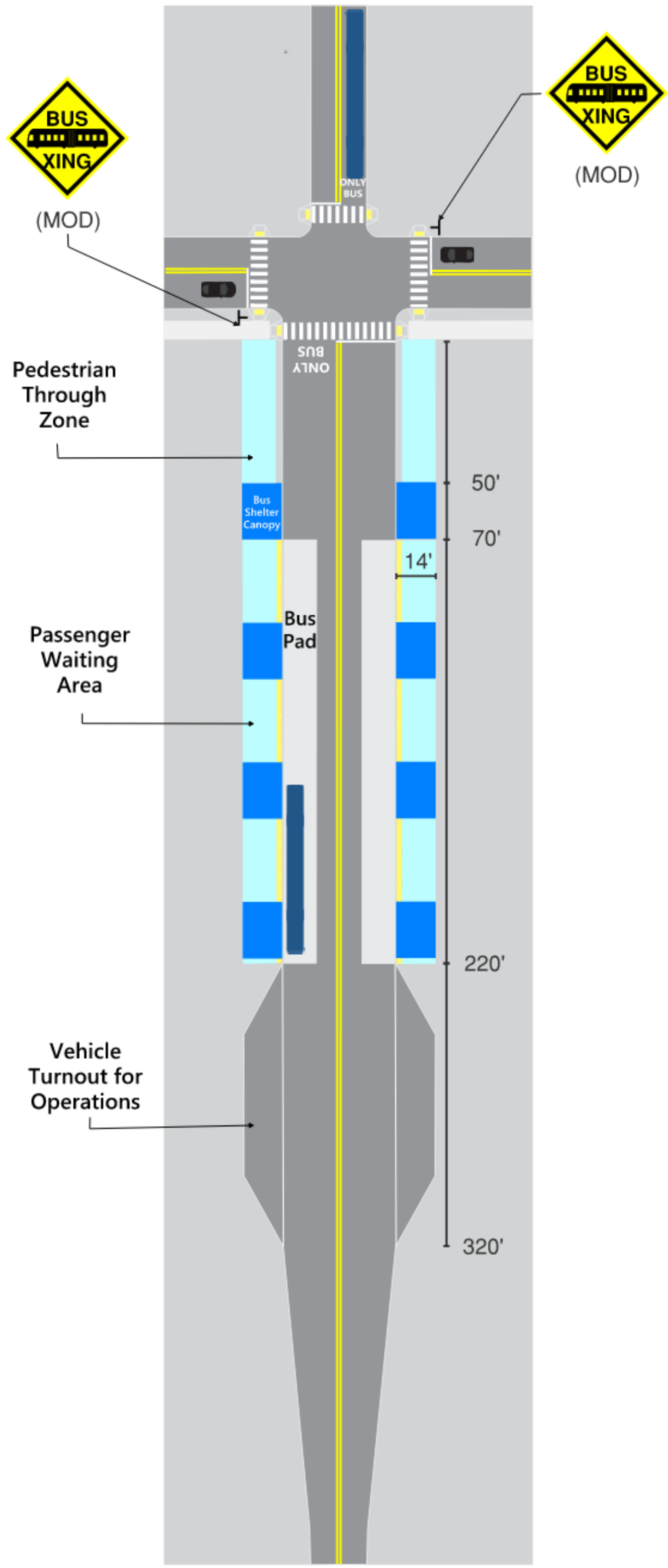
Figure 10: Bus Only Lane and Bus/Bike Only Lane Examples



BRT Exclusive Right-of-Way

Where an exclusive right-of-way intersects with public roads or pedestrian and bicycle pathways, clear signage and potentially train-line grade crossing protection such as flashing lights and gates should be considered. **Error! Not a valid bookmark self-reference.** shows an example of a fully separated transit exclusive right-of-way including the at-grade crossing with a local street and a station area. All other vehicles, including bicycles, should be expressly prohibited from the transitway.

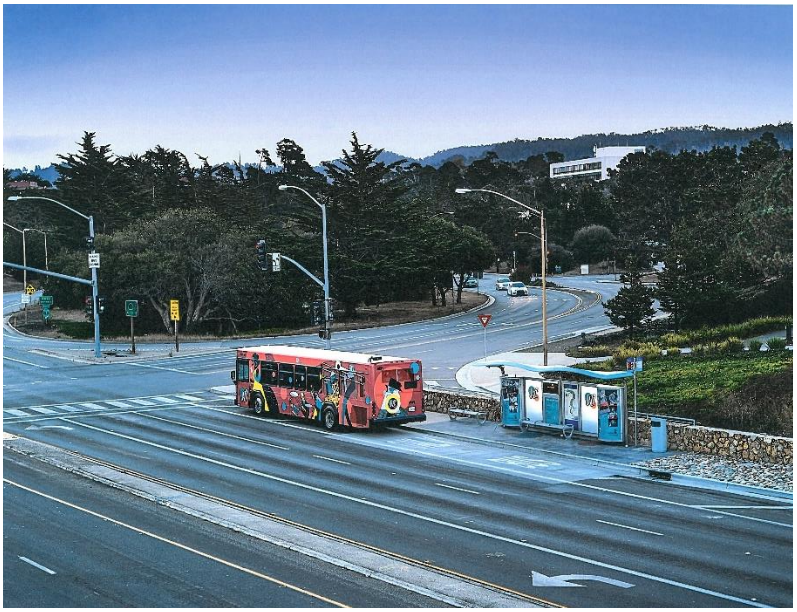
Figure 11: BRT Separated Transitway Example



3 | TRAFFIC OPERATIONS AND TRANSIT PRIORITY

Transit signal priority (TSP) and queue jump lanes are signalized intersection enhancements that reduce transit delay and improve schedule adherence. TSP is a technology which should be deployed as part of a BRT project to maximize the benefits for high-quality transit service, but both strategies are important for improving the quality of service for any route. These enhancements are "route-agnostic" and can be implemented by any jurisdiction on any corridor where buses operate. They are most valuable in highly congested corridors and in urban settings with many traffic signals.

Signal priority treatments like TSP and queue jump lanes are typically implemented by **City Staff** in coordination with MST. It may require upgrading signal equipment along a series of intersections, although most modern signal controllers are ready to implement TSP or queue jump programming.



TRANSIT SIGNAL PRIORITY

TSP modifies traffic signal controllers to provide some extra green light time in the direction a bus is traveling, to either keep buses moving through an intersection before the signal goes red, or to allow a bus to resume its route sooner than the signal would otherwise return to green. TSP technology varies and the application will be context specific.

Transit signal priority can be applied actively or passively. Table 3 summarizes active and passive TSP, including applications, context, and considerations.

Table 3: Active and Passive TSP

	Active TSP	**Passive TSP**
Definition	Modifying the traffic signal timing or phasing when transit vehicles are present, using vehicle-to-signal communication	Traffic signal timings and phasing are optimized or coordinated to on-street transit travel speeds (typically 12-20 mph) Can typically be accomplished without alterations to signal equipment
Examples	• Extending or reservicing turn phases where a bus is turning	• “Pre-timed” or Transit Signal Progressions • Passive Queue Jump Lanes
Application and Context	• Where signals are a major source of delay • Corridors with long signal cycles or distances between signals • Routes with moderate to long headways • BRT routes • Far-side stops	• Corridors with high volume of transit vehicles (10 transit veh/hr or combined headways less than 6 mins) • Corridors with short signal cycles or distances between signals • Corridors with high pedestrian activity • One-way streets • Alternating far-side and near-side stops
Considerations	• Transit facility type • Dedicated transit lanes or queue jump lanes • Traffic volumes and capacity • Signal Spacing • Cycle length • Effect on cross street delay	• Traffic volumes and capacity • Signal Spacing • Cycle length • Effect on cross street delay • Stop related delay is not considered

Source: NACTO, *Transit Street Design Guide.*

How does Transit Signal Priority work?

Passive TSP is typically done by through signal progressions or "green waves" coordinated to on-street transit speeds. Passive TSP operates based on knowledge of the transit service along the corridor and ridership patterns and does not require hardware and software investments. Since signals are timed for bus speeds, other traffic, particularly on cross streets, may experience an increase delay. Strategies such as short signal cycles and including cross-street progressions could offset the increase in delay to private motor vehicles. Passive TSP cannot react to stop related delay such as variable dwell times. Therefore, stop consolidation and dedicated transit lanes should be considered to maximize the benefits of passive TSP.

Active TSP modifies traffic signal timings or phasing following the detection of a transit vehicle. Active TSP can be activated based on conditional terms (such as transit vehicle schedule adherence or headway intervals) or unconditionally (applied for all approaching transit vehicles). Treatments can include extending a green light or a reduced red light (early green) for phases, like shown in Figure 12, or special phases for transit. These various treatments are described below along with descriptions, application, lane types, stop types, and equipment considerations in **Table 4**. Typically, the priority timing changes result in changes to the traffic signal cycle and it may take one to two additional cycles for the signal to recover to the non-priority cycle phasing and timing.

TSP is not the same as signal pre-emption, which is often used by emergency vehicles. Emergency vehicle pre-emption and railroad crossing signals override the current signal phase in order to stop traffic and allow the emergency vehicle or train to pass; TSP does not have this capability.

The **key components and participants** of an Active TSP system include the following:

- Bus and Schedule information: Transit Agency Planning Department (MST)
- Automatic Vehicle Location (AVL), GPS, or optical emitter equipment: Transit Agency Operations Department (MST)
- Detectors such as signal operations equipment, optical or GPS-based detectors, loop or vehicle detectors: City, County and State Traffic Signal Engineers
- Traffic controller with priority request generator/server and software providing TSP control strategies: City, Region and State Traffic Signal Engineers
- TSP System Management to configure settings, log events, and provide reporting: City, Region and State Traffic Signal Engineers

Modern traffic signal systems are generally TSP-ready and any modifications needed can be determined with the support of the system vendor or representative. Figure 13 shows examples of these components in relation to the intersection.

Figure 12: Green Extension and Red Truncation Cycle Examples

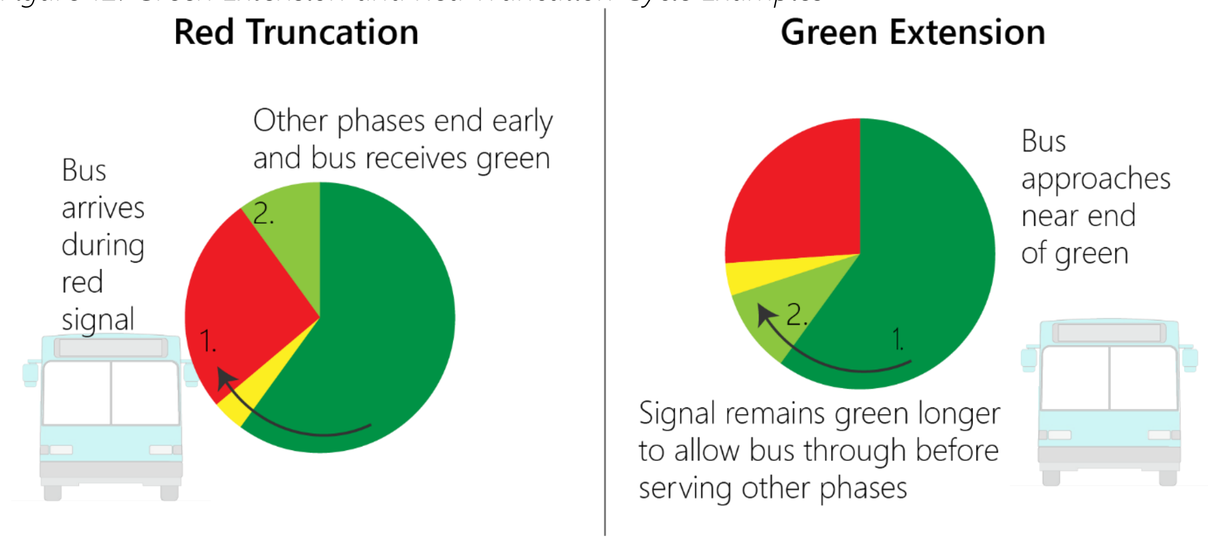


Figure 13: Active Transportation Equipment Example

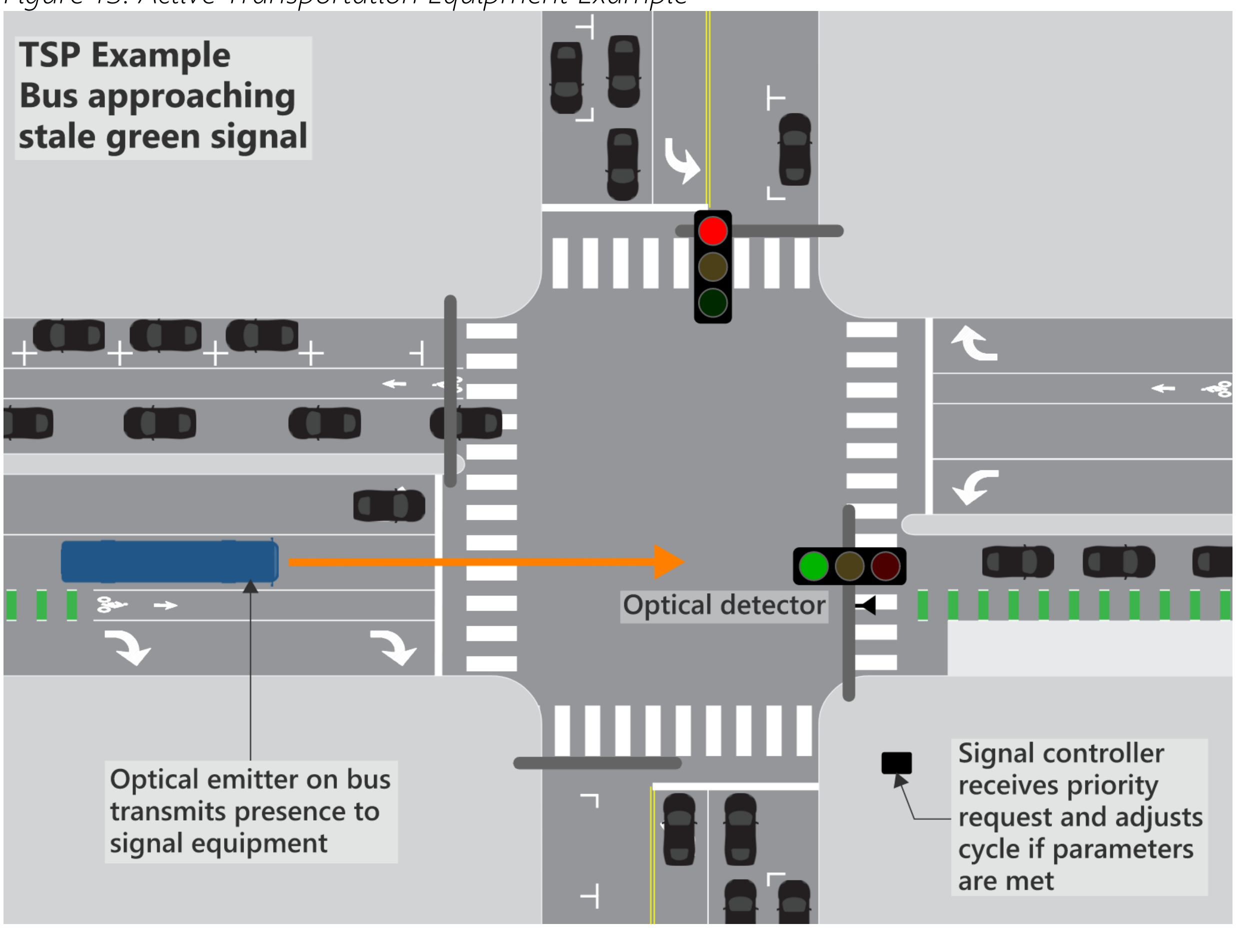


Table 4: Active TSP Treatments

Treatment	**Description**	**Application**	**Lane Types**	**Stop Types**	**Component Considerations**
Green Extension	Extra green time for detected transit vehicle	• Transit vehicle runs at back of vehicle queues • Urban, high pedestrian activity areas	• Transit Lane • Transitway • Mixed Travel Lanes	• Far-side	See key components.
Green Reallocation	Shifts when the green phase occurs	• Transit vehicle arriving behind schedule • Less impact to cross streets	• Transit Lane • Transitway • Mixed Travel Lanes	• Far-side	Requires automatic vehicle location (AVL). See key components.
Red Truncation	Provides green phase earlier than programmed (shortens red phase)	• To clear an intersection with a waiting transit vehicle • Long distance between intersections	• Transit Lane • Transitway • Shared Right Turn • Queue Jump Lane	Any	See key components. Detector equipment must be able to detect a bus from a distance far enough to clear the conflicting pedestrian phase.
Upstream Green Truncation	Stops traffic behind a bus as boarding is completed	• Allow the bus to re-enter (turn-out stop) • Prevent queuing behind a bus (far-side in-lane) • Moderate frequency transit routes	• Mixed Travel Lanes	• Far-side In-Lane • Turn-outs	See key components.
Phase Insertions/ Phase Sequence Changes	Special bus-only phases or prioritization of turn phases	• Queue jumps • Shared turn lanes	• Transit Lane • Queue Jump Lane • Shared Turn Lane • Transitway	Any	See key components.
Phase Reservicing	Provides same phase twice in a given cycle	• Left turns • Queue jump • Phases with short timing	• Transit Lane • Transitway • Mixed Travel Lanes	Any	See key components.

Source: NACTO, *Transit Street Design Guide*

QUEUE JUMPS

Queue jumps provide a designated traffic signal that allows the bus to cross an intersection and "jump ahead" of queued traffic. Queue jumps are most effective when paired with a *near-side stop (see Chapter 1)* so that the advantage of the jump is not then lost by stopping on the far-side of the intersection.

Queue jumps are only practical where a short exclusive lane can be designated for buses, or when the right-turn lane can be used by buses proceeding straight through the intersection (provided the geometry allows for the bus to continue across). The shared right-turn/queue-jump approach cannot be used when a right-turn lane has a protected signal phase (or overlap with another signal phase). The length of the queue jump lane should be long enough for buses to bypass expected peak queues. An example of a shared right turn/queue-jump approach is shown in Figure 14.

> The shared right-turn queue-jump approach cannot be used when a right-turn lane has a protected signal phase or overlap with another signal phase.

A separate signal head with a distinct design can be used to avoid motorist confusion, although this requires approval from the Federal Highway Administration for a design exception[3]. Additional signage may be provided to alert other drivers.

Queue jumps can also facilitate a bus route that must make a left turn very shortly after the intersection, by allowing the bus to cross the intersection ahead of queued traffic and crossing over to the left-turn lane downstream.

Like TSP, implementation requires coordination between **City Staff** and **MST Staff**. The queue jump signal typically creates a new phase within the overall signal cycle and may require taking a few seconds of green time away from another phase, depending on the signal timing.

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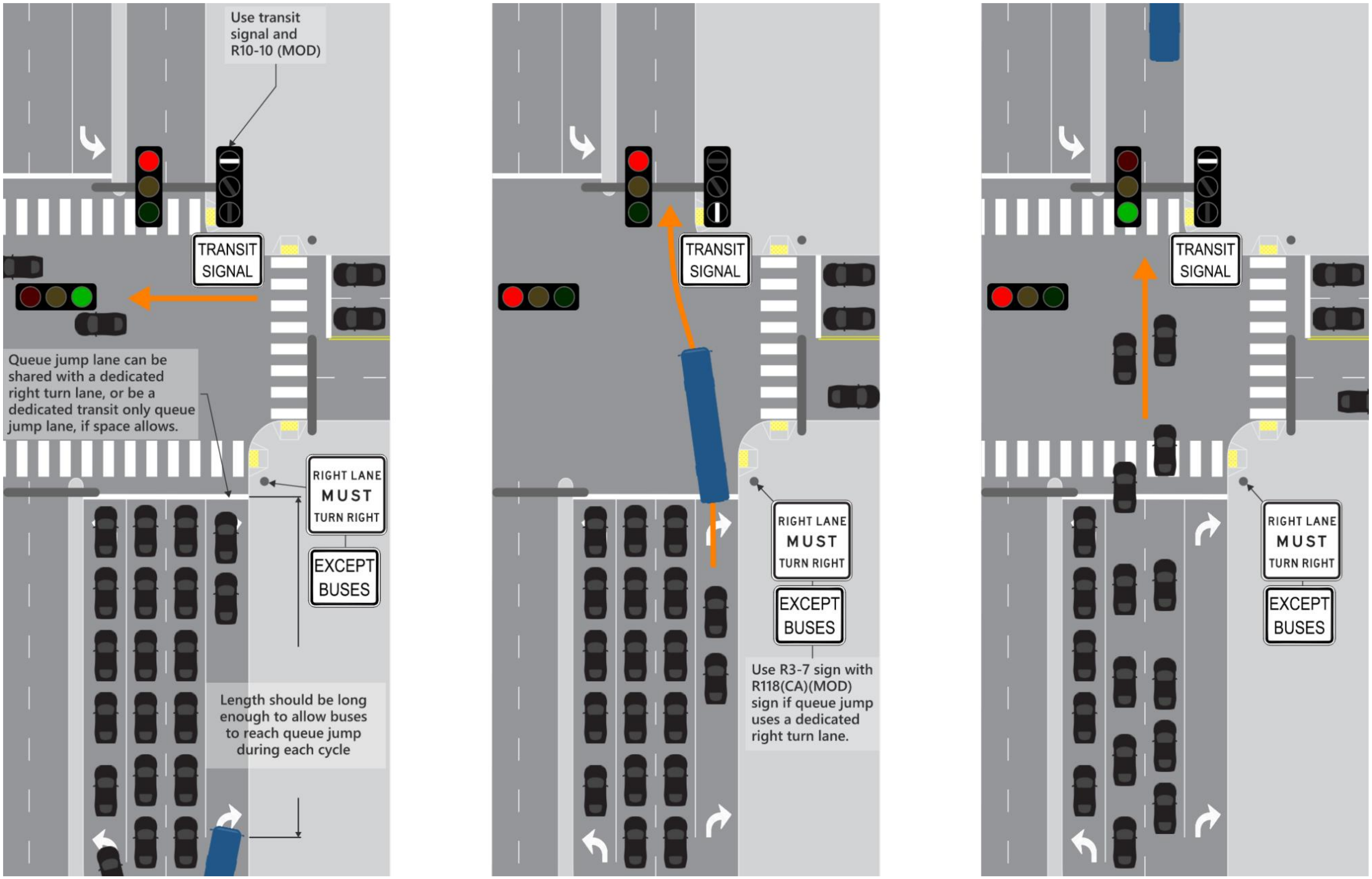
[3] "Part 4. Highway Traffic Signals." *Manual on Uniform Traffic Control Devices, 2009 Edition*. Federal Highway Administration, Washington, DC: 2009. http://mutcd.fhwa.dot.gov/pdfs/2009r1r2/part4.pdf

Figure 14: Shared Right Turn/Queue Jump Lane Example



4 | RIDER ACCESS TO BUS STOPS AND STATIONS

In order to use bus service, people of all ages and abilities must be able to reach bus stops safely. Although this seems obvious, it can be a challenge to put into practice, as bus stops are sometimes located in areas without sidewalks, crosswalks, or lighting. Over time, laws such as the ADA have been enacted to ensure that new and upgraded transit services and infrastructure provide safe and equal access for people of all abilities. Regardless of people's ambulatory abilities, everyone wants to be safe and feel safe along their journey and while waiting for the bus.

This chapter provides guidance on how to provide safe and high-quality access to and between bus stops and destinations for people of all abilities. Second, this chapter addresses bicycling and its interactions with public transit both in terms of riders using bicycles to complete their trip and in terms of general bicycle travel around and past bus stops.

ACCESS LEADING TO AND FROM STOPS

There are many reasons to ensure that people can safely access bus stops on ADA-compliant sidewalks that are in a state of good repair and which connect the bus stop with the surrounding developments and existing pedestrian network. All stakeholders should consider that providing these safe and accessible connections is not only required by Federal law, but also significantly enhances the experience for people using the bus and therefore makes the investment in the transit stop itself go even further. Providing a high-quality pedestrian environment between the stop and other destinations is important for people of all abilities and at all stages of life. A well-designed transit stop fails to serve a rider if there is no way for them to safely reach the destination once they exit the bus.

MST Staff are responsible for ensuring that the area within the bounds of the bus stop itself meet ADA requirements and MST's minimum design standards. This will require coordination with **City Staff** when the sidewalk area is owned by the city. MST Staff will also identify connections to nearby destinations or pedestrian infrastructure that may be inadequate to serve rider needs.

City Staff are responsible for ensuring that the pedestrian network connections beyond the bus stop meet ADA requirements and local jurisdiction standards. Cities may also require developers to improve pedestrian infrastructure through fees and development agreements.

Developers should work with both MST Staff and City Staff to maximize the value of investment in public transit infrastructure with high-quality access between the bus stop and a neighboring development. Ideally, new developments are oriented to the roadway so that the main entrance is as close to the street and bus stop as is feasible. For decades, development has prioritized car parking at the street front, making pedestrians and bus riders walk through the lot to reach the entrance. At a minimum, developers can reconfigure parking lots to provide a clear and safe path of travel for pedestrians to the nearby bus stop.

Using Bicycles to Access Transit

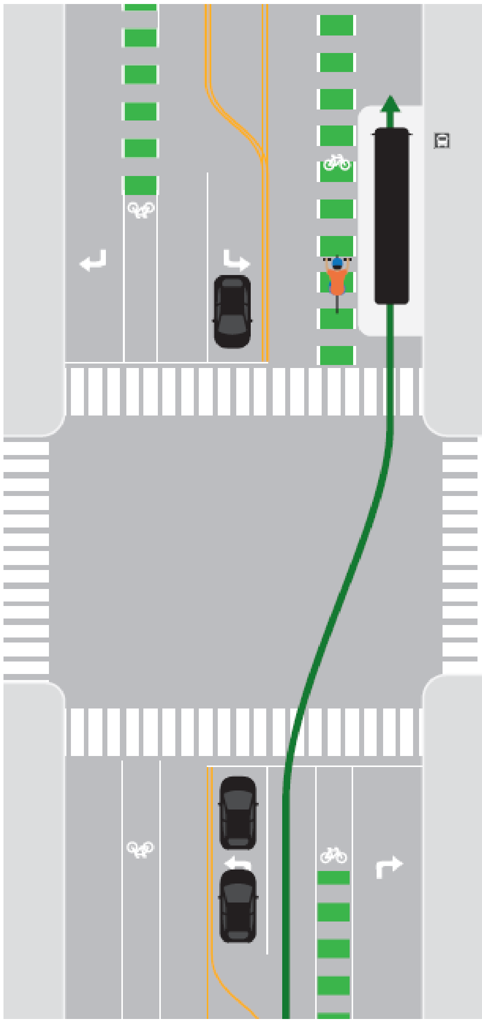
People often combine part of their transit trip with a bicycle, particularly because that may enable them to come from or go even further away. All MST buses are equipped with bike racks. Providing a high-quality bicycle network is important for **City Staff** to consider, but **MST Staff** and **Developers** have a role in ensuring that people have opportunities to safely store their bicycle at either end of their trip. This may include any combination of providing bike racks or lockers around bus stops, or ensuring that neighboring developments have an adequate supply of high-quality bicycle storage.

BUS-BIKE INTERFACE AROUND BUS STOPS

Typically, buses and bicycles share space on the right side of the road and can frequently interact with each other as they often travel at similar average speeds. As cities increasingly dedicate space for bike lanes or other types of bikeways on city streets, how those facilities and transit stops interact is an important consideration for **City Staff** and **MST Staff**.

Along the road, buses and bikes should operate in separate lanes whenever possible, ideally with a 6' striped bike lane or better facility for bicyclists and clear marking approaching bus stops (as shown below). In cases where a bus-only lane is provided but there is inadequate width for a separate bike lane, it is recommended to allow a shared bus-bike lane, with posted signage and stencils. Based on research conducted by Fehr & Peers for the Los Angeles Metropolitan Transportation Authority (Metro), cyclists generally favor sharing a lane exclusively with professional bus operators over general traffic lanes when no bike lane can be provided[4].

[4] *Bike/Bus Interface Study*, Los Angeles County Metropolitan Transportation Authority, 2018. Project summary: https://media.metro.net/about_us/committees/sfs/images/sfs_presentation_Bike-Bus_Interface_study_2017-0919.pdf



Bikes at In-Lane and Pull-Over Bus Stops

If the roadway provides a bike lane at the preferred MST bus stop configuration, green hatching paint should be used to alert all users to the crossover area where buses pull into and out of the stop, as shown in Figure 15. In many cases, a narrow road width may result in the stopped bus blocking the bike lane. It is still recommended to provide the green hatched striping through the bus stop zone at this point. Buses and bikes will not always be arriving in the stop zone at the same time, and when no bus is present, bicyclists should have a clear indication of where to ride. When a bus is present, the bicyclist should wait behind the bus for it to depart.

At stops where buses are expected to lay over or dwell for long periods of time, it may be desirable to omit the green hatch striping and instead use a bike sharrow stencil in the adjacent travel lane, only in the bus stop area.

Figure 15: Bikes at Pull-Over Stop Example

Bikes at Bus Bulb Stops

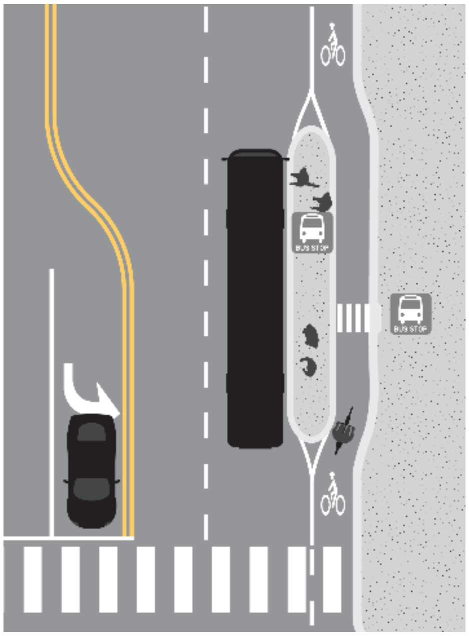


Figure 16: Bus Boarding Island Example

Bus bulbs sometimes have the disadvantage of taking space from bike lanes (or paved shoulders where a bike lane is implied). A possible solution is to divert the bike lane behind the bus stop. Doing so eliminates the conflict between the bus and the bicyclist, which is high-risk for the bicyclist. Bicyclists and pedestrians are more able to see one another and react with appropriate time to avoid a crash. This design can further minimize bike-pedestrian conflicts by raising the bike lane grade up to sidewalk level between the bus stop platform and the sidewalk, forcing bicyclists to slow down further and clearly indicating pedestrian priority. Figure 16 illustrates a bus bulb with the bicycle lane diverted behind the passenger boarding island.

The photo below shows an example of a bus boarding island with diverted bike lane on Dexter Avenue in Seattle, WA.

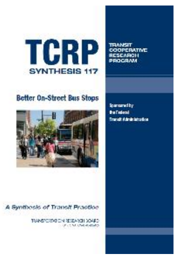
TECHNICAL REFERENCE

Sources and Additional Bus Stop and Street Design Guidance

Transit Street Design Guide

National Association of City Transportation Officials (NACTO), 2016

https://nacto.org/publication/transit-street-design-guide/



Better On-Street Bus Stops

Transit Cooperative Research Program, 2015

http://www.trb.org/Publications/Blurbs/172376.aspx

From Sorry to Superb: Everything You Need to Know about Great Bus Stops

TransitCenter, 2018

https://transitcenter.org/publication/sorry-to-superb/

2010 ADA Standards for Accessible Design, United States Department of Justice, 2010. https://www.ada.gov/regs2010/2010ADAStandards/2010ADAstandards.htm

Design of On-street Transit Stops and Access from Surrounding Areas, American Public Transportation Association, 2012. https://www.apta.com/wp-content/uploads/Standards_Documents/APTA-SUDS-UD-RP-005-12.pdf

Guidelines for the Location and Design of Bus Stops (TCRP Report 19), Transit Cooperative Research Program, 1996. http://www.trb.org/Main/Blurbs/153827.aspx

Toolkit for the Assessment of Bus Stop Accessibility and Safety, National Aging and Disability Transportation Center and Easter Seals Project Action, 2014. https://www.nadtc.org/resources-publications/toolkit-for-the-assessment-of-bus-stop-accessibility-and-safety/

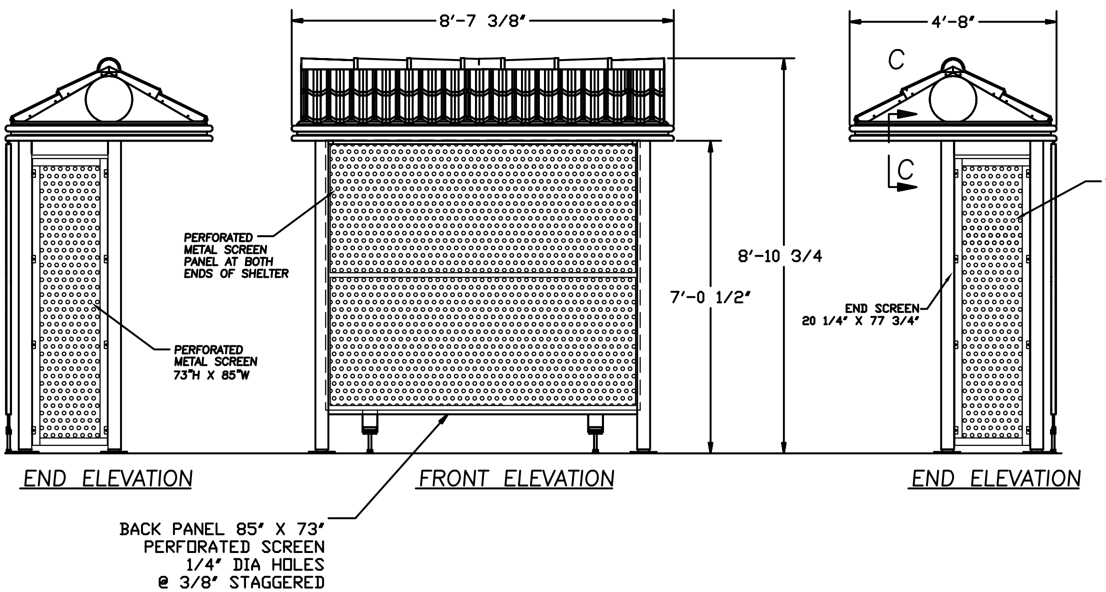
Transit Capacity and Quality of Service Manual, 3rd Edition. Transit Cooperative Research Program, 2013. http://www.trb.org/Main/Blurbs/169437.aspx

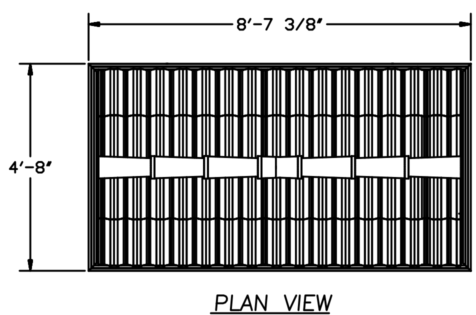
BUS SHELTER STANDARDS

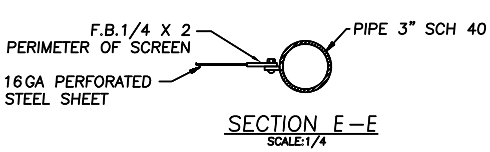
Figure T 1: Bus Shelter Standards

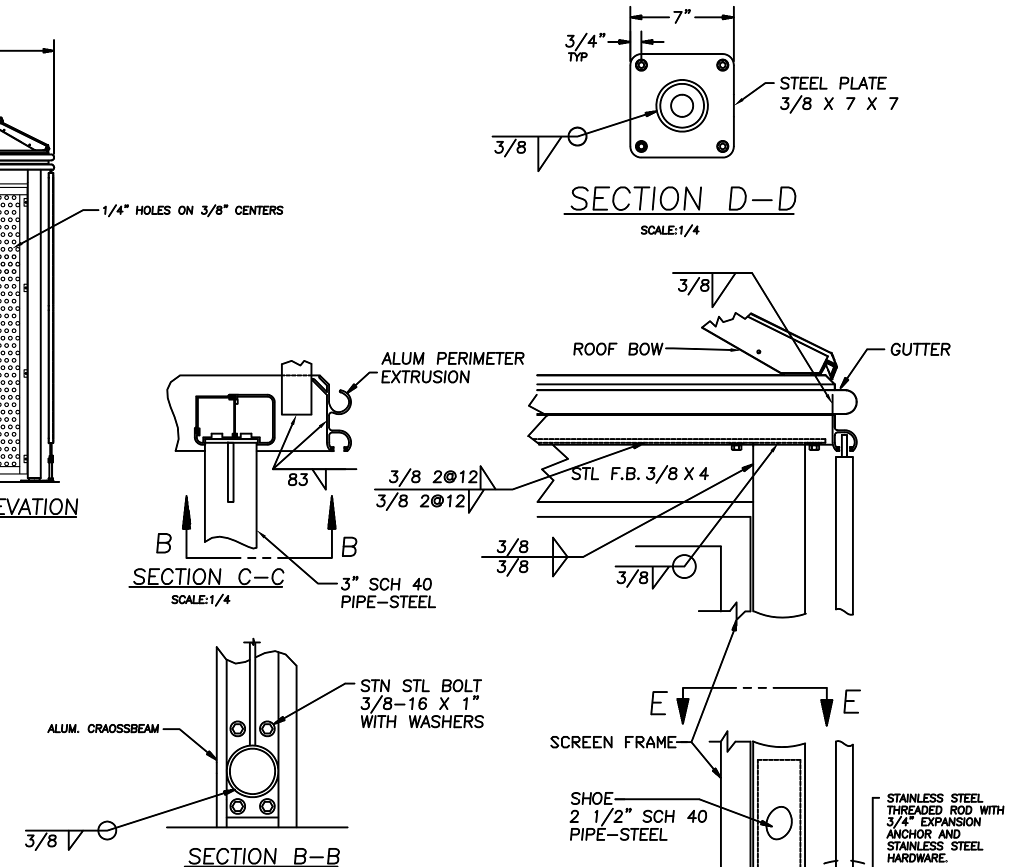
The following pages include design drawings for Tolar-brand shelters currently preferred by MST. These are provided as reference for planning stop amenities and layout. Final design should refer to the most recent information from MST and be reviewed by a licensed engineer.

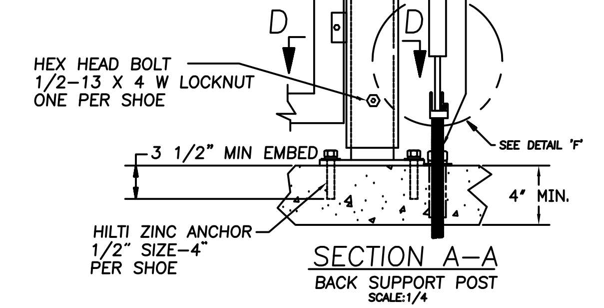
Note: Customized and decorative shelters are strongly encouraged to be designed with the community in mind. Contact MST for more information.

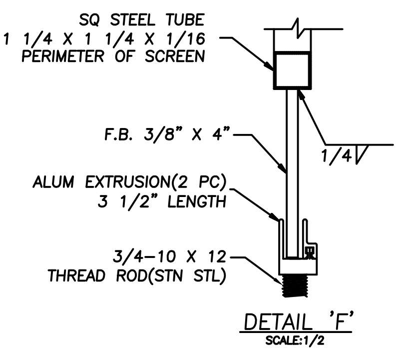












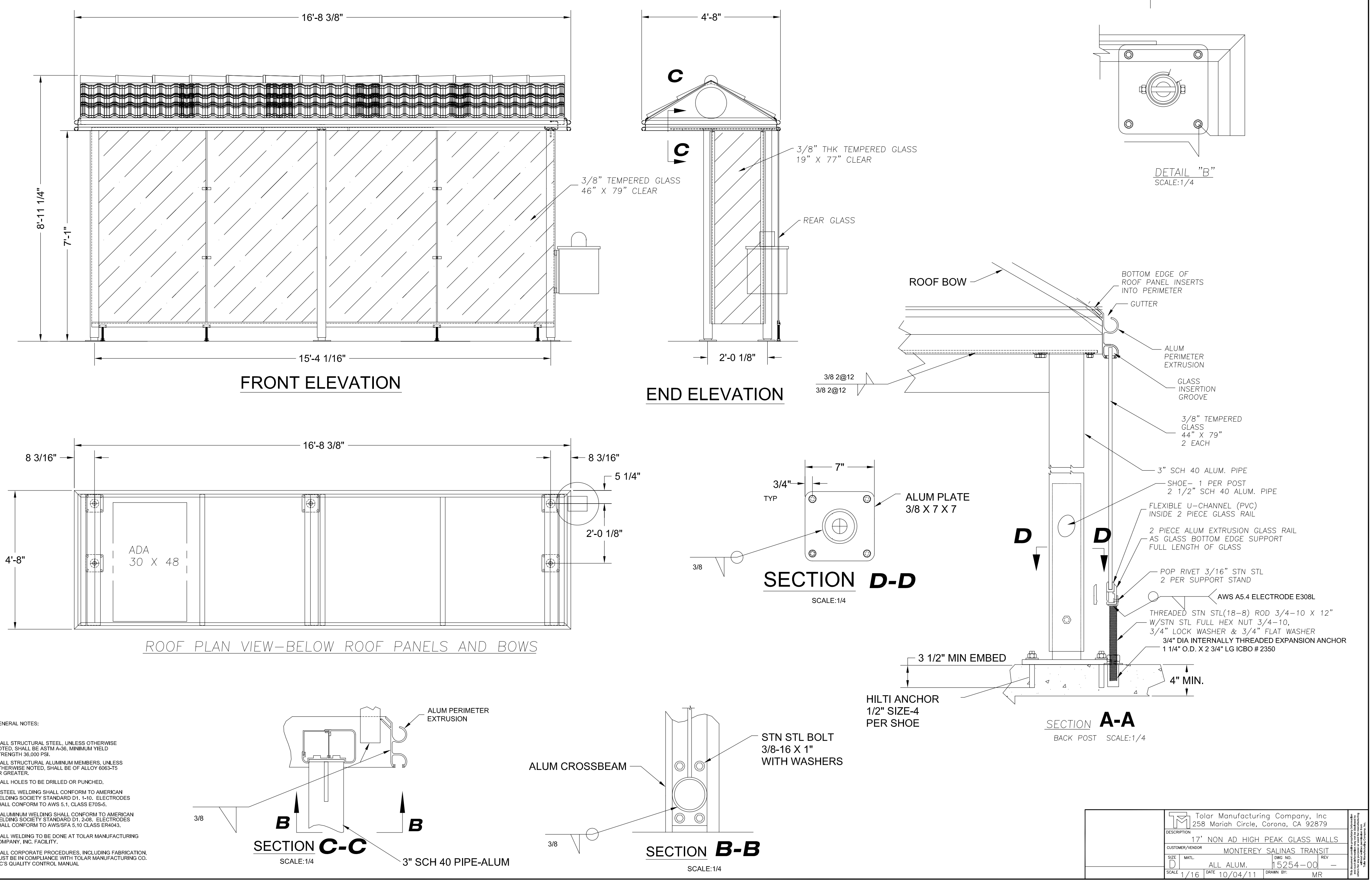
GENERAL NOTES:

1. ALL STRUCTURAL STEEL, UNLESS OTHERWISE NOTED, SHALL BE ASTM A-36, MINIMUM YIELD STRENGTH 36,000 PSI.
2. ALL STRUCTURAL ALUMINUM MEMBERS, UNLESS OTHERWISE NOTED, SHALL BE OF ALLOY 6063-T5 OR GREATER.
3. ALL HOLES TO BE DRILLED OR PUNCHED.
4. STEEL WELDING SHALL CONFORM TO AMERICAN WELDING SOCIETY STANDARD D1. 1-10. ELECTRODES SHALL CONFORM TO AWS 5.1, CLASS E70S-5.
5. ALUMINUM WELDING SHALL CONFORM TO AMERICAN WELDING SOCIETY STANDARD D1. 2-08. ELECTRODES SHALL CONFORM TO AWS/SFA 5.10 CLASS ER4043.
6. ALL WELDING TO BE DONE AT TOLAR MANUFACTURING COMPANY, INC. FACILITY.
7. ALL CORPORATE PROCEDURES, INCLUDING FABRICATION, MUST BE IN COMPLIANCE WITH TOLAR MANUFACTURING CO. INC?S QUALITY CONTROL MANUAL

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

Tolar Manufacturing Company, Inc
258 Mariah Circle, Corona, CA 92879

DESCRIPTION: 9' NON-AD W/SCREENS-NO ELEC (ELEVATION DWG)
CUSTOMER/VENDOR: MONTEREY SALINAS TRANSIT
SIZE: D | MATL. | DWG NO. 20246-01 | REV —
SCALE 1/16 | DATE 10/24/11 | DRAWN BY: EM



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7. ALL CORPORATE PROCEDURES, INCLUDING FABRICATION, MUST BE IN COMPLIANCE WITH TOLAR MANUFACTURING CO. INC'S QUALITY CONTROL MANUAL

Tolar Manufacturing Company, Inc
258 Mariah Circle, Corona, CA 92879

DESCRIPTION 17' NON AD HIGH PEAK GLASS WALLS			
CUSTOMER/VENDOR MONTEREY SALINAS TRANSIT			
SIZE D	MATL. ALL ALUM.	DWG NO. 15254-00	REV —
SCALE 1/16	DATE 10/04/11	DRAWN BY: MR	

Figure T 3: Two-Seat Post

Simme Seat Pole www.simmeseat.com

Other bus stop products, signposts, and seating are available. Please consult with MST for the latest preferred products.

BUS STOP ADA REQUIREMENTS (CITED)

Table T 1: Bus Stop Features and Amenities Requirements

Features and Amenities	**Description**	**Source**
Passenger Landing Pad	810.2.1 Surface. Bus stop boarding and alighting areas shall have a firm, stable surface. 810.2.2 Dimensions. Bus stop boarding and alighting areas shall provide a clear length of 96 inches (2440 mm) minimum, measured perpendicular to the curb or vehicle roadway edge, and a clear width of 60 inches (1525 mm) minimum, measured parallel to the vehicle roadway. 810.2.3 Connection. Bus stop boarding and alighting areas shall be connected to streets, sidewalks, or pedestrian paths by an accessible route complying with 402. 810.2.4 Slope. Parallel to the roadway, the slope of the bus stop boarding and alighting area shall be the same as the roadway, to the maximum extent practicable. Perpendicular to the roadway, the slope of the bus stop boarding and alighting area shall not be steeper than1:48.	*2010 ADA Standards for Accessible Design, Section 810.2*
Bus Shelter	A minimum distance of 2 ft should be maintained between the back-face of the curb and the roof or panels of the shelter. A minimum clear floor area measuring 30 in. wide by 48 in. long, completely within the perimeter of the shelter, must be provided. A minimum distance of 2 ft should be maintained between the back-face of the curb and the roof or panels of the shelter.	*APTA SUD-UD-RP-005-12 | Design of On-street Transit Stops and Access from Surrounding Areas*
	Light shelters when existing streetlights do not provide adequate lighting. Proper lighting is important for the safety and security of transit patrons.	*2010 ADA Standards for Accessible Design, Section 810.3*
Benches	903.2 Clear Floor or Ground Space. Clear floor or ground space complying with 305 shall be provided and shall be positioned at the end of the bench seat and parallel to the short axis of the bench. 903.3 Size. Benches shall have seats that are 42 inches (1065 mm) long minimum and 20 inches (510 mm) deep minimum and 24 inches (610 mm) deep maximum. 903.4 Back Support. The bench shall provide for back support or shall be affixed to a wall. Back support shall be 42 inches (1065 mm) long minimum and shall extend from a point 2 inches (51 mm) maximum above the seat surface to a point 18 inches (455 mm) minimum above	*2010 Standards for Accessible Design, Section 903*

	the seat surface. Back support shall be 2 1/2 inches (64 mm) maximum from the rear edge of the seat measured horizontally. 903.5 Height. The top of the bench seat surface shall be 17 inches (430 mm) minimum and 19 inches (485 mm) maximum above the finish floor or ground. 903.6 Structural Strength. Allowable stresses shall not be exceeded for materials used when a vertical or horizontal force of 250 pounds (1112 N) is applied at any point on the seat, fastener, mounting device, or supporting structure. 903.7 Wet Locations. Where installed in wet locations, the surface of the seat shall be slip resistant and shall not accumulate water.	
	All new benches must have seat partitions.	Local Standard from MST
Kiosks	308.2.1 Unobstructed. Where a forward reach is unobstructed, 48 inches (1220 mm) maximum and 15 inches (380 mm) minimum above the finish floor or ground. 308.2.2 Obstructed High Reach. 48 inches (1220 mm) maximum where the reach depth is 20 inches (510 mm) maximum. 44 inches (1120 mm) maximum and the reach depth shall be greater than 22 inches and 25 inches (635 mm) maximum. 308.3.2 Obstructed High Reach. Where a clear floor or ground space allows a parallel approach to an element and the high side reach is over an obstruction, the height of the obstruction shall be 34 inches (865 mm) maximum and the depth of the obstruction shall be 24 inches (610 mm) maximum. The high side reach shall be 48 inches (1220 mm) maximum for a reach depth of 10 inches (255 mm) maximum. Where the reach depth exceeds 10 inches (255 mm), the high side reach shall be 46 inches (1170 mm) maximum for a reach depth of 24 inches (610 mm) maximum.	*2010 Standards for Accessible Design, Section 308.2*

TYPICAL BUS SPECIFICATIONS

Table T 2: Typical Bus Dimensions, Weights, and Capacities

	30’ Coach	**35’ Coach**	**40’ Coach (Low Floor)**	**45’ Commuter Coach**	60’ Articulated
OVERALL LENGTH (with bicycle rack)	32’8”	36’6”	**41’8”**	46’6”	62’
WIDTH (with mirrors)	10’7”	10’7”	**10’7”**	10’7”	10’6”
OVERALL HEIGHT (with radio antenna)	10’5”	10’5”	**10’5”**	11’5”	11’9”
WHEELBASE LENGTH	14’2”	18’4”	**23’8”**	26’6”	19’11”+23’3”
FRONT OVERHANG	4’9”	6’1”	**5’9”**	6’4”	7’4”
REAR OVERHANG	7’5”	7’0”	**7’8””**	8’9”	10’3”
FRONT BUMPER (Distance to ground)	1’6”	11”	**1’1”**		14¼”
REAR BUMPER (Distance to ground)	1’4”	1’6”	**1’6”**		19½”
FIRST STEP (Distance to ground)	1’3”	1’3”	**1’3”**		1’3”
UNDERBODY (Distance to ground)	1’ ½ ”	1’ ½ ”	**1’ ½ ”**		10¼”
CENTERLINE (Front door to rear door)	13’5”	17’3”	**20’1”**		39’
GROSS VEHICLE WEIGHT (lbs)	34,850	39,400	**39,600**	50,000	69,320
Front Axle Capacity	11,680	14,400	**14,600**	16,000	15,660
Rear Axle Capacity	23,170	25,000	**25,000**	22,500	28,660
Seating Capacity	32	35	**36**	57	60 max
Wheelchair Securement Positions	2	2	2	2	2

Table T 3: Bus Turning Movement Dimensions	
Turning Radius	48’ minimum outside radius (with overhang), 50’ desirable 27’ minimum inside radius, 30’ desirable
Approach Angle	9 degrees
Departure Angle	9 degrees
Turning Radius (Outside)	44’

Bus Stop Area Lengths

Table T 4: Minimum Bus Stop Area Length By Vehicle Type (feet)

Stop Position	40’ Bus	60’ Bus	2 x 40’ Bus	2 x 60’ Bus
In Lane Stops[1]				
Far-Side	45	65	90	130
Near-Side[2]	35	55	80	115
Pull Out Stops[3]				
Far-Side	90	100	125	165
Far-Side (right turn)[4]	140	160	140	230
Mid-Block	120	145	185	210

Notes:

1. In lane Stop Area = Bus Stop Platform Length

2. Near-side bus should never be used at unsignalized intersections, to reduce the risks associated with a stopped bus blocking the view of people attempting to cross the street and on-coming motorists.

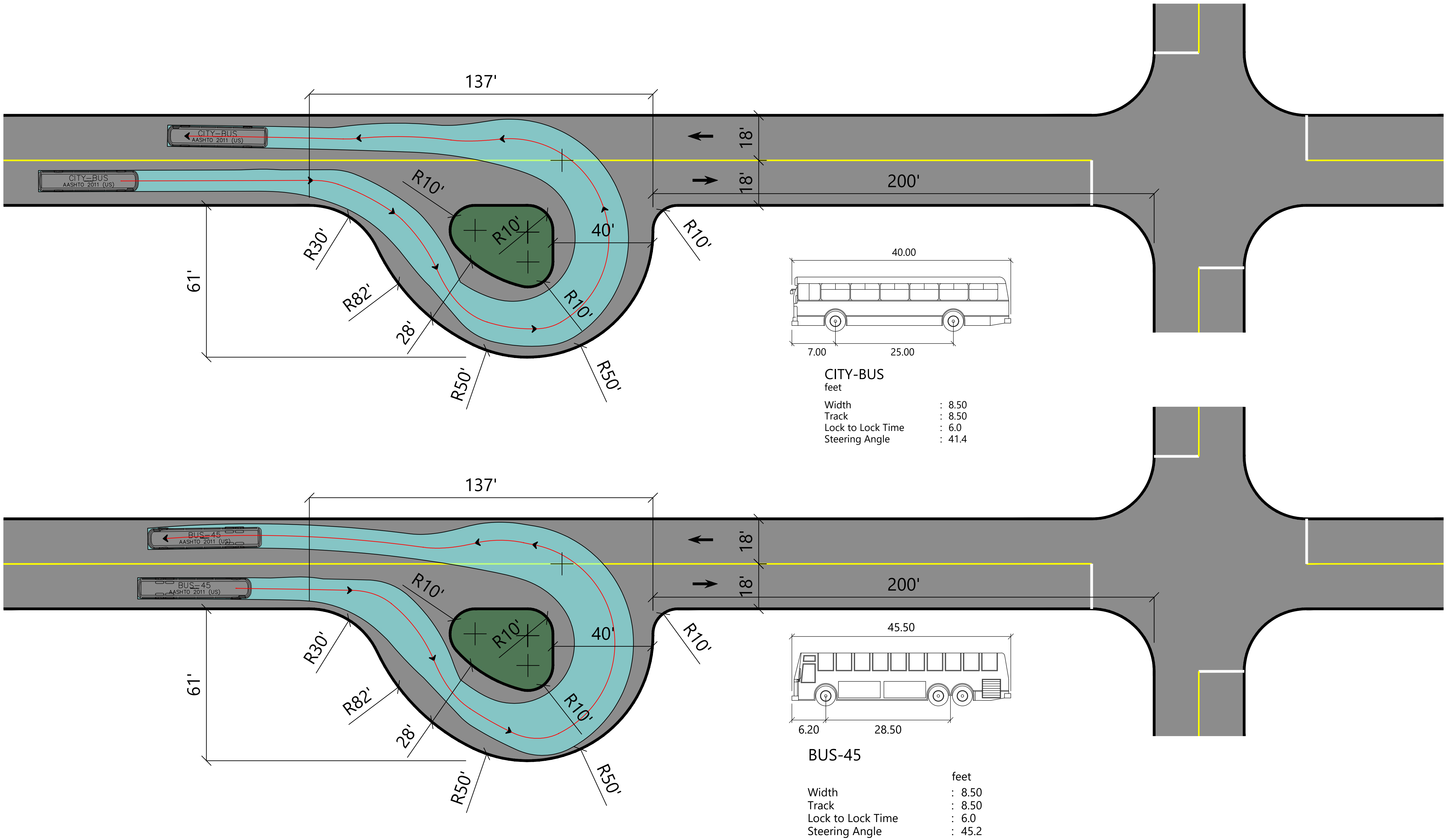
3. Pull out stop area includes the platform length and transition space in and out of the stop.

4. Applicable for locations in which a bus would be turning right around the corner of the intersection into the stop.

Source: NACTO Transit Street Design Guide

BUS TURNING TEMPLATES

Buses are among the largest vehicles on the road, and in some cases are less maneuverable than comparably sized fire apparatus or tractor-trailers due. These turning template graphics should illustrate for planners and engineers the considerations for how buses negotiate corners and turns, to ensure proper clearance is provided.

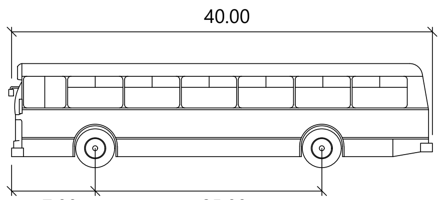


Scale
1:40

Exhibit 1

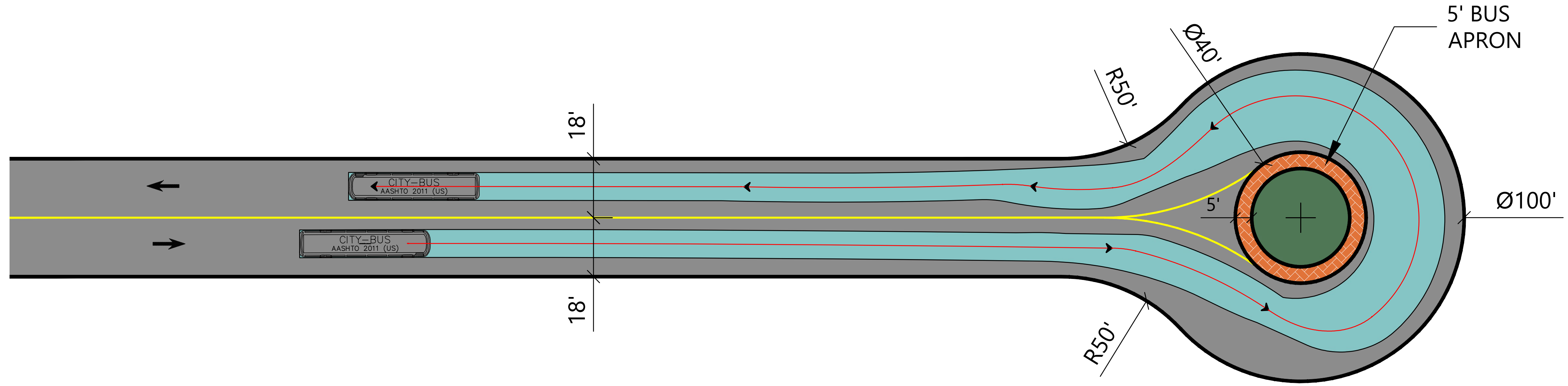
MST Design For Transit
40' / 45' Bus Turning Movements - Jug Handle

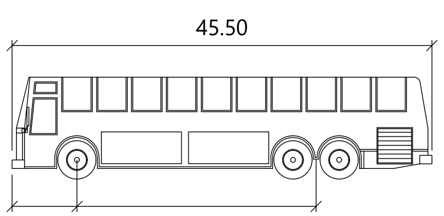
CONCEPTUAL - NOT FOR CONSTRUCTION. ADDITIONAL
DETAILED ANALYSIS AND ENGINEERING DESIGN REQUIRED.



CITY-BUS
feet

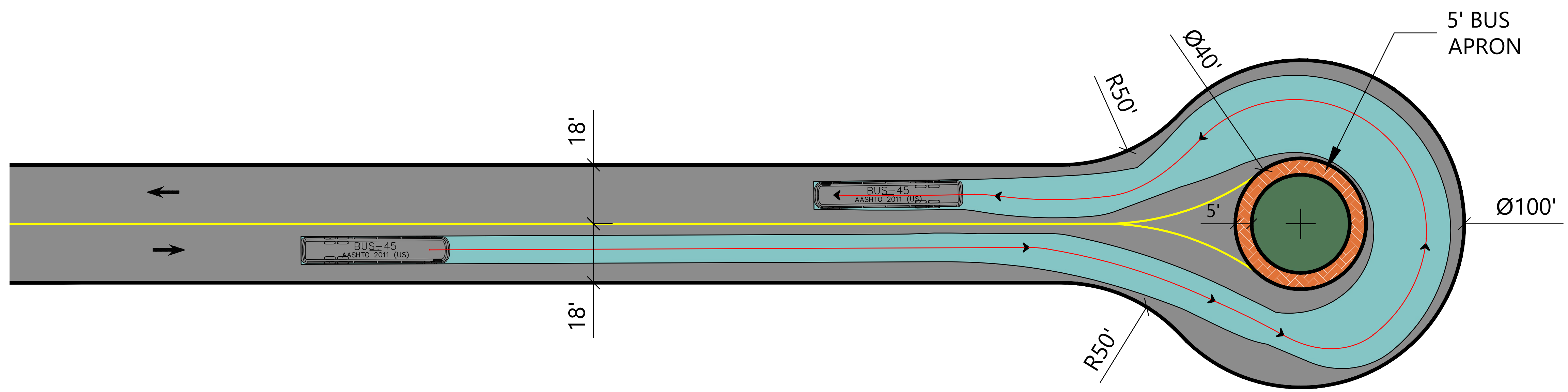
Width	:	8.50
Track	:	8.50
Lock to Lock Time	:	6.0
Steering Angle	:	41.4





BUS-45

		feet
Width	:	8.50
Track	:	8.50
Lock to Lock Time	:	6.0
Steering Angle	:	45.2

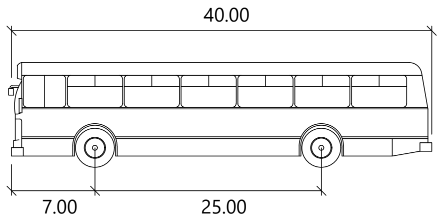


Scale
1:40

Exhibit 2

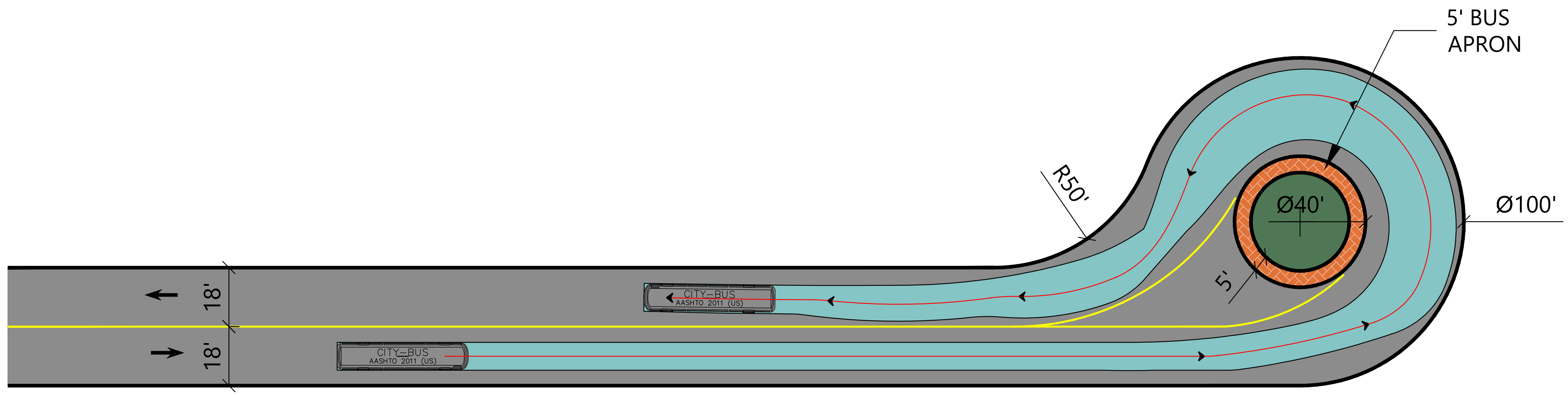
CONCEPTUAL - NOT FOR CONSTRUCTION. ADDITIONAL
DETAILED ANALYSIS AND ENGINEERING DESIGN REQUIRED.

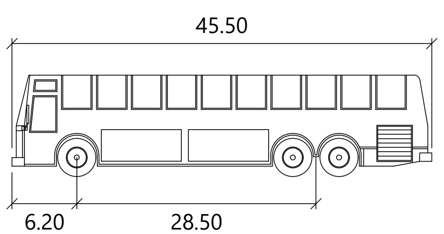
MST Design For Transit
40' / 45' Bus Turning Movements - Symmetrical Cul-De-Sac



CITY-BUS
feet

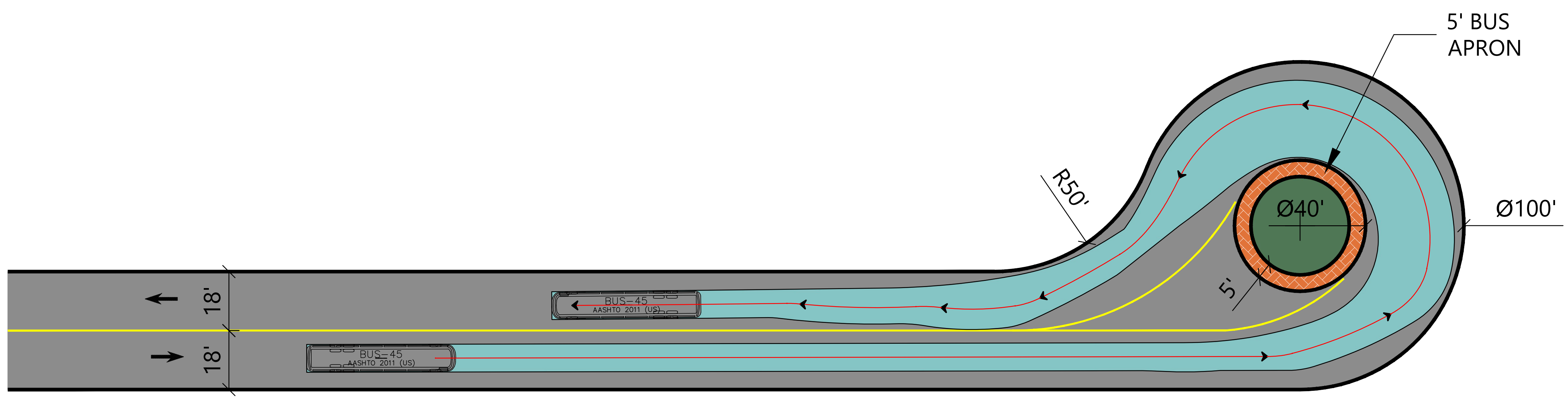
Width	:	8.50
Track	:	8.50
Lock to Lock Time	:	6.0
Steering Angle	:	41.4





BUS-45

		feet
Width	:	8.50
Track	:	8.50
Lock to Lock Time	:	6.0
Steering Angle	:	45.2



Scale
1:40

Exhibit 2

MST Design For Transit
40' / 45' Bus Turning Movements - Asymmetrical Cul-De-Sac

CONCEPTUAL - NOT FOR CONSTRUCTION. ADDITIONAL
DETAILED ANALYSIS AND ENGINEERING DESIGN REQUIRED.