OmniTrans
Connecting Our Community.

Transit Design Guidelines

Final Report

March 15, 2013

DISCLAIMER

The purpose of these guidelines is to develop suggested design criteria that should be considered when designing and placing transit facilities. This information is not to be used as a set of standard details on which to base a final design, but rather as recommended criteria and general guidance for the placement and safe design of transit facilities. It cannot be overemphasized that these guidelines must be used in conjunction with sound evaluation of the facts and planning/engineering judgment. These guidelines are intended to be used for actions on new or revised stop locations, and do not intend to apply to existing stop locations.

Local jurisdictions, in endorsing these guidelines, indicate their general acceptance of the information provided. Their acceptance of these guidelines does not modify or supersede their current standards and/or policies otherwise adopted by the jurisdiction. It is also important to note that the preferred dimensions should be planned for, and minimum dimensions are applicable only in specific constrained circumstances.

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- Omnitrans' Maintenance, Marketing, Operations, Planning, and Safety & Security departments
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  - City of Chino Hills
  - City of Colton
  - City of Fontana
  - City of Grand Terrace
  - City of Highland
  - City of Loma Linda
  - City of Montclair
  - City of Ontario
  - City of Rancho Cucamonga
  - City of Redlands
  - City of Rialto
  - City of San Bernardino
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1. INTRODUCTION

This document summarizes the recommended guidelines for the design of transit system components including bus stops, bus facilities and amenities, and the sbX system.

1.1 Purpose and Organization of Transit Design Guidelines

The purpose of this manual is to provide design criteria guidelines that should be considered when designing and placing safe and secure transit facilities. These guidelines are developed by Omnitrans, working with the local jurisdictions they serve for the goal of providing safe, comfortable and convenient high quality facilities at bus stop locations, while considering the operational needs of Omnitrans, the requirements of the Americans with Disabilities Act (ADA), other federal and state accessibility mandates, and public safety and security.

These guidelines are intended for use by city planners, designers, traffic engineers, developers, and other public officials. The general public may also find these guidelines useful in understanding the current practices for the placement of transit facilities. By no means is this information intended to be used as standard details on which to base a final design, but rather as recommended criteria and general guidance for the placement and safe design of transit facilities. It cannot be overemphasized that these guidelines must be used in conjunction with full evaluation of the facts and local conditions, and the application of sound planning/engineering judgment. Each particular site must be thoroughly examined and each particular project must be evaluated from the aspect of safety, operational requirements, and cost-effectiveness. Design solutions may need to be adjusted accordingly to satisfy site specific constraints and applicable local ordinances.

These guidelines are intended to be used for actions on new or revised stop locations and for sbX system implementation, and do not apply to existing stop locations.

1.2 Goals

The goals of the guidelines are to:

- Promote consistency in local bus stop and transit facility placement and design throughout Omnitrans' service area;
- Provide guidance for cities, property owners, real estate developers, and other partners to incorporate bus stops and other facilities within new development that meet Omnitrans' operational needs;
- Help communities meet their mobility and sustainability goals by providing safe, comfortable, and convenient transit facilities that encourage public transportation use;
- Incorporate intelligent transportation systems (ITS) seamlessly into the Omnitrans system;
- Provide comfortable and convenient high quality transit facilities; and
- Provide a template for sbX system development in identified sbX corridors and station locations.

1.3 Document Overview

Omnitrans provides a range of services, each with its own identity, to serve the San Bernardino Valley. These services require different transit infrastructure improvements based on the type of service. This document provides the design guidelines for the full range of Omnitrans services and corresponding transit facilities. This effort to include all of Omnitrans services in a single document that builds upon Omnitrans 2006 Bus Stop Design Guidelines and includes a standardized design of the sbX system that is currently under construction along Route 2 in San Bernardino and Loma Linda.

Local fixed route bus service accounts for the largest portion of Omnitrans services. In addition to the local fixed route service, Omnitrans operates the Access and Omni-link services and is introducing a new mode of transit service in its service area, Bus Rapid Transit (BRT), a premium transit service. The San Bernardino express (sbX) is a BRT system with its own unique identity and branding as well as unique system components, specialized vehicles, roadway design and station components.

Omnitrans vehicle designs vary for both for local bus service and sbX Service. Local bus stops and transit centers are designed around a typical 40′ local bus. These vehicles are 40′ long, with a 3′6″ bike rack attached to the front of the vehicle. Efficient operation of Omnitrans local bus service is dependent upon the vehicles properly interfacing with bus stops, roadway designs, other vehicles on the roadway, pedestrian and bicycle networks and transit centers, which are discussed in their respective sections of the guidelines. The other major design vehicle is the sbX specialized 60′ articulated bus. These 5-door vehicles will operate in sbX corridors, and have their own design requirements to properly interface with sbX stations and roadway components.

One of the major components of Omnitrans services are the bus stops. A range of bus stops exist including minimum, standard and high activity stops. Omnitrans is also introducing sbX stations to its service area with the development of the sbX green Line currently under construction. There are three major types of bus stops: farside stops, where the vehicle crosses into the intersection to pull up to the stop; nearside where stops are located before crossing the intersection and mid-block locations located away from intersections. Curb clearance requirements and bus stop and transition lengths are detailed here. These local bus requirements are also presented in Section 1.4, summary of requirements.

The planning and policy framework for the location of local bus stops, requests for changes to bus stop locations, community planning and development coordination, and a discussion of mitigating construction impacts on transit services are described in Section 4. The planning and policy framework has changed very little since the 2006 bus stop design guidelines, with changes consisting primarily in the addition of a checklist to review development plans to ensure location of bus stops are conducive to providing transit access. It is also important to note that the preferred dimensions should be planned for, and minimum dimensions are only applicable in specific circumstances.

Omnitrans' minimum stops are for rural or low activity stops, and standard bus stops should be planned for all new stops. As shown in Figure 1-1, Minimum bus stops must include space for ADA landing pads located at the front door (5′ x 8′) and rear door (10′ x 8′) of vehicles, along with a minimum 4′ clear pedestrian sidewalk. Curb ramps are integral to bus stop locations, and signage with route and schedule must be provided, outside of the clear zone for landing pads and to avoid conflict with bus mirrors.

Figure 1-1: Minimum Bus Stop

Amenities for local bus stops such as shelters, benches, trash receptacles, additional lighting, bicycle parking, newspaper and vendor boxes and landscaping should be considered based on a number of factors, including:

- Average daily boardings;
- Proximity to major trip generators;
- Passenger transfer activity;
- Planned neighborhood improvements;
- Transit corridor marketing efforts;
- Equity among communities in the County;
- Proximity of other nearby sheltered areas; and
- Customer and community requests.

The range of amenities provided distinguish standard bus stops, as shown in Figure 1-2, which contain a landing pad, a bus pole with signage and route information, a bus shelter and bus bench and a trash receptacle; from the high ridership bus stops, as shown in Figure 1-3 which may contain additional amenities such as bike racks, water fountains, vendor boxes, and additional seating and distinct shelters. High ridership stops also qualify for additional amenities as shown in Figure 1-3.

Figure 1-2: Standard Bus Stop

Figure 1-3: High Ridership Bus Stop

sbX stations, as shown in Figure 1-4, are passengers first impression of the sbX service and are designed to be similar to light-rail stations, and provide quicker on and off boarding of passengers. Station features such as level boarding, off board ticket purchasing through ticket-vending machines are based on a kit-of-parts that help create the sbX brand.

Omnitrans vehicles also require specific roadway design considerations for pulling in and out of bus stops, as well as locating bus stops near intersections. Considerations of roadway design are presented must take into account tradeoffs between traffic volumes, safety, and pedestrian and bicycle environments. Bus pads for reinforced roadway surfaces have proven to be helpful to prevent roadway deterioration due to the weight of transit vehicles. Bus turnouts are presented as a potential option for accommodating local bus service, however as bus turnouts increase the difficulty of buses re-entering traffic they should only be considered in special circumstances. Bus bulbouts and enhancements to the pedestrian environment are critical to providing a safe and secure path of travel to bus stops, and bus turning radii are presented.

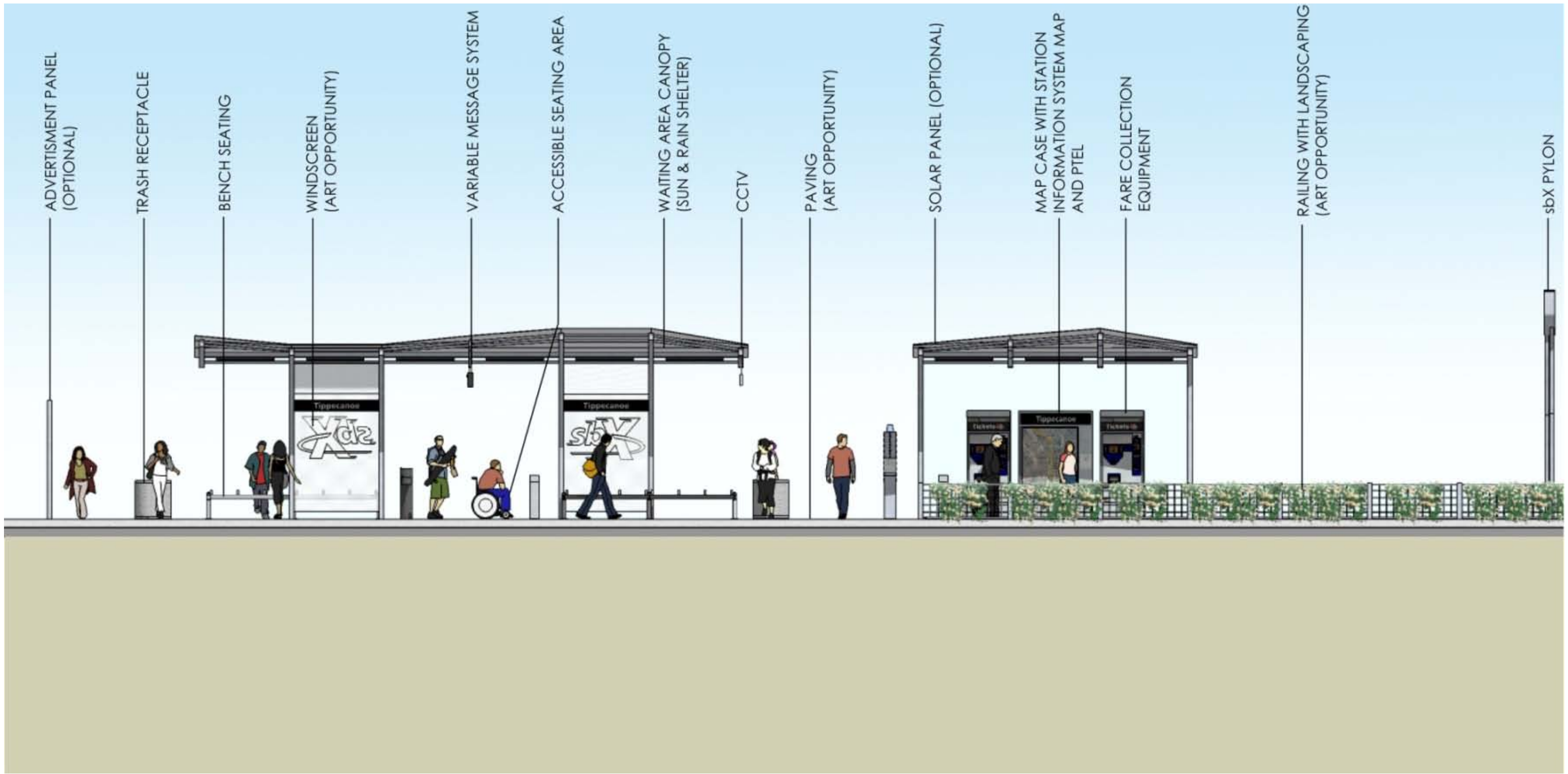

Figure 1-4: sbX Station

As a premium transit service, sbX corridors are designed for faster and more reliable service. Specific roadway elements associated with sbX service can help meet these goals, including the introduction of exclusive lanes, where only sbX vehicles would operate. Exclusive lanes, can occur either in the center of the street along the median or at the curb, and can be fully separated lanes, or converted bus lanes. Exclusive bus lane widths for the sbX service range from 12′ in the minimum condition to 14′ in the optimum condition. Queue jumper, which allow sbX vehicles to bypass traffic waiting at signalized intersections also help meet the goals of the sbX service. Multiple configurations are described, and both exclusive lanes and queue jumper lanes require special signage and roadway markings to distinguish sbX lanes from travel lanes.

Transit Signal Priority (TSP) is also a useful tool that allows for premium transit service to be introduced into sbX corridors. TSP enables transit vehicles that are behind schedule to communicate with traffic signals, and request priority treatment based on a variety of conditions. If appropriate conditions are met, then the signal either stays green for a brief period, allowing the sbX vehicles to pass through the intersection, or shortens the red cycle reducing the dwell time at intersections.

Safety and security are one of the most critical areas of Omnitrans system and is addressed at all levels, from training of drivers and staff, to the physical design of Omnitrans facilities including adherence to Crime Prevention through Environmental Design (CPTED); a major design guideline that guides physical security planning, station related systems, public areas, facility design, and security systems.

As part of the sbX service, Omnitrans is introducing new fare collection equipment at sbX stations that helps to reduce the dwell time of the sbX vehicles at stations. Before boarding, users purchase tickets at a ticket vending machine (TVM) on the station platform or use a standalone validator (SAV) for activating prepaid tickets and passes.

Parking lots, generally in the form of park-and-rides are a new element of Omnitrans service area and facility designs. Travel demand forecasting and the availability of developable land drive the number of parking spaces that are able to be provided, however basic guidelines for development and the range of amenities that these facilities may provide are described in the guidelines.

Typical landscaping considerations for sbX corridors and station areas, as well as a sample landscaping palette that was used for the development of the sbX Green Line are presented in the guidelines. Basic goals, the plant selection process, and additional guidelines are provided.

Transit centers are critical to Omnitrans services, as they provide reliable and timely as well as safe and secure points of transfers for Omnitrans users. A range of transit and transfer centers exist in Omnitrans service area, the location and accessibility are key elements in the development of the centers. Site development factors are described, and include physical constraints, passenger circulation at the site, and economic and development potential resulting from higher levels of activity at the site. Site amenities are key in provide a safe and secure center, and suggested amenities are described in detail.

A major contributing factor to the success of the sbX and Omnitrans system is Transit Oriented Development (TOD). This set of guidelines introduces the definition and characteristics of TODs. TOD development is a critical element in sbX services, by providing higher activity uses near sbX stations and transit centers, which in turn generates higher ridership on Omnitrans system. Examples of successful TODs are described in detail, including regional and local legislation that supports the integration of transit and land use planning.

1.4 Summary of Requirements

The following is a summary of requirements for Omnitrans local bus service, and sbX requirements. Minimum requirements should only be used in constrained cases where the standard or typical requirements are determined to be infeasible.

- Curb Clearance for Bus Stopping zones –Bus stopping zones should be located a minimum of 43′ from the intersection for low speed and low volume streets, with 60′ for high speed and high volume streets, not including the length of the vehicles. The curb clearance for transitioning into mixed traffic is also 43′ and 60′ based on street speed and volume, with the exception of near side stops, which can transition back into mixed flow using the intersection. If space is needed to accommodate additional vehicles, then the space for a second vehicle plus 10′ of space per additional vehicle is needed. 60′ of space from the intersection is the minimum for bus stops located after turns.
- Boarding Areas – A standard boarding area of 43′ x 10′ is required for local bus stops. Minimum boarding areas must include space for front door (5′ x 8′) and rear door (10′ x 8′) ADA landing pads, and a minimum 4′ clear pedestrian sidewalk. Additional space may be required to high ridership stops and/or to accommodate 60′ vehicles on high volume routes.
- Curb Ramps – All intersections with crosswalks within walking distance of bus stops should provide curb ramps.
- Bus Turnouts – Turnouts for buses make it difficult for buses to re-enter traffic and should only be located when a prescribed set of conditions are met. Turnouts have a standard width of 12′ and minimum of 10′. When the outside travel lane is wide, a partial turnout may be used; however, the outside travel lane width plus turnout must be at least 24′6″ to allow traffic to pass the bus. Length of the bus turnouts vary based on location and number of vehicles to be accommodated.
- Bus Pads – Bus pads should be 12′ wide and 40′ long. Bus pads should be 3000 PSI, P.C.C. pavement, 9″ deep without rebar or 8″ deep with #3 rebar at 18″ on center.
- Dedicated Bus Lanes – Width of dedicated bus lanes are 12′ - 14′ for side and center running dedicated lanes. 12′ lanes will require a 1′ buffer zone to prevent mirror-to-mirror strikes.
- Clear Space Along Curb Line – A minimum of 33′ and a standard of 43′ of clear space is required along curb area on the street side prior to bus stop pole (relative to traffic flow). The clear space should be level with a paved or concrete utility strip filled in to sidewalk at a minimum of 30′ long. The clear space is to be minimum of 4′ back from curb line.
- ADA Landing Pad – the dimensions of the ADA landing pad are 5 feet parallel to street and 8 feet deep. This can be in front of and part of shelter pad (if shelter installed) or freestanding. It should be immediately adjacent to bus stop sign pole (prior to pole in the direction of traffic). Wheelchair accessible pathway should be included, if not existing, including access ramps as necessary. The landing pad should be tied into sidewalk, if existing.
- Bus Stop Information – Bus stops must accommodate bus stop pole, flags and schedule information holders at the front of the bus stop to identify the stopping location of the bus. All bus stop signs and poles should be located no closer than 18″ to 24″ to the curb line, and not impede the 4′ clear pedestrian zone or the ADA landing pads.
- Trash – Trash and recycling containers should be placed outside of the clear space along curb line and outside the ADA landing pad. Trash Cans should be placed after pole (as per traffic flow), behind pad or sidewalk, or at the end of the clear space.

- Bus Bench – Bus bench must be located on a pad. If located on the ADA landing pad, a minimum of 8 feet is required from curb; and if outside the ADA landing pad, a minimum of 4 feet is required from the curb. Bus bench must not block pedestrian and ADA access to or from the bus stop or sidewalk.
- Bus Shelter Pad – The bus shelter pad is 5 x 13 feet with a 6 inch concrete base (may be re-enforced with wire grid) and a sub base of blue stone. The bus shelter pad should be located a minimum of 8 feet behind the curb, adjacent to the bus stop pole to accommodate ADA landing pad. The bus shelter pad should be placed outside of ADA pad, adjacent to the sidewalk, with a minimum of 4 feet back from curb line and must be within the clear curb space. An additional 4 to 6 feet wide pad extension is recommended to accommodate any newspaper boxes, trash cans, etc.
- Bus shelter – The bus shelter should be designed to eb waterproof, avoid exposing passengers to splashing water from passing vehicles and runoff, and protect passengers from the elements including wind and the sun. The shelters should not be placed in front of regularly used building exits or commercial signs, displays or building windows. bus shelter should be located on the bus shelter pad at a minimum vertical clearance of 7.5′ with a minimum roof dimension of 6′ x 9 and a preferred dimension of 10′ x 20′. The shelter overhang should be a minimum of 2′ back from the curb line. The bus shelter supports should be located outside of the landing area. When the sidewalk is at the rear of the shelter a 4′ sidewalk width is the minimum and 5′ is preferred. Shelter supports and the bus bench must be located outside of the ADA landing pad. A 12″ minimum clear zone at the rear of the structure is required when the sidewalk is in front of the shelter. A minimum space of 30″ x 48″ of clear floor space for people in wheelchairs is required within the shelter. Shelters should not be placed such that they block sight distance at intersections or driveways. This can normally be accomplished by placing the shelter more than 25′ from the beginning or end of curb return of an intersection or driveway;
- Vendor Boxes – Vendor boxes must be located outside of clear curb space, and outside of ADA landing pad area. Vendor boxes must not impede pedestrian and ADA traffic flow to and from bus stop, landing pad and shelter. Vendor boxes should be located beside shelter, behind the front line of shelter and sidewalk, or with trashcans at end outside of the clear curb space. Free publication vendor boxes are discouraged.
- Electric – Electric connections must include a 1-inch conduit to junction box at rear corner of shelter pad (circuit breaker). Electrical connections should be to building power (if possible) or nearest signal control box or electric power junction box. Electricity (120 volts/20 amp circuits) and communications to support ticket vending machines, real-time passenger information, and lighting of stop, security cameras and emergency call boxes should be provided. Additionally, for cleaning purposes and landscape maintenance, provide outlet for maintenance equipment. The shelter shall be grounded by installation of a grounding rod or similar acceptable method, and outlets shall utilize Ground Fault Interrupter protection.
- Landscaping – Trees for shade and lightning arrestors should not be placed within clear curb zone, and 3 to 4 feet of back of curb line. Trees may be placed immediately outside of clear curb area, or back of sidewalk. Bus nub may be installed to accommodate tree line and still give proper ADA landing pad and clear curb space.

- Traffic Protection – Crash barrier should be installed in advance of stop/shelter for passenger protection, if applicable, for major road (speed limit 45 or higher) without sidewalks, or street parking, or other natural barriers to protect bus riders. Especially if there is narrow curb space, and passengers have to stand within 6 feet or curb line.
- Transfer or High Volume Stops – Transfer or high volume stops are where routes cross, usually at a cross street intersection. Location of these stops should be as close to the intersection as possible, near a marked crosswalk to encourage proper street crossing, and within line of sight of each other. These stops usually require a shelter. Route information needs to be provided for all routes, so area for sign holder, kiosk or other information delivery systems needs to be provided. Besides all of the above, extra space for passenger waiting, along shelter or clear curb space, should be included in design. A standard of 8-10 square feet per peak load passenger should be used. Special care should be taken with placement of trashcans and vendor boxes to keep pedestrian pathways and waiting area clear.
- Key Stops or Express Stops – Key stops or express stops are stops that have been identified as major stops on routes, usually several blocks apart. In addition to all of the above, the shelter at these stops should be designed to cover a 10′ x 20′ area, with seating and overhanging roof for standing under roof covering inside and outside the shelter. Visibility of the bus approach route is required and trees must not block view of bus approach path. These stops should also include lighting, public information display systems, route maps, transit information, stop request and security call mechanisms, radiant heaters, ticket vending machines, and advertisements. Solar technology should be used where feasible.
- Lighting – Lighting internal to shelter should be 3 foot candles 3′ above the concrete shelter pad and illuminate approximately 40 square feet; external to shelter, should follow local standards with a suggested 2-5 foot candles. Solar units must be capable of providing 5 days of full brightness and provide a minimum of 4 foot candles at the sidewalk from an elevation of 10′ with a 6 square feet area of illumination at the sidewalk.

2. OMNITRANS' SYSTEM

2.1 Background

Omnitrans was founded in 1976 under a Joint Powers Agreement to provide public transportation service to the San Bernardino Valley. Omnitrans is the major public transportation provider in the San Bernardino Valley, with a service area of approximately 456 square miles, serving fifteen municipalities and many unincorporated areas of San Bernardino County. Omnitrans also travels beyond the service area to Pomona and Riverside, to provide links to neighboring transit agencies. The service area is bordered by the Los Angeles County line to the west, the San Gabriel and San Bernardino Mountains to the north, Yucaipa in the east and the Riverside County line to the south.

The board of directors is made up of elected officials from each of the member jurisdictions governs the agency. The member jurisdictions include the following:

- City of Chino
- City of Chino Hills
- City of Colton
- City of Fontana
- City of Grand Terrace
- City of Highland
- City of Loma Linda
- City of Montclair
- City of Ontario
- City of Rancho Cucamonga
- County of San Bernardino
- City of Redlands
- City of Rialto
- City of San Bernardino
- City of Upland
- City of Yucaipa

2.2 Omnitrans' Mission

Omnitrans' mission is to provide the San Bernardino Valley with comprehensive public mass transportation services that maximize customer use, comfort, safety, and satisfaction, while efficiently using financial and other resources, in an environmentally sensitive manner.

2.3 Omnitrans' Services

Omnitrans provides arrange of transit services that connect and complement one another to form an efficient overall system. The types of services presently offered are summarized in the following sections.

Branding of Omnitrans' family of services is important to establishing the collective identity and individual identities of the organization's primary service elements. Omnitrans' brands assist transit passengers, policymakers, and other stakeholders in recognizing services and building long-term relationships with the organization. Distinct branding is critical for communicating Omnitrans' unique services in the San Bernardino Valley. Omnitrans' family of brands includes the following:

- Omnitrans' corporate brand and traditional fixed route bus service
- OmniGo circulator service
- OmniLink general public demand-response service
- Access ADA paratransit service
- sbX bus rapid transit service

2.4 Traditional Fixed Route Service

Omnitrans' fixed-route bus service is the organization's largest and most visible service component.

Omnitrans' fixed-route service covers 15 cities and portions of the unincorporated areas of San Bernardino County, to major destinations such as large employers, business districts, medical centers, educational facilities, shopping malls, community centers, and Metrolink stations.

Routes are operated primarily with 40' buses, running primarily along major east-west and north-south corridors. Omnitrans' latest fixed-route bus model is a 40' low floor vehicle, shown in Figure 2-2.

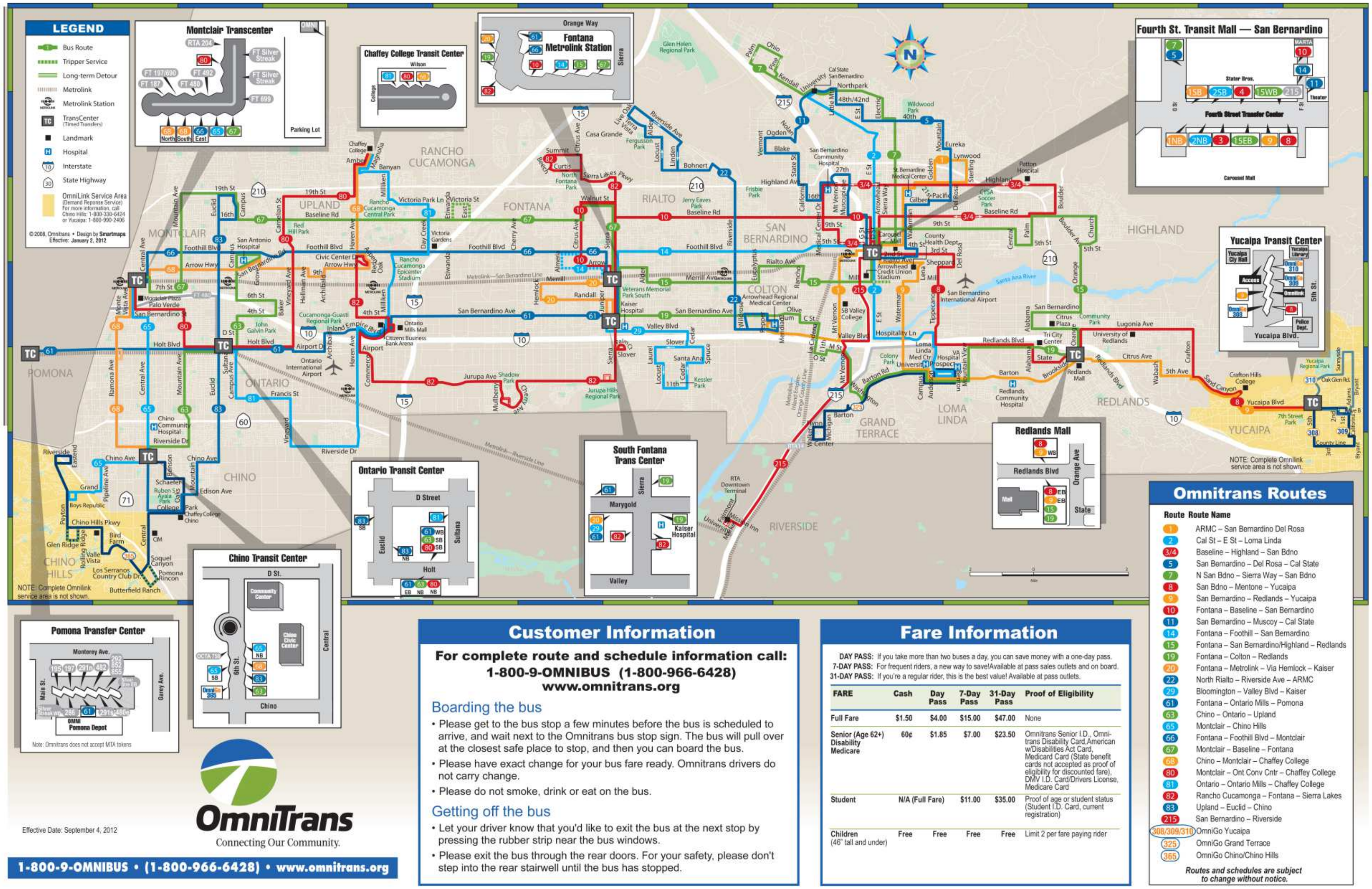

Figure 2-1: Omnitrans System Map

Omnitrans operates 27 local fixed route services at 15 to 60 minute intervals. All 27 routes operate Monday through Friday, and on Saturdays there are 25 routes in operation. On Sundays there are 23 routes in service.

Figure 2-2: Omnitrans' 40' Low Floor Vehicles.

Omnitrans also coordinates fixed-route service with Metrolink, Foothill Transit, Los Angeles County Metropolitan Transportation Authority, Mountain Area Regional Transit Authority, Orange County Transit Authority, Riverside Transit Agency, and Victor Valley Transit Authority, through Cooperative and/or Joint Service Agreements.

Omnitrans' corporate brand, used for traditional fixed route service, was updated in August 2012 and is shown in Figure 2-3. The colors symbolize Omnitrans' commitment to environmental quality, particularly air quality, thanks to the 100% natural gas-powered fleet of vehicles. The orientation of the logo graphic, "Omnitrans" title, and "Connecting Our Community" tagline must always be oriented and placed according to the style and usage guidelines. All public materials featuring the Omnitrans branding must be reviewed and approved by the Omnitrans Marketing Department.

2.5 Express Fixed Route Service

Omnitrans currently operates the Route 215 between San Bernardino and Riverside along the I-215 freeway, making limited stops. Omnitrans may develop additional routes in the future that use regular fixed-route vehicles and branding but stop at limited locations to improve travel times.

2.6 OmniGo Circulator Service

OmniGo is a fixed route community circulator service that currently operates in the cities of Chino Hills, Grand Terrace, and Yucaipa but may be expanded to other cities.

OmniGo features 16-passenger vehicles and fixed route fares. Implemented in September of 2010, it connects points of interest within each city and provides connectivity to Omnitrans' fixed route bus service. All OmniGo services are operated by a private contractor.

Figure 2-3: The Corporate Brand and Color Standards

2.7 OmniLink

OmniLink is a demand-response transportation system providing curb-to-curb service for the general public in Yucaipa (and portions of Calimesa) and Chino Hills. OmniLink minibuses do not go on a regular route, but respond to customer's telephone requests for service on a daily basis. Branding of these services are distinct from the Omnitrans corporate brand and regular fixed-route service to distinguish their unique, targeted services (Figure 2-4).

Figure 2-4: OmniGo, OmniLink, and Access vehicles.

2.8 Access Service

Omnitrans Access Service is an Americans with Disabilities Act (ADA) mandated public transportation service for people unable to independently use the fixed route bus service in South Western San Bernardino County for all or some of their trips. Access provides curb-to-curb service to complement the Omnitrans fixed-route bus system, and is available during the same time periods that fixed-route service operates. The Access service area is up to 3/4 mile on either side of an existing bus route; service is available outside the standard area for an additional fee. Access riders make reservations for their trips, or arrange a subscription service.

2.9 sbX Service

sbX is the first-of-its-kind bus rapid transit (BRT) service to be constructed in the Inland Empire. sbX is designed to provide more frequent and direct transit service along major corridors in the Omnitrans service area. While Omnitrans' traditional network of local bus services provides good coverage in its general service area, sbX provides a "premium" level of service that is more competitive with the automobile in capturing riders who are making medium- to long-distance trips.

By the year 2035, substantial changes will occur in the Valley in the form of population and employment growth, development and travel patterns, and additional transit service needs. Early planning and implementation of the sbX system is critical for providing opportunities to prioritize development of these 10 corridors. These sbX BRT corridors generally include:

- Limited stop service with station spacing approximately every mile;
- Substantial transit stations;
- Traffic signal priority to the extent that there are traffic signals on the corridor;

- Low-floor vehicles or level boarding;
- “Branding” (distinguishing through marketing and physical characteristics) of the proposed service;
- 10 minute peak/15 minute off-peak frequencies or better while operating at least 14 hours per weekday;
- BRT vehicles will operate in dedicated lanes in some corridor segments. during peak periods.
- Substantial investment as demonstrated by features such as the following:
    - Park-and-ride lots,
    - Bus arrival and departure information signage,
    - Intelligent transportation system technology,
    - Off-board fare collection,
    - Advanced bus technology, and
    - Other features that support the long-term corridor investment.

The first sbX route, known as the sbX E Street Bus Rapid Transit (BRT) Project or the Green Line, is currently under construction. As shown in Figure 2-5, the sbX Green Line is a 15.7-mile BRT corridor spanning between northern San Bernardino and Loma Linda, primarily following Omnitrans’ existing Route 2. As a premium BRT service, the sbX Green Line features 16 art-inspired rapid bus stations for fast boardings at key university, government, business, entertainment and medical centers as well as four park-and-ride facilities.

The sbX Green Line is a high quality limited stop service, with 10-minute headways using 60’ articulated buses. Transit Signal Priority (TSP) improvements and signal upgrades are included in the corridor to reduce travel time.

The sbX Green Line will operate on existing city streets in the cities of San Bernardino (north of Interstate I-10) and Loma Linda (south of I-10), and includes over five (5) miles of exclusive, center-running bus lanes. The sbX Green Line also features various roadway improvements and pedestrian improvements. Implementation of the project is expected to increase transit usage, reduce traffic congestion and automobile vehicle miles traveled, and improve regional air quality. Operation of the sbX Green Line is expected to begin in 2014.

Figure 2-5: sbX Green Line

The sbX Green Line is the first of 10 sbX corridors identified in the Omnitrans 2010 System-Wide Plan as depicted in Figure 2-6, and planned for implementation in the San Bernardino Valley. These 10 premium transit corridors have the potential to develop into major fixed route transit investments. Early consideration of the sbX system and opportunities to expand and enhance the transit network as part of the streetscape and roadway network will ensure successful development of the sbX system. The sbX system will be integrated with the overall Omnitrans fixed route system that is illustrated in Figure 2-1.

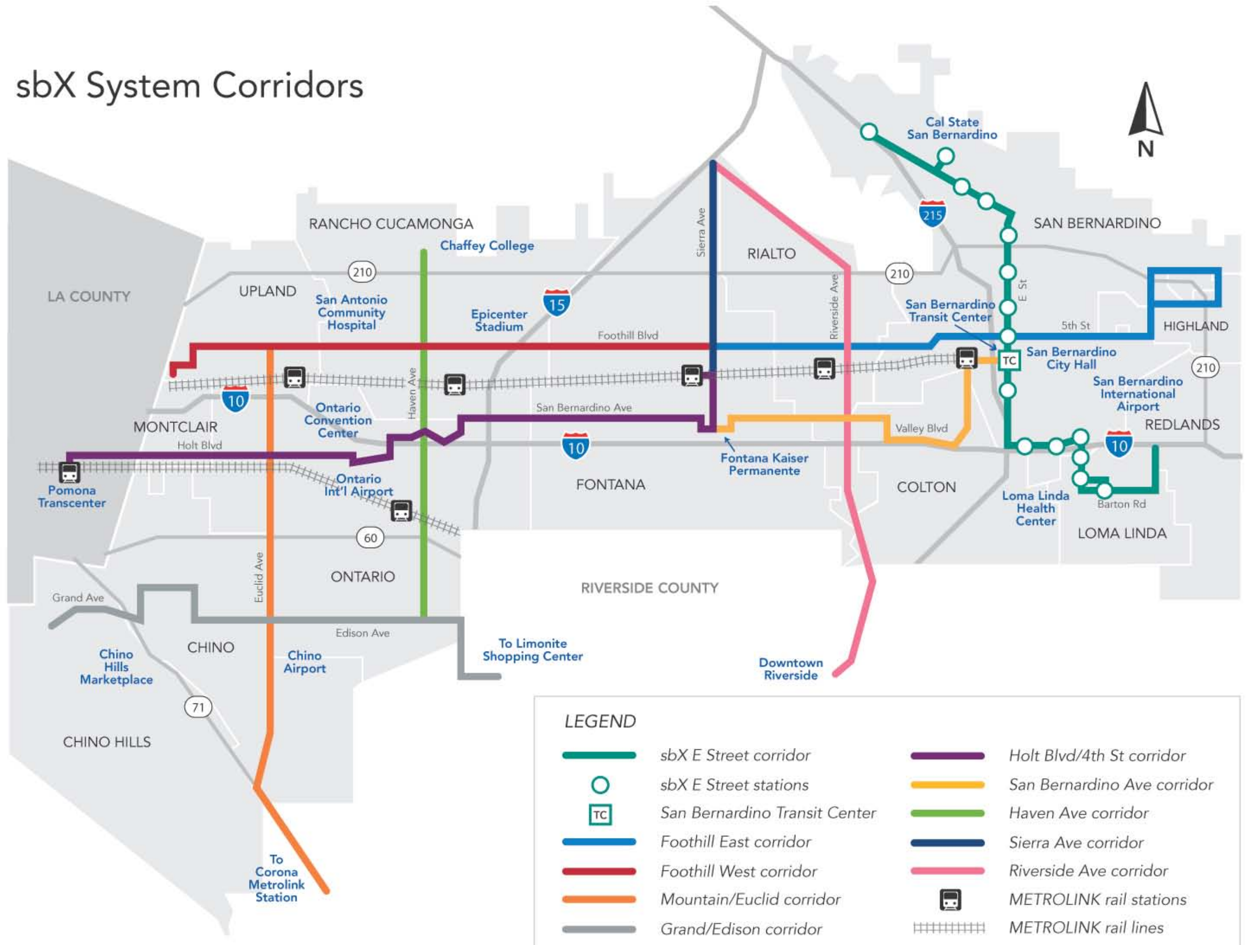

Figure 2-6: sbX Systemwide Map

Figure 2-7: Official colors for the sbX Logo

2.9.1 sbX Branding

Because sbX is a unique level of service and technology for the Omnitrans service area as compared to traditional local bus service, use of a distinct identity and brand is critical.

- In the early stages of sbX planning and development, the sbX brand assists in building public awareness and understanding of the system's ability to reduce vehicle congestion, improve air quality, and encourage economic development;
- In delivering transit service, sbX-branded vehicles and stations are distinctive from Omnitrans local bus service and other regional transit services, providing fast, safe, high-technology service on medium- to long-distance trips within the service area; and
- In supporting community revitalization, the sbX brand contributes to establishing an identity for an entire corridor, conveying uniqueness, high-quality service, and a strong sense of permanency.

The graphic look and feel of the sbX program is intended to provide a unifying graphic identity in the minds of passengers, policymakers and the community-at-large. It is also intended to reinforce written and verbal communications about the program.

The official logo shown in Figure 2-7 is the most important visual expression of the sbX corporate identity. It must appear on all sbX-related communication pieces. The letters "sbX" are not to be taken literally or as an abbreviation, though they do imply San Bernardino Valley and express. When utilizing the color version, only the official corporate colors should be used, indicated in Pantone Matching System (PMS) and CMYK (process color).

2.9.2 sbX Vehicles

sbX vehicles are custom-designed for use on sbX routes and in providing level passenger access on all station platform types. The 60′, articulated five-door buses are fueled on compressed natural gas (CNG). While the bus design specifications are distinct from Omnitrans' local bus coaches, the sbX logo will be applied consistently across the sbX coaches to achieve the following:

- Distinguish the service from other transit services, particularly Omnitrans local bus service;
- Strengthen passenger understanding of sbX vehicles serving only sbX-branded stations; and
- Connote speed and a premium level of service.

The body's base color is silver and the graphics are red, blue, and white (see section 3 for design vehicle information, and Figure 2-8 for application on the vehicle). When graphics are placed over a window, a translucent wrap is used, allowing bus riders to see out through them. The sbX logo should also be displayed on the front and back end of the vehicle.

Figure 2-8: sbX vehicles

While sbX vehicles allow for flexible use on almost all road and street types in the Omnitrans service area, to prevent confusion among riders these vehicles should not be used for local bus service, unless in emergency situations. The same guideline applies to use of Omnitrans' local buses for sbX service.

2.9.3 sbX Line Designation

sbX lines are designated by color types (e.g., sbX Green Line) for the following reasons:

- Distinguish from Omnitrans and other local bus services, which use a number and primary destination descriptors (e.g., Route 2: Cal State - Loma Linda);
- Support branding of the sbX system as a unique and premium service, more akin to a rail-type technology; and
- Designate the routes for passenger reference.

Figure 2-9 features the current line designations based on existing, planned, and potential sbX corridors throughout the San Bernardino Valley. Similar to Omnitrans' family of brands, color standards for each line should be consistently applied on sbX station signage and public information materials to strengthen customer understanding and awareness.

2.9.4 sbX Station Design

As described in detail in Section 9, there are a number of sbX station design objectives, a few of which include:

- A location which is integrated with other modes of transportation and has linkages with adjacent land uses;
- A distinctive image or brand that emphasizes motion and technology;
- A sense of place provided at stations; and
- Protection from the sun, wind and rain.

In general, the basic sbX station closely resembles a light rail station by incorporating shelters to protect riders from wind, sun and rain; art that captures the heritage of the community it serves; electronic display signs with bus information; and additional premium features. Collectively, these features contribute to conveying sbX's premium level of service and progressive image that differentiate it from existing local bus services and assist in attracting choice riders.

Future Line Designations by Color			Color Specifications		
Location	*Color*		*PMS #*	*Matthews Paint #*	
E Street	**Green**		**3288**	**MP24502 Country Club Green**	LRV 17.5
Foothill East	**Blue**		**285**	**MP28073 American Blue**	LRV 13.9
Foothill West	**Red**		**187**	**MP42212SP Scarlet Red**	LRV 11.6
Mountain/Euclid	**Orange**		**1655**	**MP23906 Bright Orange**	LRV 28.1
Grand / Edison	**Silver**		**430**	**MP10158 Just Grey**	LRV 28.0
Holt / 4th	**Purple**		**260**	**MP29705 Grape Jello**	LRV 10.3
San Bernardino Ave.	**Gold**		**130**	**MP55149 Schoolbus Yellow**	LRV 39.3
Riverside	**Pink (Rose)**		**1915**	**MP29315 Bubblegum**	LRV 22.6
Haven	**Lime**		**369**	**MP26749 Spring Green**	LRV 28.3
Sierra	**Navy**		**281**	**MP55795 Bluetooth**	LRV 6.7

Figure 2-9: sbX Line Designation

As such, application of the sbX brand at stations is important for supporting the station design, sense of place, and passenger experience. Proper application of the sbX brand at station locations contribute to the following:

- Identifying a distinct transit facility that provides only sbX service;
- Providing passengers with wayfinding or directional support for station platform access; and
- Conveying the station as a public room providing a sense of place.

Section 9 outlines the architectural kit of parts that can be combined in various ways depending on unique site conditions, ridership, and adjoining uses. The shelter design, pylon, and sbX logo, for example, are essential to the branding of the sbX system. The art panels, paving, and railings can be designed by the local community to fit the local character.

The Federal Transit Administration (FTA) recognizes the importance of long term corridor investment, and provides transit funding for fixed guideway improvements under the Section 5309 New Starts/Small Starts program. The capital cost threshold for Small Starts projects is $250 million with potential for up to $75 million in FTA funding. The evaluation of potential New/Small Starts projects is based on two main criteria, project justification and local financial commitment. The ranking process considers the following main factors:

- Project Justification;
  - Mobility Improvements;
  - Congestion Relief;
  - Environmental Benefits;
  - Cost Effectiveness;
  - Transit Supportive Land Use Policies;
  - Economic Development Effects;

- Local Financial Commitment;
    - Non Section 5309 (New Starts/Small Starts) Funding;
    - Capital Finance Plan; and
    - Operating Finance Plan.

The Federal New Starts/Small Starts funding process also includes the Very Small Starts process that provides funding for improvements to corridors that can meet minimum requirements to ensure significant transportation benefits commensurate with a project's cost. The capital cost threshold for Very Small Starts projects is $50 million with potential for up to $25 million in FTA funding.

Figure 2-10: Station Pylon featuring the sbX Logo Mark the Station Entrance

The sbX BRT corridors presented in this document can also be considered for the Very Small Starts funding program which rewards corridors with an automatic "Medium Rating" for funding if the corridors include:

- Substantial transit stations;
- Traffic signal priority/pre-emption, to the extent, if any, that there are traffic signals on the corridor;
- Low-floor vehicles or level boarding;
- "Branding" (distinguishing through marketing and physical characteristics) of the proposed service;
- 10 minute peak/15 minute off-peak frequencies or better while operating at least 14 hours per weekday (not required for commuter rail or ferries);
- Are in corridors with existing riders who will benefit from the proposed project that exceed 3,000 per average weekday; and
- a total capital cost less than $50 million (including all project elements) that is less than $3 million per mile, exclusive of rolling stock.

All the corridors in the sbX system have the potential to qualify for these Small or Very Small Starts funds. By planning for these opportunities, improvements to transit operations and long term investments in the corridors are more likely to be successful.

The transportation reauthorization bill most recently passed by Congress in 2012 is called Moving Ahead for Progress in the 21st Century, or MAP-21. That legislation includes some changes in the various funding programs and their requirements, as well as the manner in which projects competing for the available funding are evaluated. FTA will issue updated guidelines regarding the planning and project development of New/Small Starts projects by the end of 2012 or early 2013. The new MAP-21 project approval process is summarized in Figure 2-11. The intent is to streamline the process by which projects are analyzed, approved and funded, and reduce the overall time required for implementation.

It is important to note that the Alternatives Analysis (AA) process is no longer required by FTA. The Project Development phase of the New/Small Starts funding process is now restricted to completing the NEPA process which leads to selection of the Locally Preferred Alternative and submittal of a New/Small Starts application to obtain a satisfactory rating, prior to receiving FTA approval for entry into the Engineering (preliminary engineering and final design) phase. However, agencies must receive FTA approval to enter the Project Development/NEPA phase by providing significant information typically developed during an AA or equivalent process, including:

- Project definition;
- Problem statement/purpose and need;
- Evaluation measures;
- Conceptual alternatives with initial mode, alignment, costs and ridership; and
- NEPA initiation documents.

Omnitrans will follow this prescribed process for each of the potential sbX corridors as appropriate. The new FTA guidelines will be added to this document when they are available.

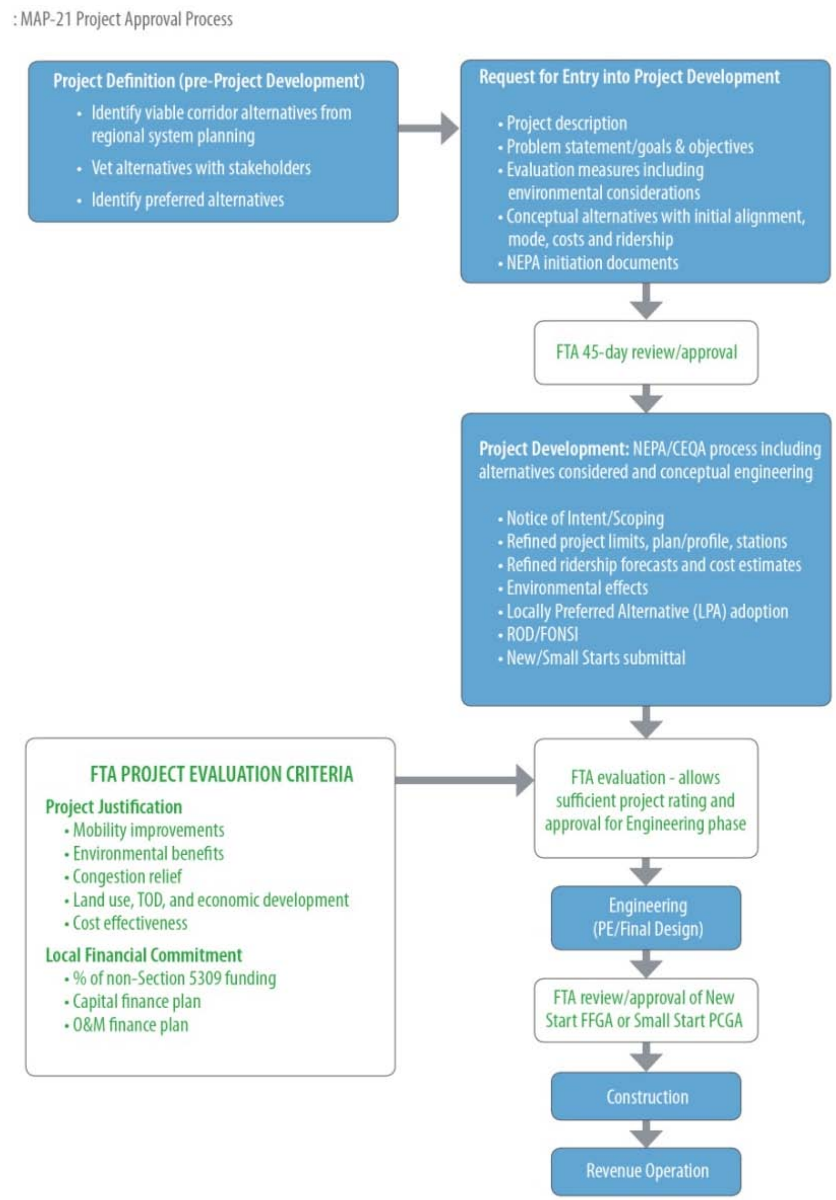

Figure 2-11: MAP-21 Project Approval Process

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3. DESIGN VEHICLES

The vehicle design is a major design criterion for stations and roadway designs. All Omnitrans 40' and 60' vehicles operate using compressed natural gas (CNG) propulsion systems.

3.1 25' Cutaway Vehicles

OmniGo, OmniLink, and Access vehicles currently in operation are 25' long, 16-passenger cutaway vehicles, as shown in Figure 3-1 below. The smaller size of these vehicles allows for navigation through narrow residential streets more cost-effectively than standard 40' coaches.

Figure 3-1: OmniGo Cutaway Vehicle

3.2 Standard 40' Vehicle

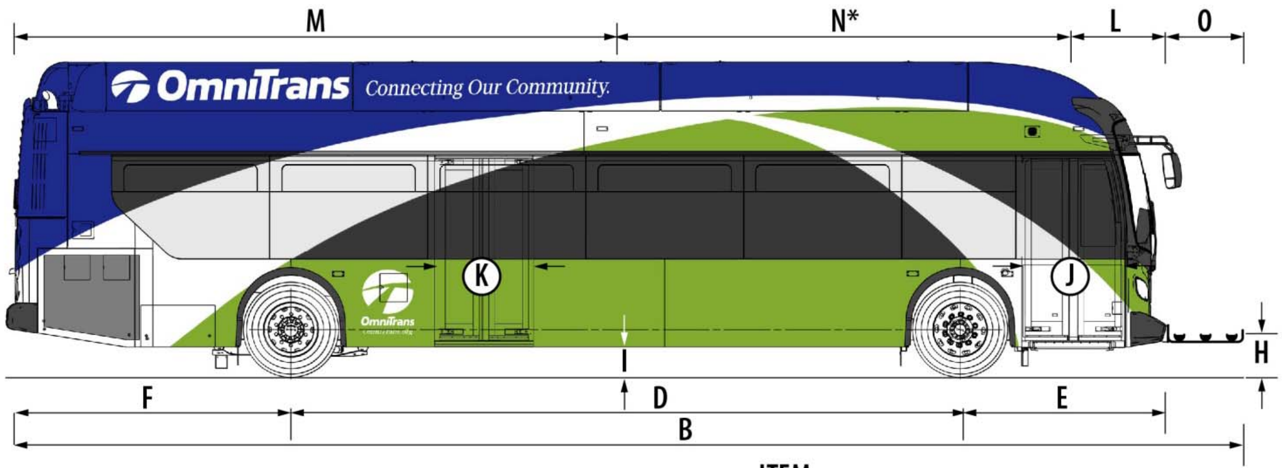
The majority of Omnitrans' fleet is the standard 40'coach shown in Figure 3-2. The vehicles are renewed on FTA's 11-year fleet lifecycle, and have various seating configurations. Omnitrans has had two-bike racks on the front of every fixed route bus since 1996, and has recently instituted a policy of installing three-bike racks on all new buses due to capacity issues.

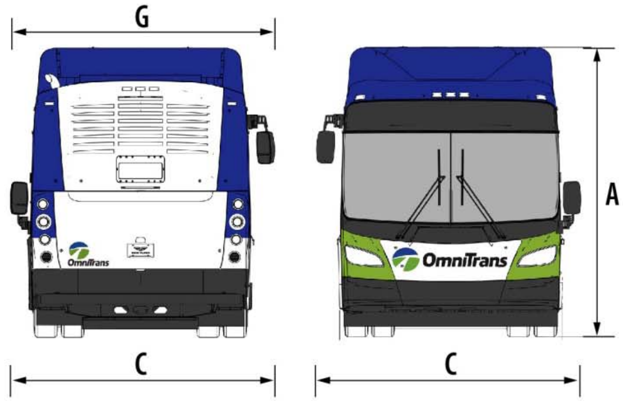
3.3 60' Articulated Vehicle

The sbX system will use specialized 60' articulated vehicles, as shown in Figure 3-3. The vehicles are specially designed with 5 doors, to allow for boarding at center running and side-running stations. The vehicles feature a low floor (13.5") for level boarding at sbX stations to allow for quick boarding, and also contain a wheelchair ramp for passenger use. The vehicles have a stylized wrap as shown in Section 2, and prominently feature the sbX brand. Vehicles are designed for comfort and a smooth ride and hold approximately 96 passengers at maximum capacity with up to eight bicycles on board.

In the future, 60' articulated vehicles may be used for local service, but with the Omnitrans local fixed route branding on the vehicle rather than the sbX branding.

Interiors are characterized by high-quality amenities, such as comfortable seats, better lighting, and real-time arrival and information displays.





ITEM			
A	Overall Height	11′	2″
B	Overall Length	43′	6″
C	Overall Width	12′	6″
D	Wheel Base	23′	8″
E	Front Axle to Bumper	7′	3.75″
F	Rear Axle to Bumper	9′	4.75″
G	Edge Mirror to Mirror	12′	6″
H	Step to Ground, Entrance	1′	5″
I	Step to Ground, Exit	1′	4.5″
J	Clear Door Opening, Entrance	2′	6″
K	Clear Door Opening, Exit	2′	2.5″
L	Centerline Door to Front	3′	0″
M	Centerline Door to Rear	17′	11.25″
N	Centerline Door to Door	19′	8″
O	Bike Rack	2′	6″

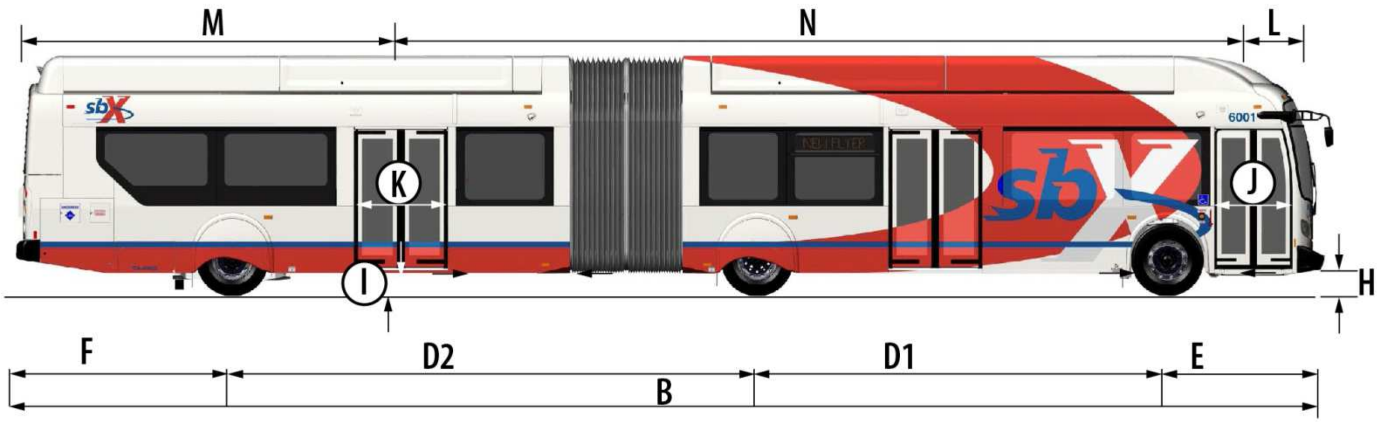
NET/GROSS VEHICLE WEIGHT**	
Front Axle	7,420/11,980
Rear Axle	18,060/24,660
Seating Capacity	38
Standing Capacity	43

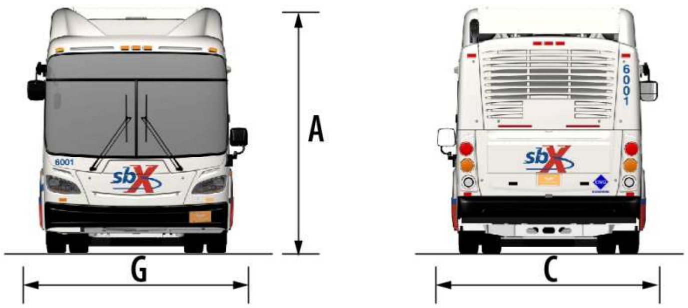
NOTES:

**VARIES FOR DIFFERENT TYPES OF 40′ BUSES*

***NET WEIGHT IS 'ROAD READY' WITHOUT PASSENGERS GROSS INCLUDES PASSENGERS*

Figure 3-2: Typical Dimensions of Standard 40′ Coaches





NET/GROSS VEHICLE WEIGHT*

Front Axle	11,800/16,420
Rear Axle	12,130/16,420
Center Axle	14,970/24,250

MAXIMUM BEND ANGLE

Horizontal	7,420/11,980
Vertical	18,060/24,660
Seating Capacity	41
Standing Capacity	57

ITEM

A	Overall Height	10′	4″
B	Overall Length	59′	10″
C	Overall Width	12′	6″
D	Wheel Base (D1/D2)	18′7“/ 24′0″	
E	Front Axle to Bumper	8′	8″
F	Rear Axle to Bumper	8′	8″
G	Edge Mirror to Mirror	12′	6″
H	Step to Ground, Entrance	1′	2″
I	Step to Ground, Exit	1′	2″
J	Clear Door Opening, Entrance	3′	8″
K	Clear Door Opening, Exit	3′	6″
L	Centerline Door to Front	3′	6″
M	Centerline Door to Rear	21′	4″
N	Centerline Door to Door	35′	0″

NOTES:

**NET WEIGHT IS 'ROAD READY' WITHOUT PASSENGERS GROSS INCLUDES PASSENGERS*

Figure 3-3: Typical Dimensions of sbX Vehicles

Listed in Table 3-1 below, are the basic dimensions of a typical articulated bus to be used for sbX Corridors:

Table 3-1: Articulated Bus Dimensions

Length Overall	60 feet
Maximum low floor height front	15 inches
Maximum low floor height rear	15.5 inches
Kneeler option height above pavement	11 inches
Minimum horizontal turn radius (outer body)	38 feet

3.4 Bus Related Systems

All coaches are equipped with intelligent transportation systems, including automatic vehicle location equipment to provide real-time passenger information, on board fare collection equipment and safety and security systems. sbX vehicles also are equipped with Transit Signal Priority equipment. These systems are detailed in later sections of this report.

4. BUS STOP POLICIES

4.1 Requests for Changes in Bus Stops

Potential local bus stop locations or concerns regarding existing stops may originate from city staff, Omnitrans staff, passengers or the general public. These requests include issues such as requests to add, move, or remove bus stops or bus service; add, move, or remove amenities at existing bus stops; and operational or safety/security issues related to the stop location.

Requests for changes in bus stops should be sent to:

BusStops@Omnitrans.org

The following process will be followed:

- Both Omnitrans and local jurisdiction (city or county) staff will review the request and will jointly determine if a stop should be changed, relocated, or removed; if amenities should be removed or added; or if the stop in question raises any safety or operational challenges.
- If the issue affects the safety and security of Omnitrans passengers, both Omnitrans and the local jurisdiction will perform an analysis of the site to identify options to reduce the dangerous condition. Careful consideration should be taken to determine whether removal of the stop may have a direct impact on persons that utilize the stop on a daily basis.
- Omnitrans and the local jurisdiction will confirm in writing, the work to be completed by each agency.
- The jurisdiction will notify adjacent property owners if necessary.

4.2 Community Planning and Project Development

When a local jurisdiction (city or county) begins the process to create or update a general plan, specific plan, or roadway project, or to review a development proposal, there is an opportunity to incorporate transit into the planning process.

Omnitrans shall be provided the opportunity to review and respond to all proposed plan changes before and during the public review process. Any amendments to these plans that will have a direct impact on the location of stops should be forwarded to Omnitrans for review and comment.

Communications should include the name of the contact person at the jurisdiction, and the name and contact information of the contact person of the developer. Omnitrans will review the plans and consult with the jurisdiction or others as necessary to properly comment on the plans. Omnitrans will provide written comments on the plans to the jurisdiction. Revised plans should be returned to Omnitrans along with prior comments for subsequent reviews.

Meeting invitations, notices, scoping letters, and copies of plans should be sent to:

Planning@Omnitrans.org

Or mailed to:

Planning Department, Omnitrans
1700 W. Fifth St.
San Bernardino, CA 92411

Local jurisdictions should also consider the following suggestions:

- It is recommended to include a transit element in community general plans, with information such as proposed bus routes, transit centers, and planned sbX BRT corridors.

- It is recommended that local jurisdictions require contractors and property developers to coordinate with Omnitrans. Below is some sample language that can be used in development conditions of approval:

  Contact and coordinate with the public transportation agency, Omnitrans, on bus stop design prior to final building permits of any bus stop being constructed as part of this development. Additional guidance for bus stop construction specifications can be found in Omnitrans Bus Stop Design Guidelines document.

- Some cities also require property developers to construct and maintain bus turnouts or shelters in conjunction with private development. The following is sample language that can be used in general plans to integrate transit into community design:

  1.1: Continue to consult with regional transit operators to maintain and improve the coverage and frequency of transit service in the City.

  1.2: Consult with Omnitrans to establish and maintain transit hubs at key locations throughout city, both existing and planned.

  1.3: In addition to requiring private development to provide transit amenities, consult with regional transit operators to provide attractive and convenient bus stops, including shade/weather protection, seats, transit information, and bus shelters as appropriate.

  1.5: Continue to require that the siting and architectural design of new development, infill or redevelopment projects promotes safety, pedestrian-friendly design, and access to transit facilities.

  1.6: Enhance pedestrian and bicycle access to local and regional transit, including facilitating connections to transit.

  1.7: Continue to design and operate arterials and intersections for the safe operation of all modes of transportation, including transit, bicyclists, and pedestrians.

  1.8: Continue to require that new development participates in the cost of transportation mitigation and improvements necessitated by new development, including non-automobile solutions.

  1.9: Require that new and substantially renovated office, retail, industrial, and multi-family developments implement transit amenities, including bus turnouts, transit shelters, and other streetscape elements, as appropriate.

  1.10: Require the future development of community-wide serving facilities to be sited in transit-ready areas that can be served and made accessible by public transit. Conversely, plan (and coordinate with other transit agencies to plan) future transit routes to serve existing community facilities.

  Sources: The Ontario Plan and City of Rancho Cucamonga General Plan

- Development and roadway improvement plans received by jurisdictions will be evaluated for potential impacts on current or future transit operations using the following criteria. Plans which meet one or more of the following criteria should be sent to Omnitrans for review:
  - Identified transit streets in General or Specific Plans;
  - Existing streets with transit routes;

- o Major streets;
- o Projects that affect streets serving high density residential, commercial, industrial areas or educational or medical institutions;
- o Streets that would logically connect existing or planned transit routes or connecting areas which have or are planned to have transit service; and
- o Any other project that in the jurisdiction's opinion should be assessed for current or future transit needs.

An example of a shelter constructed by a private developer in the City of Rancho Cucamonga

The following is a checklist that can be used to review development plans, to ensure that the design is conducive to transit access:

- Pedestrian routes to bus stops should be designed to meet the needs of all users (including disabled, elderly, and children);
- The pedestrian system should provide convenient connections between destinations including residential areas, schools, shopping centers, public services and institutions, recreation, and transit;
- Provide a dedicated sidewalk and/or bike paths through new development that are safe and direct to the nearest bus stop or transit center;
- Minimize the distance between buildings and the bus stop through proximity and orientation. This can be encouraged by including transit accessibility concerns in zoning policies, setback guidelines, building orientation guidelines, and parking requirements to encourage transit-oriented development;
- Buildings should be located with entrances from sidewalks, wherever possible;
- Minimize the use of elements that restrict pedestrian movement such as meandering sidewalks, walled communities, and expansive parking lots.
- Pathways should be designed so pedestrians traverse a straight, direct path wherever possible;
- Eliminate barriers to pedestrian activity. This includes sound walls, landscaping, berms, or fences which impede pedestrian access or visibility. If there is restricted access, gates should be installed at access points;
- Pave pedestrian pathways and ensure they are accessible to everyone. Provide accessible circulation routes that include curb cuts, ramps, visual guides, signage (visual and Braille) and railings where needed. Place ADA compliant curb ramps at each corner of intersections;
- Adequate drainage should be provided to avoid pooling and muddy conditions; and

- Provide street lighting along bus stop access routes and safety lighting at intersections to promote safety and security for transit patrons. Ideally bus stops should be illuminated by nearby street lighting, if not; consider installation of lighting at the bus stop.

4.3 Construction Impacts

Public Works and private development construction activities often impact bus operations and bus stops. The following information attempts to reduce construction conflicts, provide information for the contractor, and guide local jurisdiction staff coordinating both design and construction work with the private development community. Omnitrans considers construction coordination a local function, but is available to provide assistance if requested. Omnitrans will participate in any decisions on construction that requires temporary stop closures, relocations, or route disruptions.

Construction coordination information should be directed to:

Detours@Omnitrans.org

Construction impacts caused by private development or public projects can be minimized through conditions of approval applied to the development, such as the following two examples:

Provide the public transportation agency, Omnitrans, a written notification five (5) days prior to any construction that will impede on nearby bus stop or service.

Provide written notification to Omnitrans five (5) day prior to any road closures and/or construction detours that will impact a bus stop or service as a result of this development.

Plans and specifications usually contain language requiring contractors to maintain pedestrian access and signage, etc. Notes on the construction plans provide instructions to contractors and construction inspectors.

Typical standard plans and specifications may include the following notes:

A minimum four (4) feet wide walkway shall be provided to maintain passenger access to and from bus stops during construction.

Temporary access to bus stop zones during construction shall be approved by Omnitrans in advance of construction activities.

The contractor shall notify Omnitrans at least 5 work days in advance for all street closures affecting transit operations regardless of the duration of the closure. This will allow Omnitrans sufficient time to plan detours and notify the general public.

The contractor shall work with Omnitrans to establish an approved temporary bus stop location.

Omnitrans will provide and post the appropriate temporary bus sign signage.

The contractor shall notify Omnitrans at least 5 days in advance of construction completion so that permanent bus stop signs can be re-installed by Omnitrans.

Recommended construction plan notes include:

Contact Omnitrans for coordination and review requirements.

Contractor may not remove any bus stop signs without prior authorization from Omnitrans.

All work shall conform to the requirements of the Americans with Disabilities Act (ADA) including provisions for temporary access to and from bus stops.

Temporary access to bus stop zones during construction shall be approved by Omnitrans at least 5 days in advance of construction activities.

The contractor is responsible for all costs incurred for loss or damage to bus stop signs, hardware, and street furniture. Project acceptance will be delayed at the request of the local jurisdiction for any damaged street furniture or non-payment of costs.

Temporary removal of street furniture to avoid damage and conflict during construction requires a 30 day advance notice to both the city and the owner of the street furniture.

The contractor is responsible for construction of the passenger boarding pad on which street furniture will be placed. The pad must be designed and located in conformance with local jurisdiction standard details. Any necessary deviations from standard details require the written approval of the local jurisdiction.

The contractor shall receive approval from the local jurisdiction for the location of street furniture placement prior to construction of the passenger boarding area.

Prior to final acceptance or release of certificate of occupancy, the local jurisdiction must be notified to inspect and approve all bus stop related improvements.

A minimum of 48 hours advance notice to local jurisdiction and Omnitrans for final inspections is required.

In addition, the construction plans need to show existing and proposed bus stop locations. The following special provisions may be included in the permitting process, the inspection process, pre-construction conferences, or wherever it is most appropriate:

Contractor shall provide Omnitrans with the name and telephone number of the contractor's construction manager prior to the commencement of all construction projects involving bus stops or bus route detours.

Contractors shall make every effort to schedule their work to minimize impacts and the duration of impacts to transit operations and the general public.

The contractor is responsible for the construction of the passenger boarding area.

A representative of Omnitrans should be invited to the project's pre-construction conference.

4.4 Resolution of Conflicts between Omnitrans and Jurisdictions

The decision on the location of bus stops is the responsibility of the local jurisdiction, who considers the recommendations made by Omnitrans prior to making a final decision. Jurisdictions have the authority to remove bus stops in cases where safety and security issues exist. When jurisdictions remove stops for safety and security concerns, they shall notify, and work in conjunction with Omnitrans in an effort to solve the safety and security problem and reopen or relocate the stop in a timely manner.

If situations occur where the staff of Omnitrans and that of the jurisdiction are unable to agree on proposed plans, bus stop locations, or other issues, the issue is to be raised to higher levels. Normally a meeting will be held at the director level in an attempt to resolve issues. If the issue remains unresolved, an additional meeting will be held at the CEO/General Manager and City Manager level. If the issue is still unresolved, the jurisdiction's representative may address the issue to the Omnitrans Board of Directors at the next regular meeting.

The appropriate points of contact at each agency are listed in Appendix D.

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5. LOCAL BUS STOP PLACEMENT

This chapter lays out Omnitrans' policies and guidelines for the placement of bus stops.

Because of the number of factors involved, each new or relocated stop must be examined on a case-by-case basis. However, general guidelines for stop spacing and placement are as follows.

5.1 Stop Spacing

The current stop spacing policy is contained in Omnitrans Short Range Transit Plan (http://www.omnitrans.org/about/reports/). The Figure 5-1 below shows how stop spacing can be adjusted to capture the most potential passengers within the ½ mile walk shed.

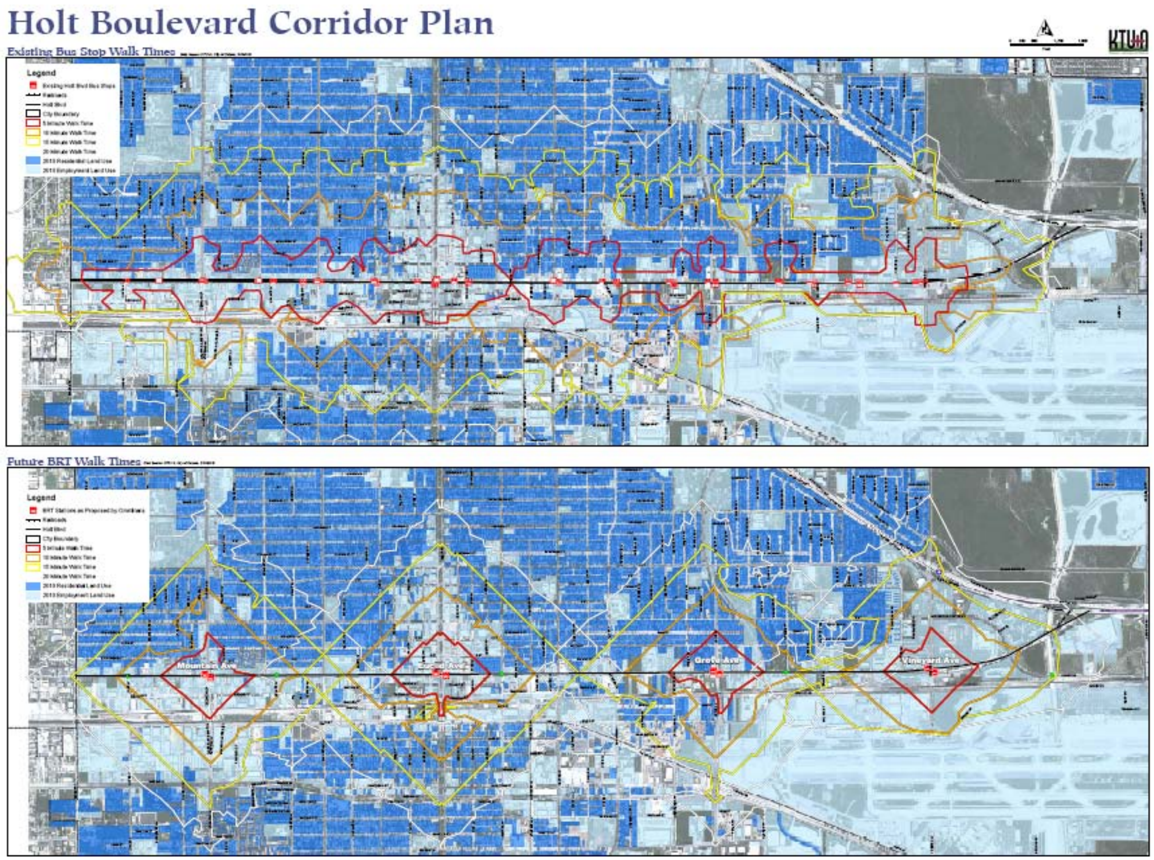


Figure 5-1: Stop Spacing and Pedestrian Walk Shed for Holt Boulevard

Produced for the City of Ontario by KTU+A, Holt Boulevard Corridor Streetscape and Strategic Plan, February 2012 (draft).

5.2 Placement of Bus Stops

The proper location of stops is critical to the safety and security of passengers and motorists, and to the proper operation of the transit system. Bus stop locations are recommended by Omnitrans, and approved by the local jurisdictions. Local jurisdictions can suggest bus stop locations at their discretion. It is important to consider the unique circumstances at each intersection when selecting bus stop locations, including:

- Proximity to major trip generators, based on population density and/or specific use (i.e. major employment centers, regional shopping centers, hospitals, etc.);
- Presence of sidewalks and curb ramps leading to trip generators and nearby pedestrian circulation system;
- Availability of adequate right-of-way to ensure that the bus stop meets the Americans with Disabilities Act (ADA) accessibility standards;
- Pedestrian safety and security including access to stop, level pathways leading to and from bus stop areas, firm surface, and free of obstacles;
- Width, placement and condition of sidewalks (sidewalks should be wide enough to accommodate waiting passengers without blocking ADA clear path;
- Protected crossings at signalized or stop controlled intersections, or at crosswalks;
- In general, it is safer to locate the bus stop on the far side of a crosswalk, so that passengers will cross behind, rather than in front of, the bus;
- Convenient passenger transfers to other routes;
- Effect on adjacent property owners;
- Conflict between buses, other traffic, and pedestrians;
- Pedestrian activity through intersections;
- Open and visible spaces for personal security and passenger visibility;
- Street illumination, see sections 8.4 and 12.3 for lighting specifications;
- Ability to restrict parking if needed, feasibility to move or provide parking and truck delivery zones;
- Adequate curb space for the number of buses expected at the stop at any one time;
- Volumes and turning movements of other traffic, including bicycles;
- Proximity and traffic volumes of nearby driveways;
- Street and sidewalk grade;
- Ease for bus re-entering traffic stream;
- Bus route turns;
- Unusual intersection angles or predominant turning movements;
- Proximity to rail crossings or emergency driveways;
- Sight distance at adjacent intersections and driveways;
- Curb clearance – adequate space for buses to stop, and return to the traffic flow;
- Operational effectiveness issues (including relation to the nearest intersection, bus turning requirements, and re-entering the travel lane); and,
- Proximity to other transit such as rail or sbX service;
- Landscaping issues - The presence of trees and bushes at a bus stop may necessitate periodic trimming to prevent

buses from hitting tree branches and bushes from encroaching on sidewalks. Tall bushes are discouraged as they are a potential security problem, and additional lighting should be considered at stops with this issue. Crime Prevention through Environmental Design (CPTED) principles should be looked at for landscaping plans.

- Limited visibility over hills and around curves - Bus stops should not be located over the crest of a hill, immediately after a road curve to the right, or at other locations that limit the visibility of the stopped bus to oncoming traffic. If the bus stops in the travel lane at such locations, it is in danger of being struck from the rear. Even if the bus pulls off the road at such stops, pulling back into the travel lane presents accident potential. If a bus stop must be located at such a location, approaching cars should be warned of the need to be prepared to stop.
- Transfer locations - In locations where transfer activity between routes is heavy, bus stops should be located to minimize street crossings of passengers transferring to other routes.
- Drainage - Areas which tend to accumulate standing water should be avoided or improved. However, bus stops should not be located so that passengers are required to step over catch basins when boarding or alighting from the bus, as this creates a potential tripping hazard.
- Bicycle facilities - To the extent feasible, bus stops should be located so they do not block bicycle travel lanes. Bus stops should also be located so that bicycle racks do not block pedestrian access to the bus boarding and alighting area.
- Consideration of potential safety and security risks:
    - Uneven surfaces, which could result in a fall;
    - Slope of the terrain surrounding the landing area, which can put passengers in danger of falling in an adjacent ravine or into the travel lane;
    - Presence of hazardous objects, such as broken street furniture and jagged edges;
    - Surface traction (for example, stone aggregate can be exceedingly slippery when wet for wheelchair users);
    - Water accumulation areas, which can also result in muddy and slippery surfaces;
    - Overgrown bushes, which could potentially present a security hazard as well as encroach on the sidewalk and landing area;
    - Other obstacles in the sidewalk that, in addition to making it inaccessible, force pedestrians to walk in the street; and
    - Design bus stop and surrounding area to discourage vandalism and loitering and provide for a long service life with minimum maintenance under conditions of intensive use.

For more detailed safety and security considerations, please refer to the APTA publication *Bus Stop Design and Placement Security* and other resources in Appendix C for guidance on crime prevention through environmental design.

5.2.1 Nearside or Farside Stops

Bus stops are generally located at intersections where they may be placed on the nearside or farside of an intersection. This maximizes pedestrian accessibility from both sides of the street and provides connection to intersecting bus routes.

The placement of bus stops at intersections varies from site to site. Figure 5-2 below shows the general placement options for bus stops along a route. However, general considerations for the placement of bus stops at intersections include:

- Mid-block stops are highly discouraged because they typically place passengers far away from a safe (signalized) crossing and encourage unsafe street crossings.
- When the route alignment requires a left turn, the preferred location for the bus stop is on the farside of the intersection after the left turn is completed.
- If there is a high volume of right turns at an intersection, the preferred location for a stop is on the farside of the intersection after the turn.
- If the transit route turns right at an intersection, the preferred location for a stop is after the bus has turned.
- In circumstances where the accumulation of buses at a farside stop would spill over into the intersection and additional stacking length is not available, the stop should be placed on the nearside of the intersection. This removes the potential for queuing buses to overflow into and block the intersection.
- At complex intersections with multi-phase signals or dual right or left turn lanes, farside stops are preferred because they remove the buses from the area of complicated traffic movements at that intersection.
- When transfer activity between two lines exhibits a strong directional pairing (i.e., heavy volumes from westbound to northbound) placing one stop nearside and one farside can minimize pedestrian activity within the intersection.

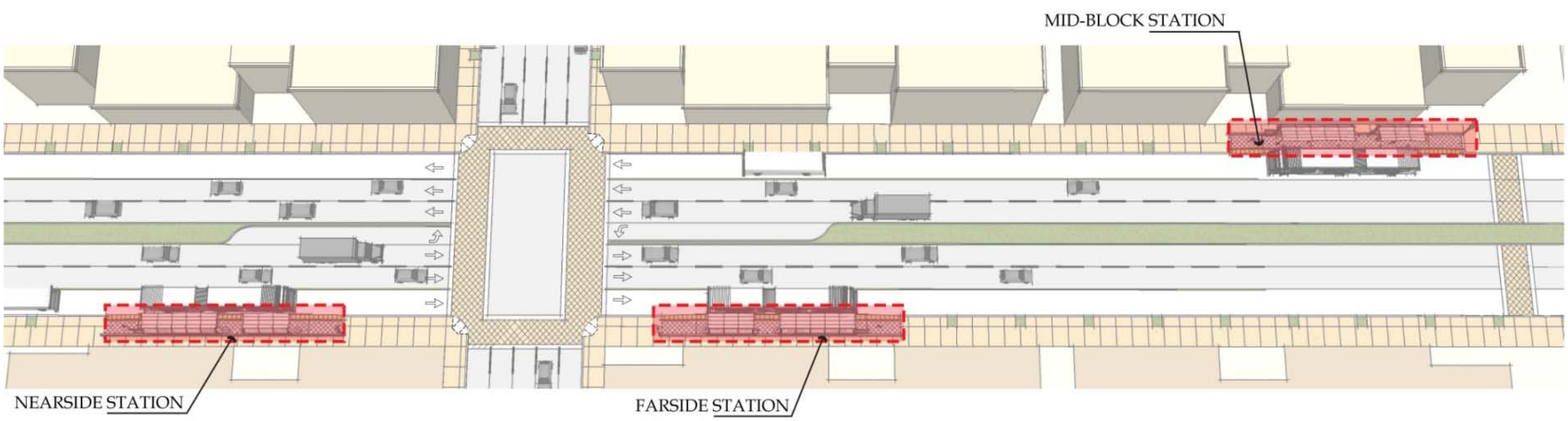


Figure 5-2: Bus Stop Placement

Table 5-1: Advantages and Disadvantages of Stop Placement Relative to the Nearest Intersection

Bus Stop Location	Advantages	Disadvantages	Recommended When the Following Location Conditions Exist
Nearside Located immediately before an intersection	• Less potential conflict with traffic turning onto the bus route street from a side street. • The bus boarding door is close to the crosswalk. • Bus has intersection to merge into traffic. • Bus Driver can see oncoming buses with transfer passengers.	• Potential conflicts with right turning traffic due to cars cutting in front of the bus. • The stopped bus obscures the sight distance of drivers and pedestrians entering from the right. • The stopped bus may block visibility of the stop signs or traffic signals. • At signalized intersections, may result in schedule delays.	• When traffic is heavier on the farside than on the approaching side of the intersection. • When pedestrian access and existing landing area conditions on the nearside are better than on the farside. • When street crossings and other pedestrian movements are safer when the bus stops on the nearside than the farside. • When the bus route goes straight through the intersection. • When adequate sight distance can be achieved at the intersection.
Farside Located immediately after an intersection	• Does not conflict with vehicles turning right. • Appropriate after the route has made a turn. • The stopped bus does not obscure sight distance to the left for vehicles entering or crossing from the side street. • At signalized intersections, buses can more easily re-enter traffic. • The stopped bus does not obscure traffic control devices or pedestrian movements at the intersection.	• The stopped bus obscures the sight distance to the right of drivers entering from the cross street to the right of the bus. • If the bus stopping area is of inadequate length, the rear of the stopped bus will block the cross street (especially an issue for stops where more than one bus may be stopped at a time). • If the bus stops in the travel lane, it may result in queued traffic behind it blocking the intersection.	• When traffic is heavier on the nearside than on the farside of the intersection. • At intersections where heavy left or right turns occur. • When pedestrian access and existing landing area conditions on the farside are better than on the nearside. • At intersections where traffic conditions and signal patterns may cause delays. • At intersections with transit signal priority treatments.

Bus Stop Location	Advantages	Disadvantages	Recommended When the Following Location Conditions Exist
Mid-Block Located 300'or more beyond or before an intersection	• The stopped bus does not obstruct sight distances at an intersection. • May be closer to major activity centers than the nearest intersection. • Less conflicts between waiting and walking pedestrians.	• In most cases, there is no safe crosswalk available mid-block. • May increase customer walking distances if the trip generator is close to an intersection. Length of mid-block stops can vary due to depth of a turn-out and a bus' ability to maneuver in/out of traffic lanes. • Requires most curb clearance of the three options (unless a mid-block sidewalk extension or bus bulb is built).	• When there is a safe, well-marked crossing or signalized crossing (such as a HAWK signal) adjacent to the stop.

5.3 Curb Clearance for Bus Stopping Zones

The preferred minimum requirements for curb clearance for one 40′ or one 60′ bus are indicated in Figures 5-3 to 5-5. It must be noted that these clearances are not always feasible in the urban environment, but should be aimed for wherever possible to ensure that buses have room to serve the stop parallel to the curb with comfortable space to exit and re-enter the travel lane. At an absolute minimum, an additional 25′ would be needed for pulling in and pulling out (totaling 50′ for both), plus the length of the vehicle (totaling 90′ for a 40′ bus at a mid-block stop. Where the parking lane is over 8′ in width, or where turnouts are used, additional space is needed for the bus to reenter the traffic flow, thus the clearance area must be increased a corresponding amount.

For bus stops at which more than one bus may be stopped at a given time, additional curb clearance is needed. A general rule of thumb is to add one bus length plus 10′ for each additional bus to be accommodated at the stop at the same time. Curb clearances for multiple buses are shown in Figure 5-6. Additional curb clearance will be needed for stops following right-hand route turns and may also be needed following left-hand turns.

Along high-ridership routes or major arterials, 60′ articulated vehicles may be used in the future instead of 40′ vehicles as demand warrants. As such, 60′ vehicles will be needed to accommodate at a stop, with additional room for a minimum of 25′ for pulling in and pulling out. Room for two 60′ sbX vehicles may be desirable based on demand at stops, with 10′ of separation between vehicles.

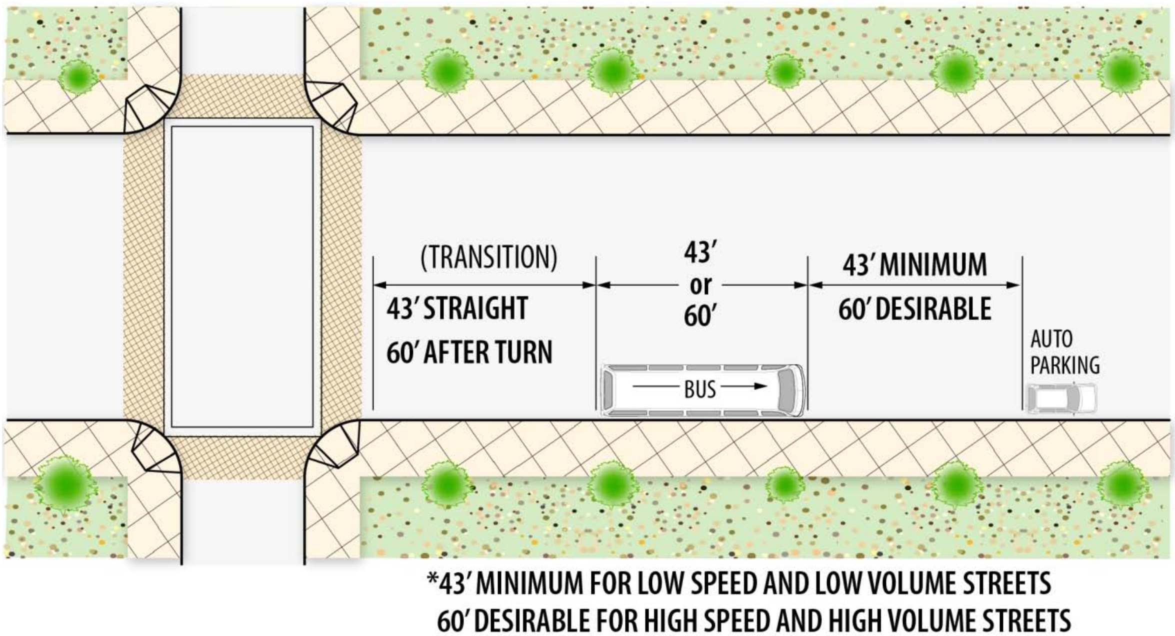
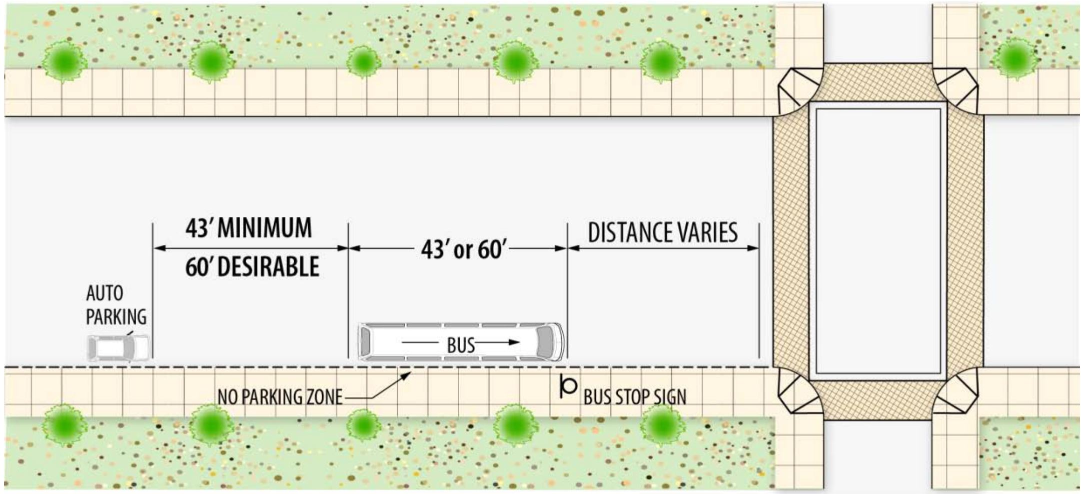
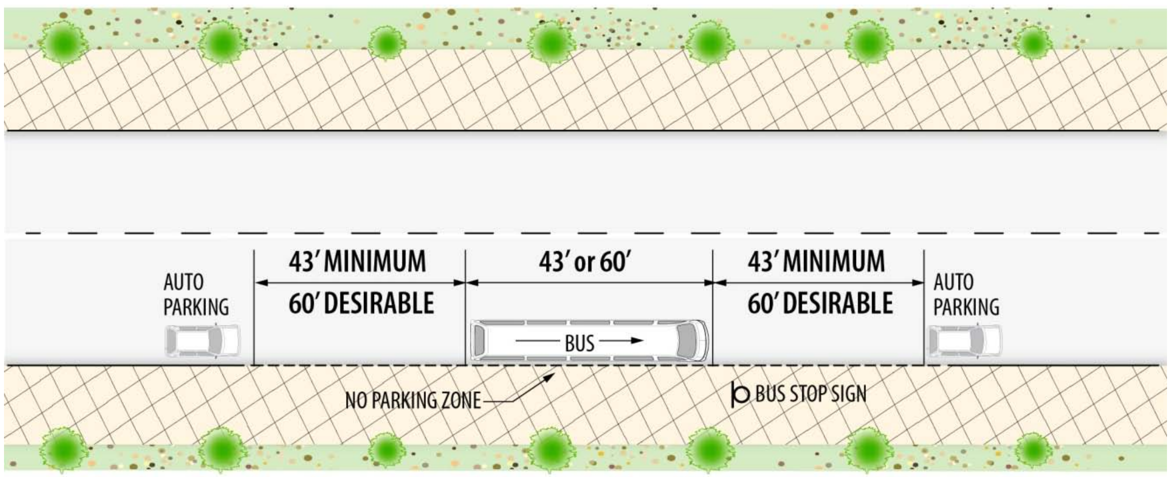


Figure 5-3: Typical Dimensions for Farside Stops



*43' MINIMUM FOR LOW SPEED AND LOW VOLUME STREETS
60' DESIRABLE FOR HIGH SPEED AND HIGH VOLUME STREETS

Figure 5-4: Typical Dimensions for Nearside Stops



*43' MINIMUM FOR LOW SPEED AND LOW VOLUME STREETS
60' DESIRABLE FOR HIGH SPEED AND HIGH VOLUME STREETS

Figure 5-5: Typical Dimensions for Midblock Stops

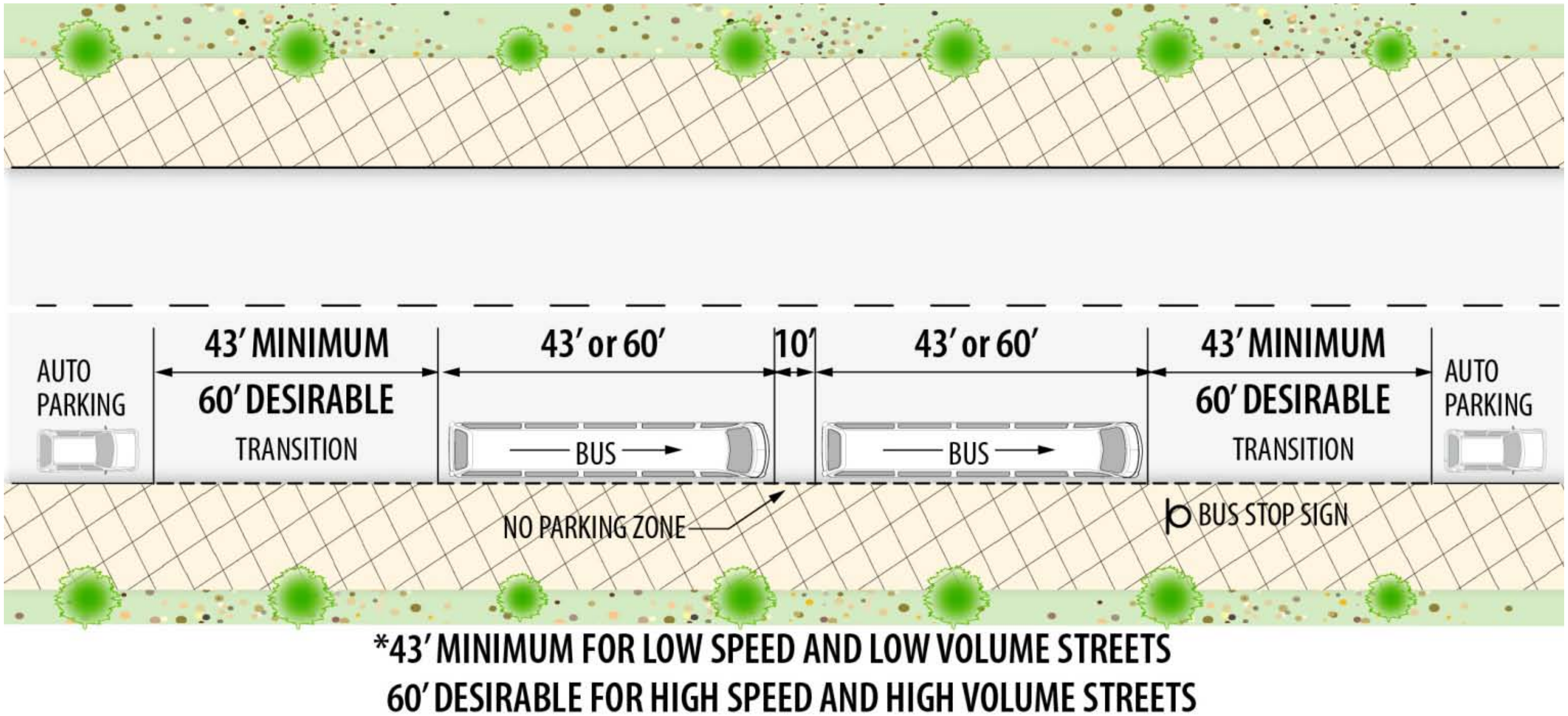


Figure 5-6: Typical Dimensions for Multiple Bus Stops

5.4 Abutting Property Owners / Tenants

Some commercial establishments are interested in having a bus stop placed in front of their establishment, while residents may object to the presence of a bus stop in front of their home, especially if the stop is used for layovers. All efforts should be taken to minimize the impact to each property owner, but vehicle and pedestrian safety and security should be the over-riding factor in determining the final bus stop location.

Bus stops should also be located adjacent to shop windows and entrances, to allow businesses to be visible from the street, as necessary.

5.5 Parking Restrictions at Bus Stops

Parking restrictions (either red curb or "No Parking" signs) shall be placed at bus zones when parking is expected to impact bus operations, in accordance with the California Vehicle Code Section 22500 (i). The lack of parking restrictions could impact bus operations, traffic movement, safe sight distance, and passenger access.

It is also recommended to paint "BUS ONLY" on the pavement at bus zones. Potential issues include:

- The bus may have to double park when serving a stop, which would interfere with traffic movements.
- Passengers would have to maneuver between parked vehicles when entering or exiting the bus, which can endanger the passengers.
- The bus would lack access to the curb/sidewalk area for boarding or alighting passengers in wheelchairs.

It is important that these parking regulations are enforced in a consistent and expedient manner by the appropriate local jurisdiction.

5.6 Bus Stops and Driveways

Whenever possible, bus stops should not be placed within 25' of a driveway. However, if placing a bus stop near a driveway is unavoidable, the following guidelines can be followed:

- Attempt to keep at least one exit and entrance open to vehicles accessing the property while a bus is loading or unloading passengers, as shown in Figure 5-7. When there are two driveways to a parcel on the same street, the upstream driveway should be blocked forcing vehicles to turn behind the bus to access the driveway;
- It is preferable to fully rather than partially block a driveway to prevent vehicles from attempting to squeeze by the bus in a situation with reduced sight distance;
- Locate bus stops to allow good visibility for vehicles leaving the property and to minimize vehicle/bus conflicts. This is best accomplished by placing bus stops where driveways are behind the stopped bus; and
- Ensure that passengers have a safe area to wait when loading must occur in or adjacent to a driveway.

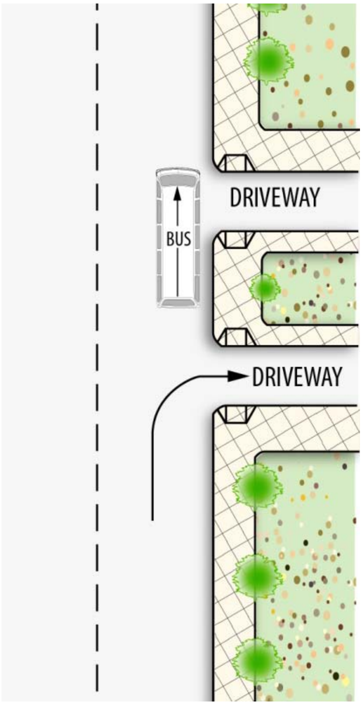


Figure 5-7: Bus driveway conflicts

6. MINIMUM REQUIRED BUS STOP ELEMENTS

The following minimum bus stop elements are required under the Americans with Disabilities Act.

6.1 Landing Area and Sidewalk Connections

Bus stop sites shall be chosen such that, to the maximum extent practicable, lifts or ramps can be deployed on a firm, stable surface to permit a wheelchair or mobility aid user to maneuver safely onto or off the bus and to/from the bus stop. This is referred to as the landing area, the area from which passengers board the bus and onto which passengers alight from the bus. Figure 6-1 shows an example of a bus stop without an ADA landing area, where passengers do not have an accessible path to the bus door.

- Dimensions: The minimum landing area requirement (ADAAG, 10.2.1) is a continuous, unobstructed solid area contiguous to the curb that measures at least 5' parallel to the street and at least 8' perpendicular to the street at the front door, and at least 10' parallel to the street and at least 8' perpendicular to the street at the back door. The landing area can be in front of and part of shelter pad (if shelter installed) or freestanding, and should be immediately adjacent to bus stop sign pole (prior to pole in the direction of traffic).

- Distance between front and rear boarding areas is 18‘, for a total minimum landing area of 30’ long for 40’ buses. These are the minimum dimensions needed to deploy a lift or ramp and allow a customer in a wheelchair to board or alight from the vehicle. 40’ of clear paved or concrete space starting from the bus pole along the curb area is preferred, minimum 4’ wide, outside of the front and rear landing areas which are a minimum 8’ deep from the curb (ADAAG 4.3, 4.5). Typical Dimensions are shown in Figures 6-2 to 6-4. Stops where more than one bus is boarding/alighting passengers at the same time will need additional boarding and alighting areas to be determined by the size and placement of the buses serving each stop. Wheelchair accessible pathway should be included and tied into sidewalk, if not existing, including access ramps as necessary.

Figure 6-1: Example of a bus stop without an ADA landing area, where passengers do not have an accessible path to the bus door.

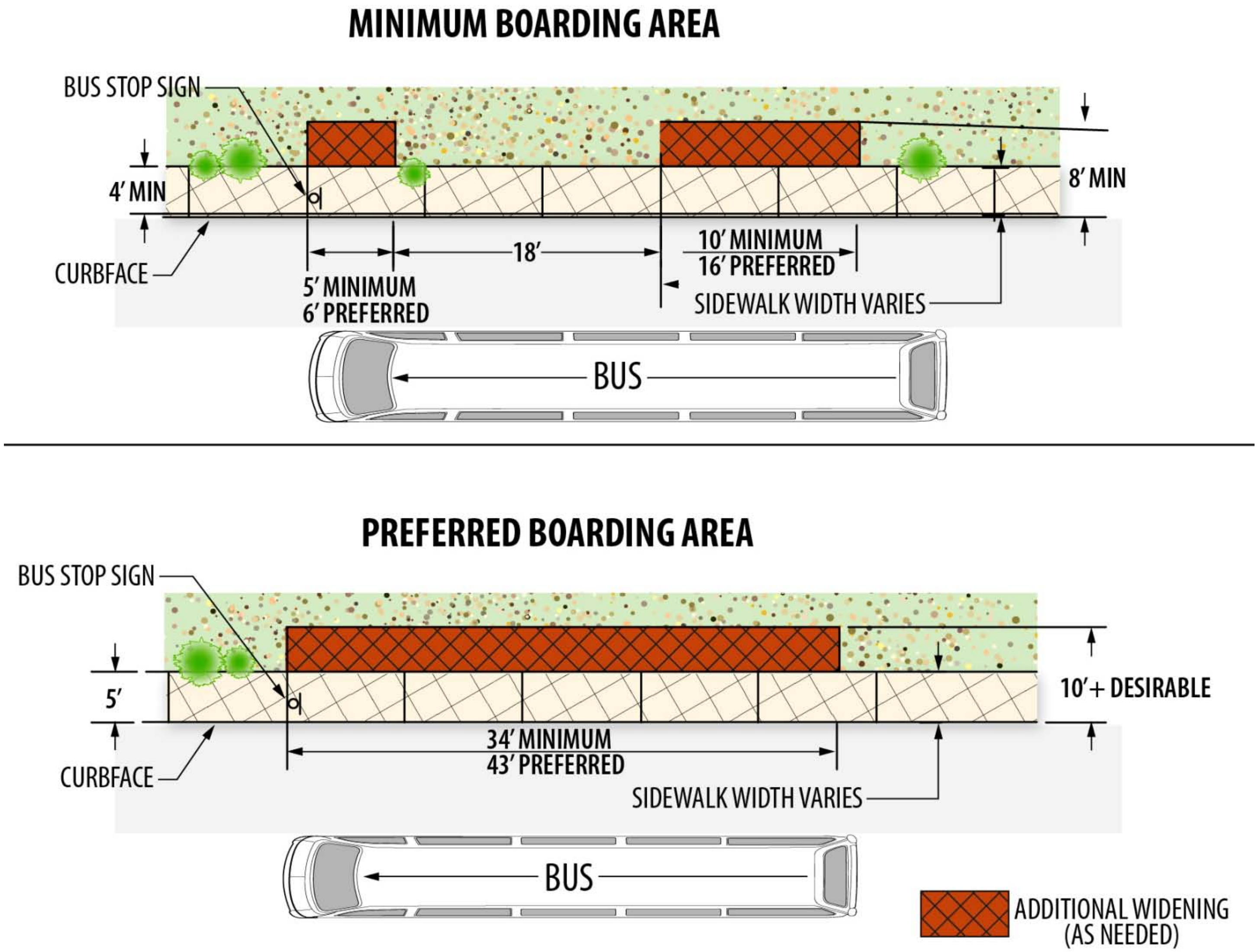


Figure 6-2: Typical Stop Dimensions – Sidewalk Adjacent to Curb

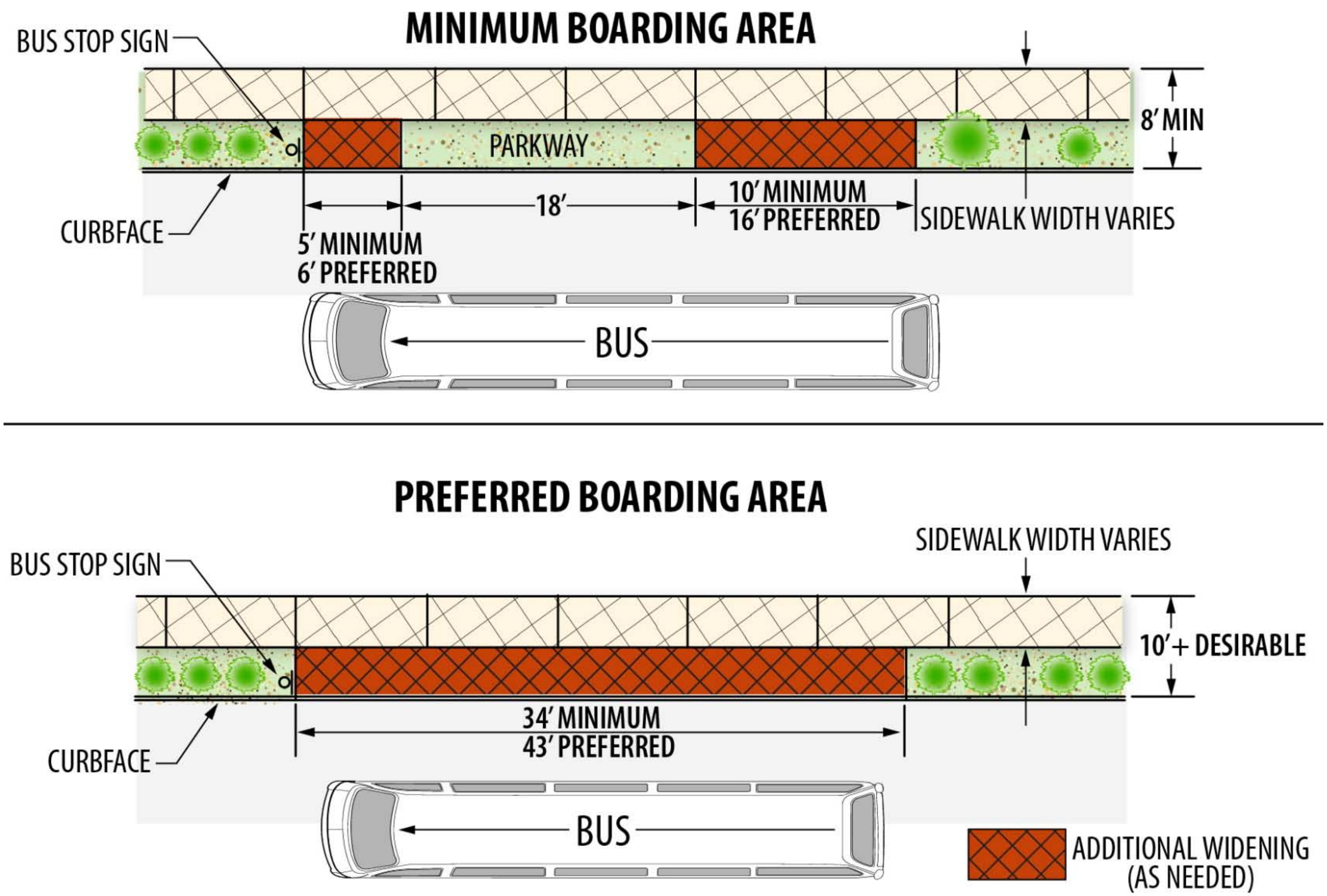


Figure 6-3: Typical Stop Dimensions – Sidewalk behind Parkway Strip

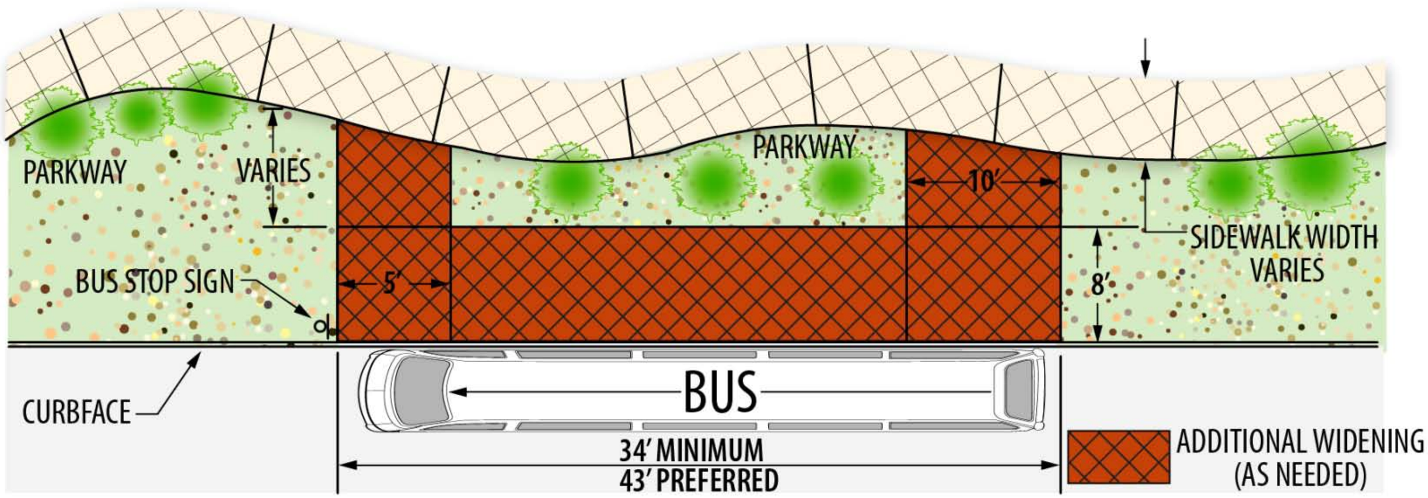


Figure 6-4: Typical Stop Dimensions – Meandering Sidewalk

- Slope: The slope of the landing area must be parallel to the slope of the roadway in order for the bus wheelchair lift or ramp to be effectively deployed. The slope should not exceed 1'vertical over 20' horizontal (5%), and the cross slope should not exceed 1' vertical over 50' horizontal (2%).
- Surface Material: The landing area must be firm, stable, and slip-resistant. Concrete is the preferred surface for the landing area. It is possible for the lift or ramp to span an area of another material, such as grass or soil in a planter strip between the curb and the sidewalk. However, for the safety of ambulatory customers who may stumble on an uneven surface, it is strongly recommended to construct a continuous concrete pad. In newer developments where a new bus stop will be placed, a continuous surface from the curb and the sidewalk should be provided for the purposes of deploying a bus ramp or lift for wheelchairs or other mobility devices. In uncurbed shoulder areas, the landing area may be constructed of asphalt.
- Height Relative to the Street: It is also preferable that the landing area be elevated above street level for pedestrian safety. For stops served by low-floor, ramp-equipped buses a standard curb provides an acceptable ramp slope.
- Clearances: A horizontal clearance between obstructions of 48", and a vertical clearance of 84" should be maintained in the boarding area.
- If items such as newspaper boxes, utility poles, trash cans, and encroaching grass or bushes constrict a portion of the sidewalk to less than 4', the sidewalk is not accessible to

wheelchair users. If necessary, the existing sidewalk should be widened or new sidewalk constructed to ensure that customers are able to get to and from the bus stop.

- To the extent feasible, sidewalk connections around bus stops should provide safe pedestrian access to the passenger trip generators near the bus stop.
- A 6′ wide sidewalk is preferred.
- In rural areas without sidewalks, a minimum 4′ wide paved shoulder, or of decomposed granite, compacted and stabilized, should be provided if possible.
- At rural bus stops, a concrete landing area should be provided if possible. The paved area 35′ long and 8′ wide is desirable, with a minimum of 5′ long by 8′ wide as needed for lift operation. A tactile warning device should be place between the roadway and the bus landing area to allow visually impaired pedestrian to identify the bus stop position.
- Where a bus stop serves as a transfer point, there should be a paved connection to the connecting route stops.
- Pathway slope should not exceed 1′ vertical over 20′ horizontal (5%).
- Pathway cross slope should not exceed 1′ vertical over 50′ horizontal (2%).
- A minimum horizontal clearance of 48"(preferable 60") should be maintained along the entire pedestrian access route (PAR).
- A vertical clearance of 84" should be maintained along the entire pathway.
- In locations where there is currently no demand for a bus stop but where a bus stop may be needed in the future, an 8′ wide sidewalk should be placed adjoining the curb that could serve as a landing pad. This will reduce the cost of retrofitting if a bus stop is added in that location in the future. Inquiries about the future demand for bus stops can be sent to BusStops@Omnitrans.org, as outlined in Chapter 4, Bus Stop Policies. New residential development should provide breaks in walls between properties to allow pedestrian access to bus stops.

Figure 6-5: Pedestrian Access Route

6.2 Curb Ramps

Curb ramps are required, with slopes no steeper than 1 inch of level change across 12" (ADAAG, 4.8.2) of distance, where level changes occur (such as a crosswalk at an intersection). Curb ramps are an integral part of the pedestrian access route leading to and from bus stop locations.

6.3 Signage

Omnitrans will install a sign at each stop, as shown in the photo, which indicates to passengers and drivers where the buses stop and publicizes the availability of service. The sign is securely mounted on its own post or a light standard, at an angle perpendicular to the street within 18' to 24' of the edge of the curb. The bus stop sign will neither block nor be blocked by other jurisdictional signs. The signs will not affect the pedestrian path of travel (See Figure 6-6). The header sign is the point at which the front of the bus should be aligned when the bus is servicing passengers and thus should be placed approximately 1' beyond the far side of the landing area for stops served by front-lift buses. The bottom edge of the sign is positioned at a height of at least 80" from the ground. The Header sign is shown in detail in Figure 6-7 along with NexTrip sign in Figure 6-8 and the Omnitrans Access pickup point sign detail in Figure 6-9. Omnitrans is currently in the process of developing design criteria for placement of Access pickup point signs.

In order to meet ADA minimum specifications for signs posted at 80", the letters and numbers are at least 3" high. The ADA standards further specify that the characters have a width-to-height ratio between 3:5 and 1:1, and a stroke-to-width ratio between 1:15 and 1:10. These standards make signage accessible to persons with low vision. These requirements do not apply to route and schedule information posted at bus stops.

6.3.1 Route and Schedule Information

At bus stops at major transfer points, or where attracting additional ridership is desirable, Omnitrans may post an up-to-date route and schedule. Space must be provided on all four sides for a passenger to inspect posted information. The schedules should be mounted on the side facing away from the street.

Bus stop signs are placed to notify the general public where the bus will stop, to provide reference for coach operators, and to assist in marketing the system. Figure 6-10 illustrates a typical post anchor detail. The sign:

- Identifies the location as a designated bus stop;
- Provides route specific information; and
- Displays the transit information telephone number and website.

Effective in 2013, there will also be a sign with information about the NextTrip system at every bus stop. Signs will indicate how to find out when the next bus will arrive at the stop via text message, mobile application, or telephone. Transit centers and high-ridership stops will have electronic message signs telling riders when the next bus will arrive.

There are multiple criteria involved in placing a bus stop sign. Concerns for passenger and public safety, ADA requirements, convenience, bus stop visibility and passenger amenities must all be addressed. The following are general guidelines for bus stop sign locations and clearances:

- Whenever possible, the bus stop sign should be located at the front of each bus zone;

- Bus stop signs should be mounted on square unistrut posts. This is particularly useful for visually impaired patrons to determine the exact location where the bus will stop;

- Whenever possible bus stop signs should be placed independently of all other street signs to maintain transit stop identity;
- The bottom of the sign should be 7‘ above grade and no higher than 10’, consistent with Figure 6-6;
- The top of the informational cassette should be mounted no higher than 60” above grade; and
- Pole to be placed 18” -24” from curb line, and at the front of the bus stop to identify the stopping location of the bus. Placement of pole shall not impede 48” ADA path of travel and should be placed at the back of sidewalk if necessary.

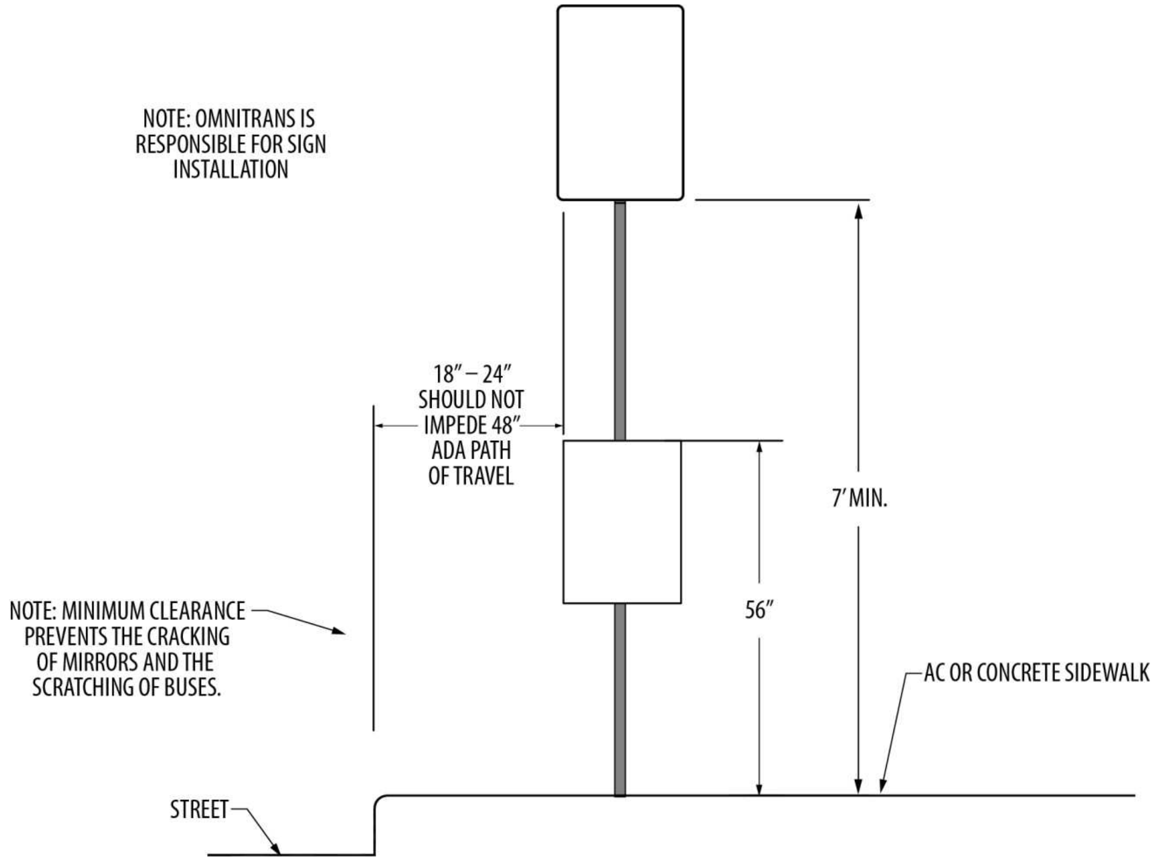


Figure 6-6: Bus Stop Sign Placement Criteria

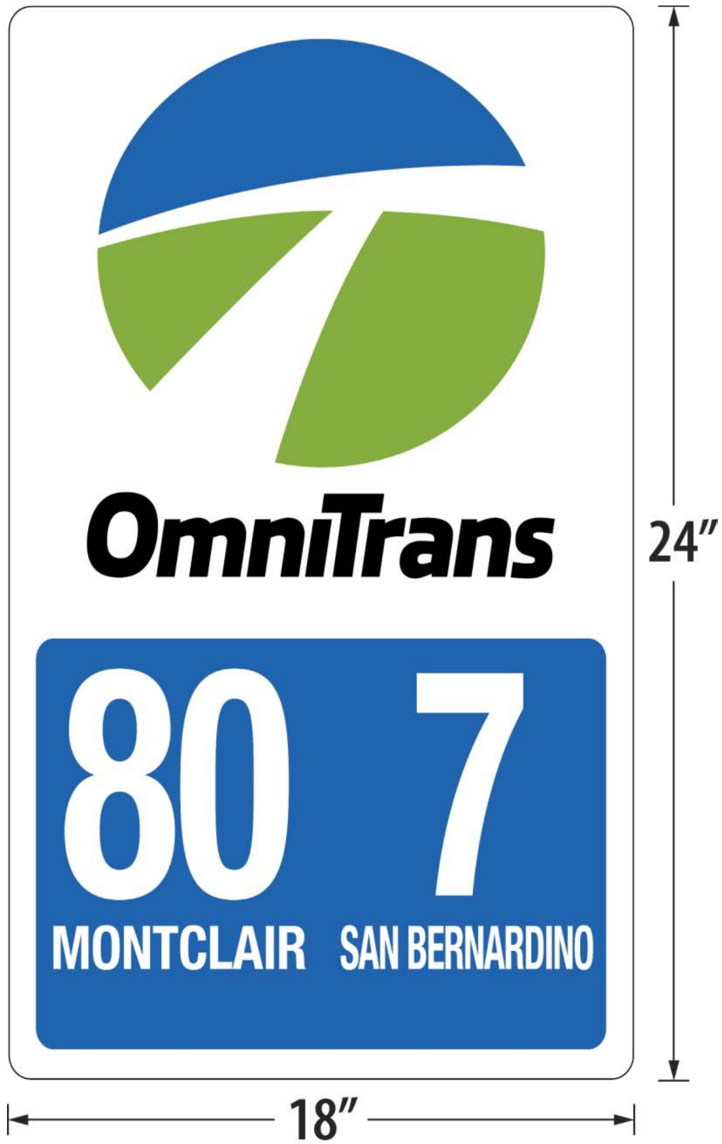


Figure 6-7: Omnitrans Sign Detail

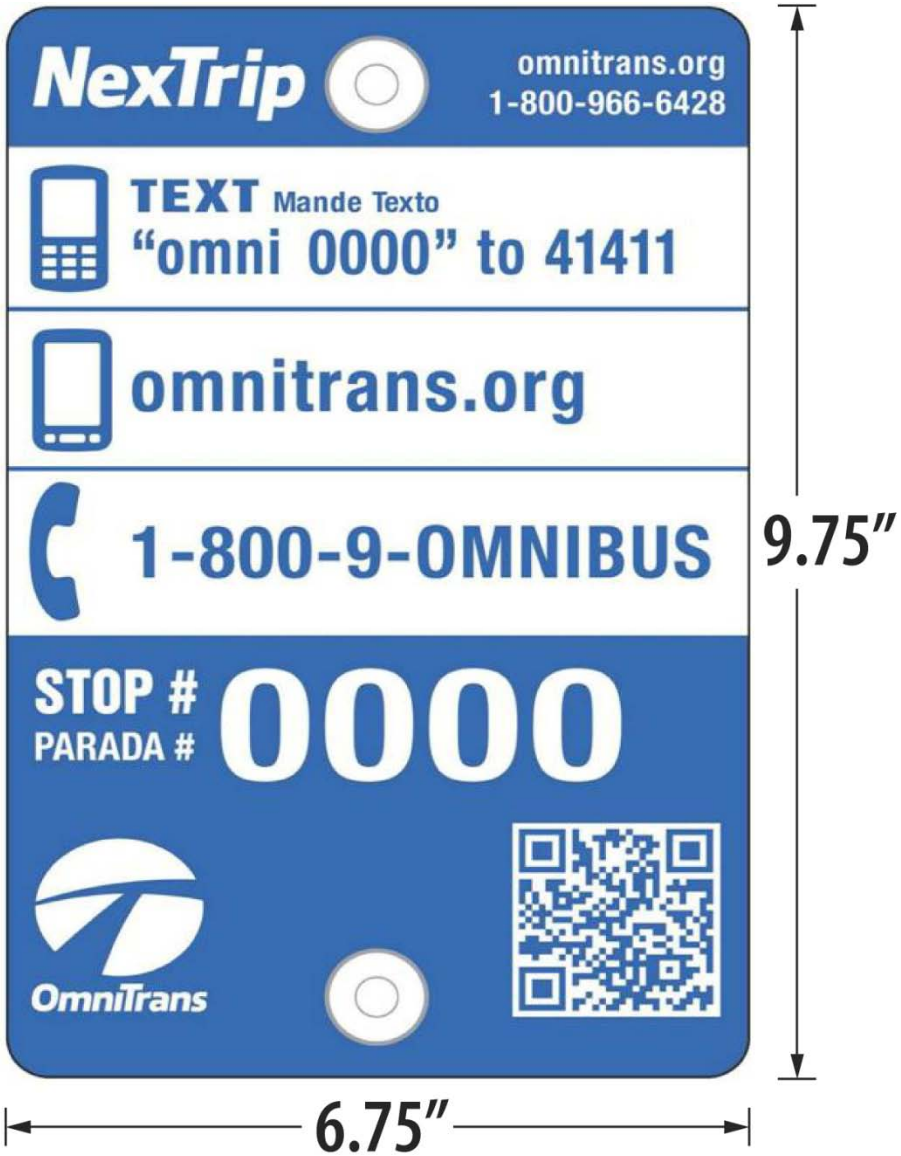


Figure 6-8: NexTrip Sign Detail

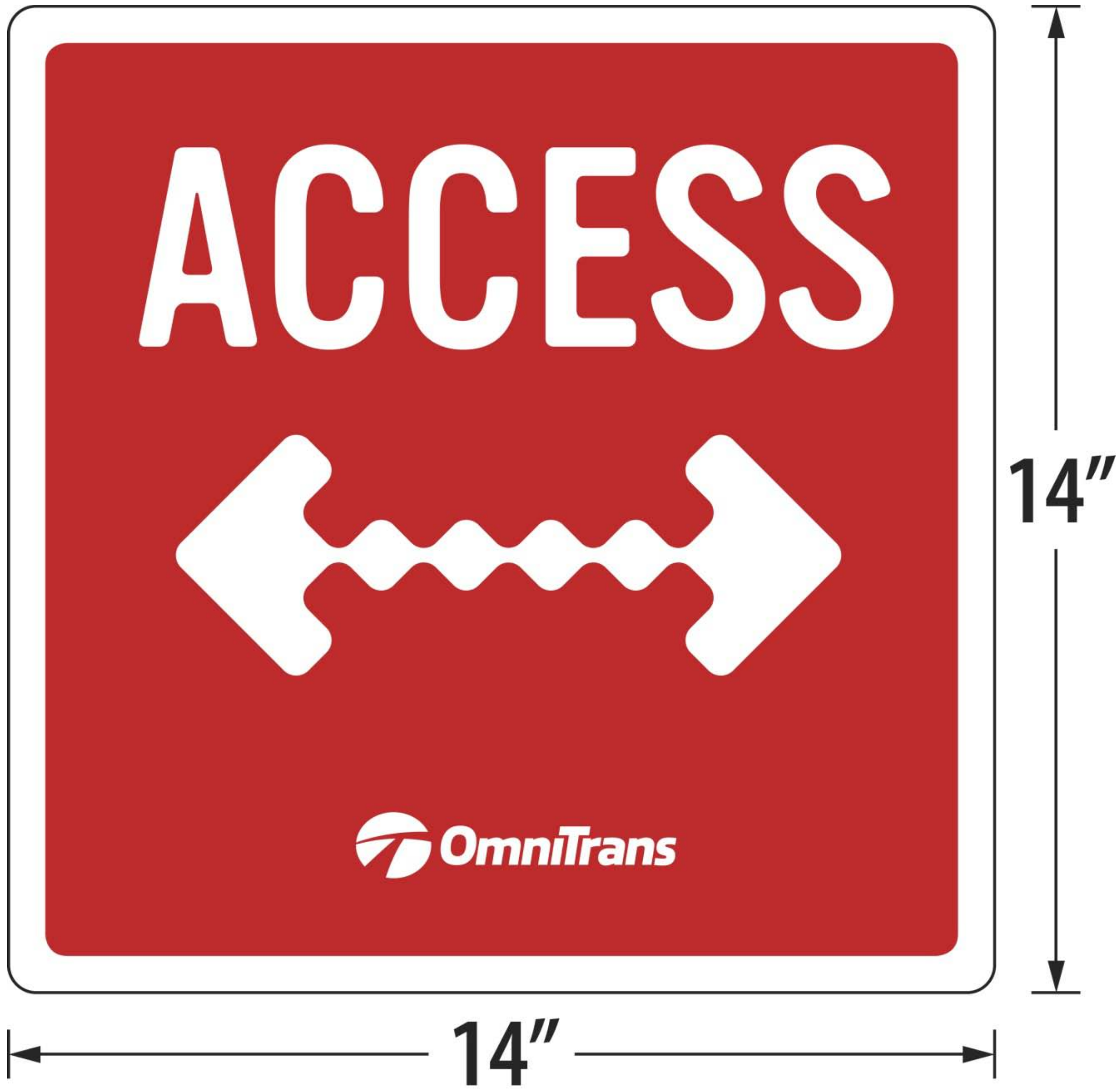


Figure 6-9: Access Sign Detail

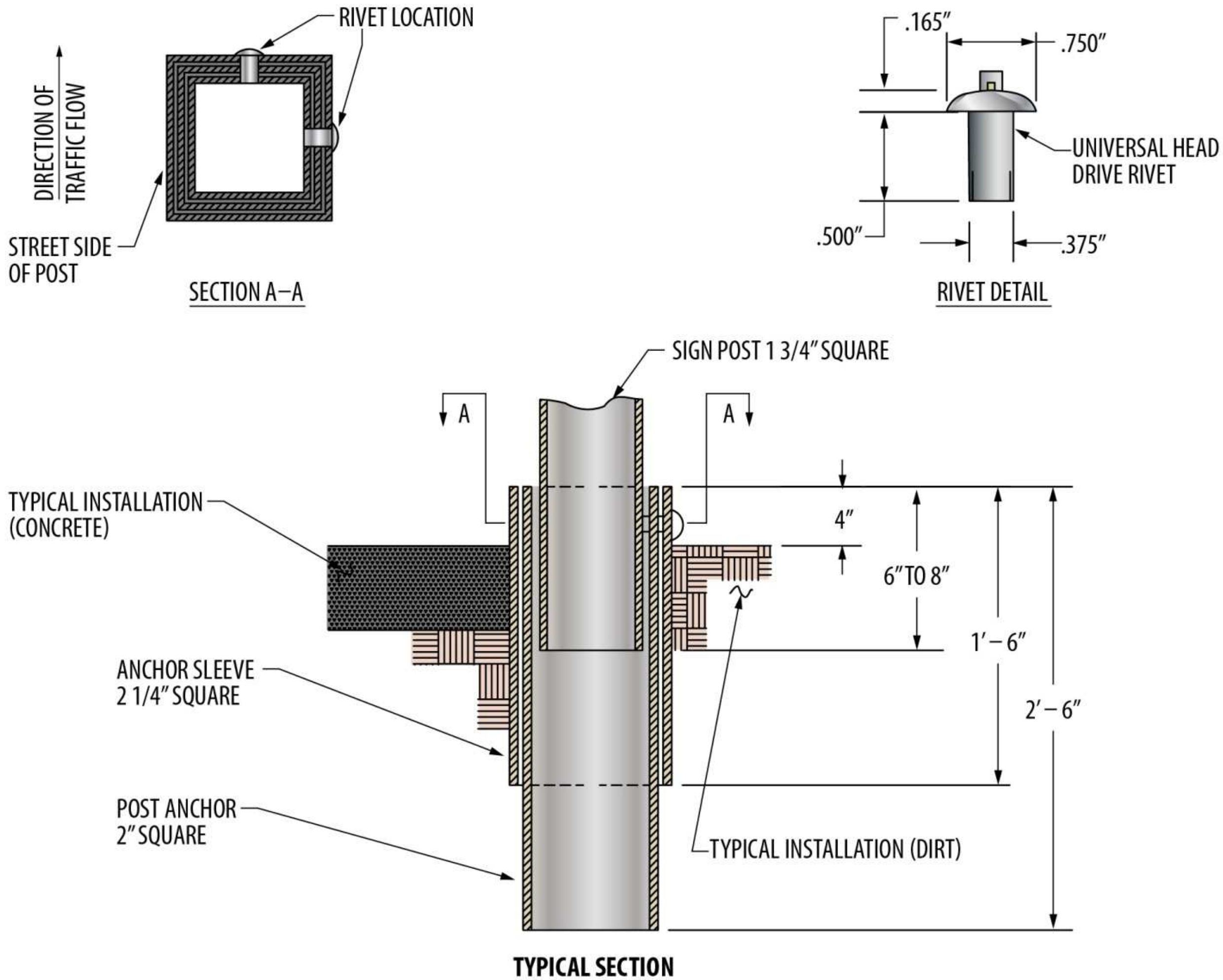


Figure 6-10: Typical Post Anchor Detail

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7. ROADWAY DESIGN AT BUS STOPS

This part provides details of geometric design guidelines for bus facilities.

7.1 Bus Turnouts

Because bus turnouts use additional right-of-way and make it more difficult for buses to re-enter traffic, bus turnouts should only be used where street traffic speeds are 40 mph or more and one of the following conditions exist:

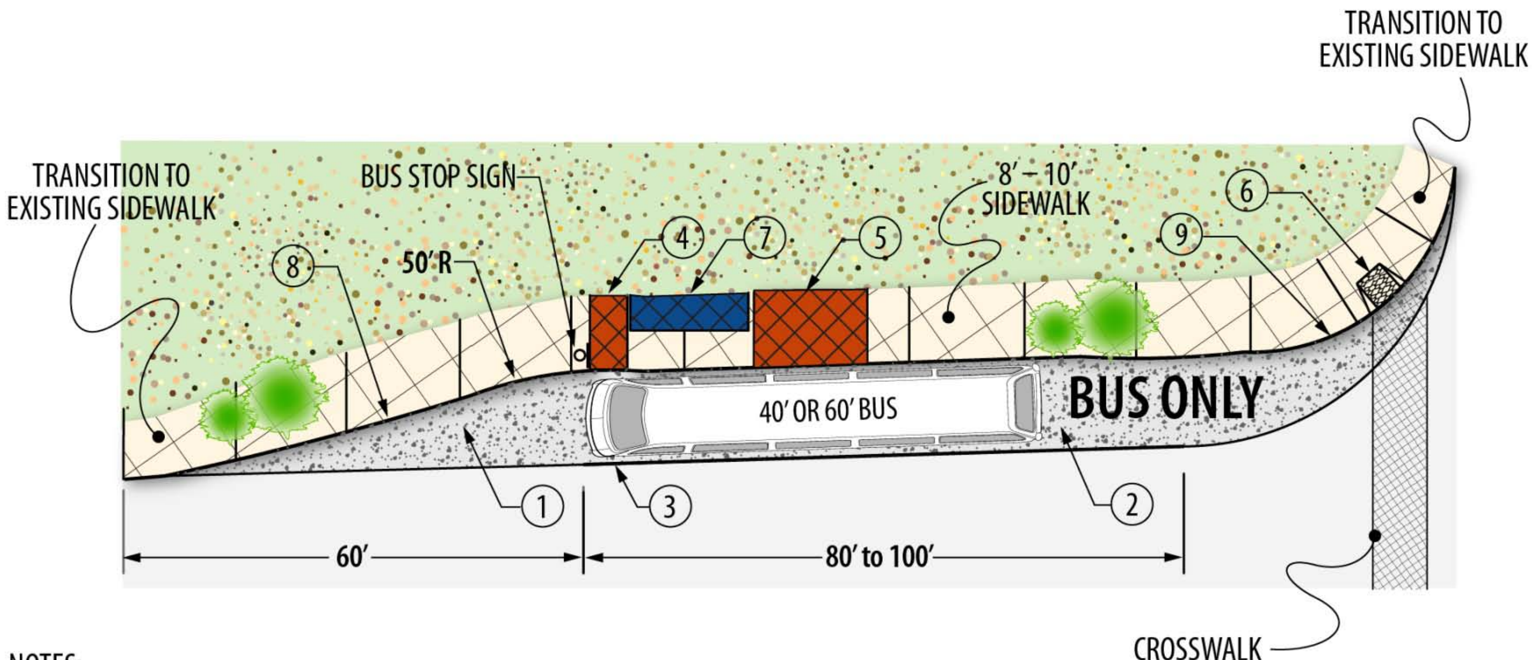
- Peak period boarding average exceeds 20 boardings per hour;
- Average peak period dwell time exceeds 30 seconds per bus;
- The local jurisdiction becomes aware of a high frequency of accidents involving buses and/or pedestrians within the past year;
- When traffic in the curb lane exceeds 250 vehicles during the peak hour and the curb lane is less than 24'6" wide or when bus volumes exceed 10 or more per peak hour;
- Where bus stops in the curb lane are prohibited;
- Where sight distances prevent traffic from stopping safely behind a stopped bus (e.g. hills, curves);
- At stops where there are consistent wheelchair lift boardings;
- Where buses are expected to layover at the end of a trip; and
- Where there is adequate space for turnout length and depth given to allow a bus to safely exit and enter into the flow of traffic.

Farside of an intersection is the preferred location for turnouts. Nearside turnouts typically should be avoided because of conflicts with right turning vehicles, delays to transit service as buses attempt to re-enter the travel lane, and obstruction of pedestrian activity as well as traffic control devices. The exception is where buses use a right turn lane as a queue jump lane associated with transit signal priority treatment at an intersection (where a farside pullout is not possible). Turnouts in mid-block locations are not desirable unless associated with key pedestrian access to a major transit-oriented activity center and subject to the general guidelines above.

Guidelines for bus turnouts:

- Turnout should be placed at signalized intersections where the signal can create gaps in traffic allowing the bus to re-enter the street.
- On streets with bike lanes and where bus layovers occur, the turnout should be wide enough so that buses do not impede the bike lane. Where the outside travel lane is wide, a partial turnout width may be used.
- The minimum combined width of the outside travel lane plus turnout width must be at least 24', to allow traffic to pass the bus.

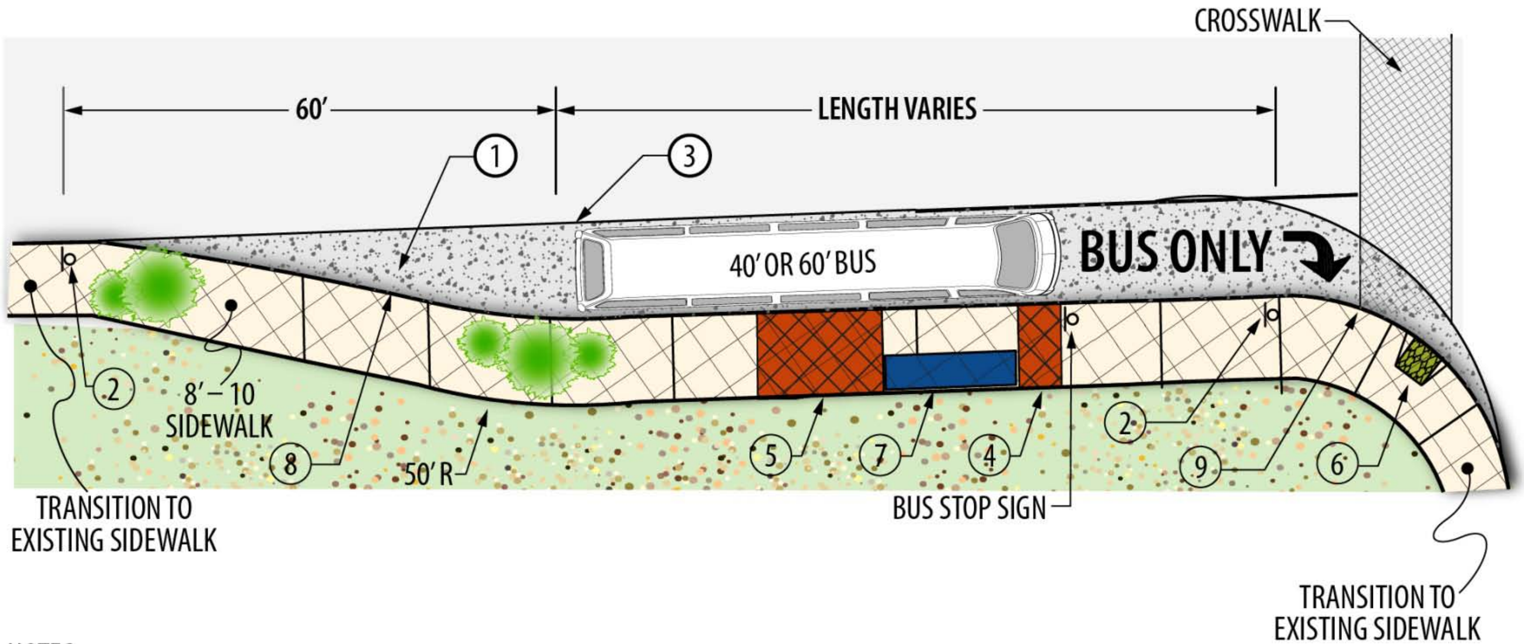
Bus turnout designs and cross-sections are illustrated in Figures 7-1 through 7-7.



NOTES:

1. 12' WIDE BUS PAD – 3000 PSI P.C.C PAVEMENT, 9" DEEP WITHOUT RE-BAR, OR 8" DEEP WITH #3 RE-BAR AT 18" ON CENTER.
2. R3-7 SIGN WITH BUS EXEMPT SIGN.
3. PER CALTRANS STANDARD PLANS A20D, DETAIL 38A.
4. 5' WIDE X 8' DEEP FRONT DOOR LANDING AREA.
5. 10' WIDE X 8' DEEP REAR DOOR LANDING AREA.
6. WHEELCHAIR ACCESS RAMP.
7. SHELTER (10' X 20' PREFERRED, 9' X 6' MINIMUM) OR BENCH LOCATION.
8. DRIVEWAYS SHOULD BE AVOIDED WITHIN TURNOUT/BUS ZONE.
9. RADIUS VARIES BASED ON LOCAL DESIGN STANDARDS.

Figure 7-1: Farside Turnout Design



NOTES:

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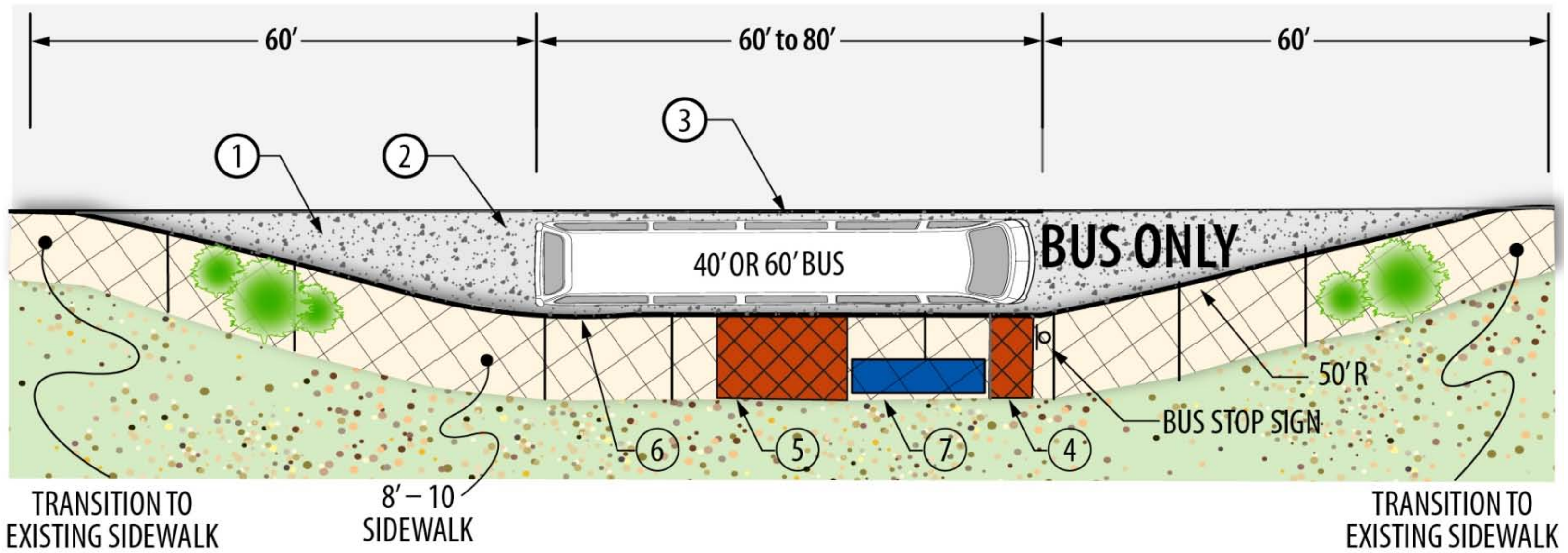
8. DRIVEWAYS SHOULD BE AVOIDED WITHIN TURNOUT/BUS ZONE.
9. RADIUS VARIES BASED ON LOCAL DESIGN STANDARDS.

Figure 7-2: Nearside Turnout Design



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4. 5′ WIDE X 8′ DEEP FRONT DOOR LANDING AREA.
5. 10′ WIDE X 8′ DEEP REAR DOOR LANDING AREA.
6. WHEELCHAIR ACCESS RAMP.
7. SHELTER (10′ X 20′ PREFERRED, 9′ X 6′ MINIMUM) OR BENCH LOCATION.

Figure 7-3: Midblock Turnout Design (Type 1A)

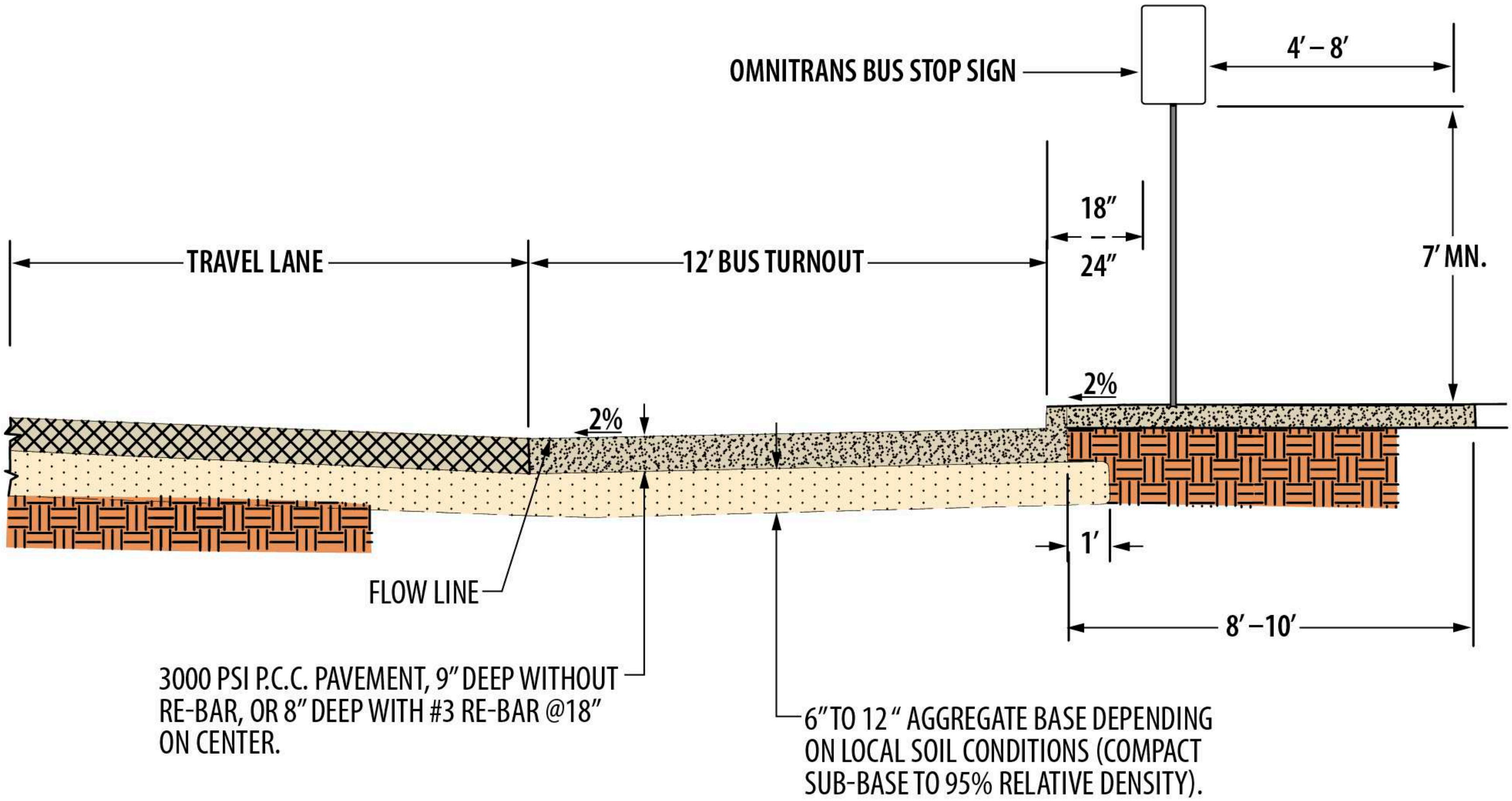
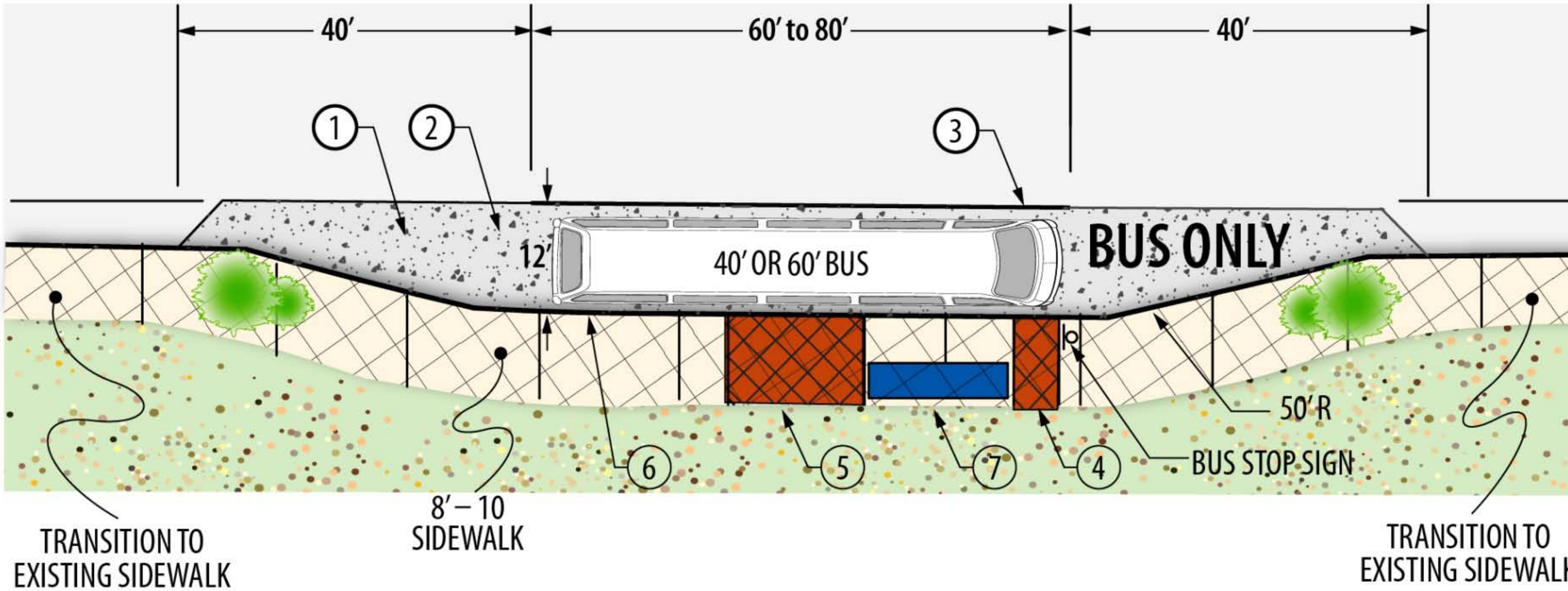


Figure 7-4: Midblock Turnout Cross-section Design (Type 1A)



NOTES:

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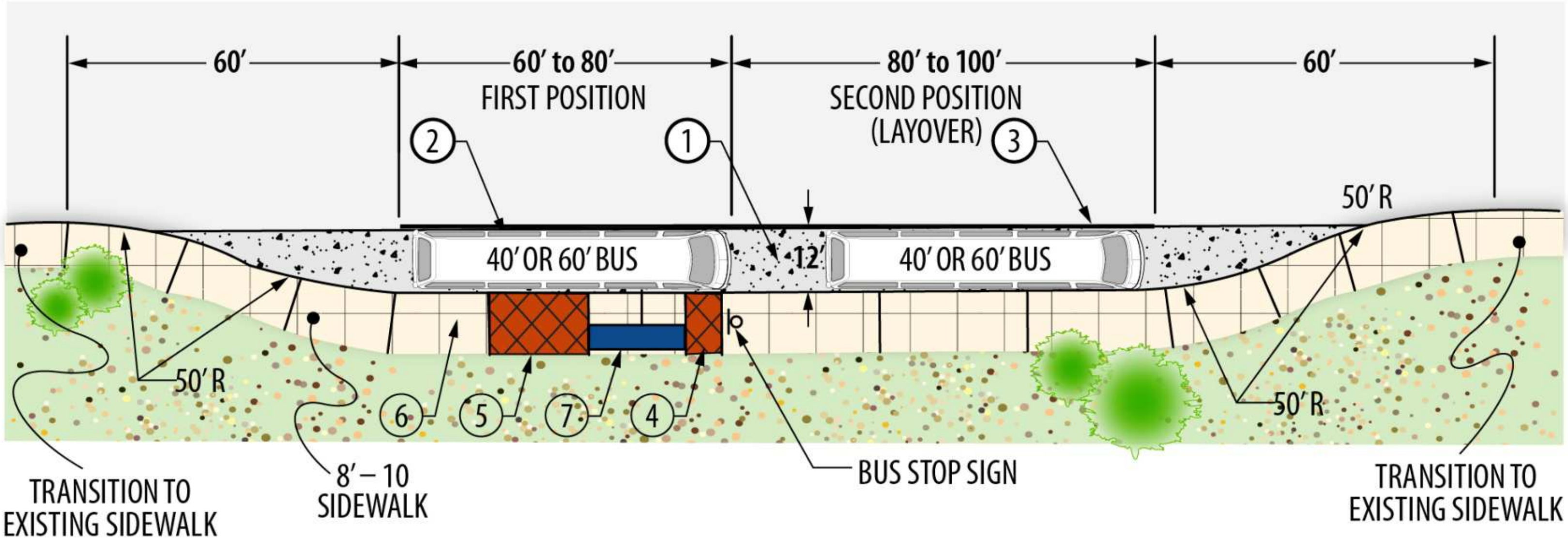
5. 10′ WIDE X 8′ DEEP REAR DOOR LANDING AREA.
6. WHEELCHAIR ACCESS RAMP.
7. SHELTER (10′ X 20′ PREFERRED, 9′ X 6′ MINIMUM) OR BENCH LOCATION.

Figure 7-5: Midblock Turnout Design (Type 1B)



NOTES:

1. 12' WIDE BUS PAD – 3000 PSI P.C.C PAVEMENT, 9" DEEP WITHOUT RE-BAR, OR 8" DEEP WITH #3 RE-BAR AT 18" ON CENTER.
2. R3-7 SIGN WITH BUS EXEMPT SIGN.
3. PER CALTRANS STANDARD PLANS A20D, DETAIL 38A.
4. 5' WIDE X 8' DEEP FRONT DOOR LANDING AREA.
5. 10' WIDE X 8' DEEP REAR DOOR LANDING AREA.
6. WHEELCHAIR ACCESS RAMP.
7. SHELTER (10' X 20' PREFERRED, 9' X 6' MINIMUM) OR BENCH LOCATION.

TO DETERMINE THE DIMENSIONS FOR A BUS TURNOUT WITH MULTIPLE BERTHS:

- THE FIRST POSITION SHOULD BE 60 FEET LONG FOR 40 FOOT VEHICLES (80 FEET FOR ARTICULATED VEHICLES).
- FOR EACH ADDITIONAL PASSTHROUGH BUS, 60 FEET IS REQUIRED.
- FOR EACH ADDITIONAL LAYOVER BUS, 80 FEET SHOULD BE ADDED (100 FEET FOR ARTICULATED VEHICLES).

Figure 7-6: Dimensions of Multiple Berth Bus Turnouts

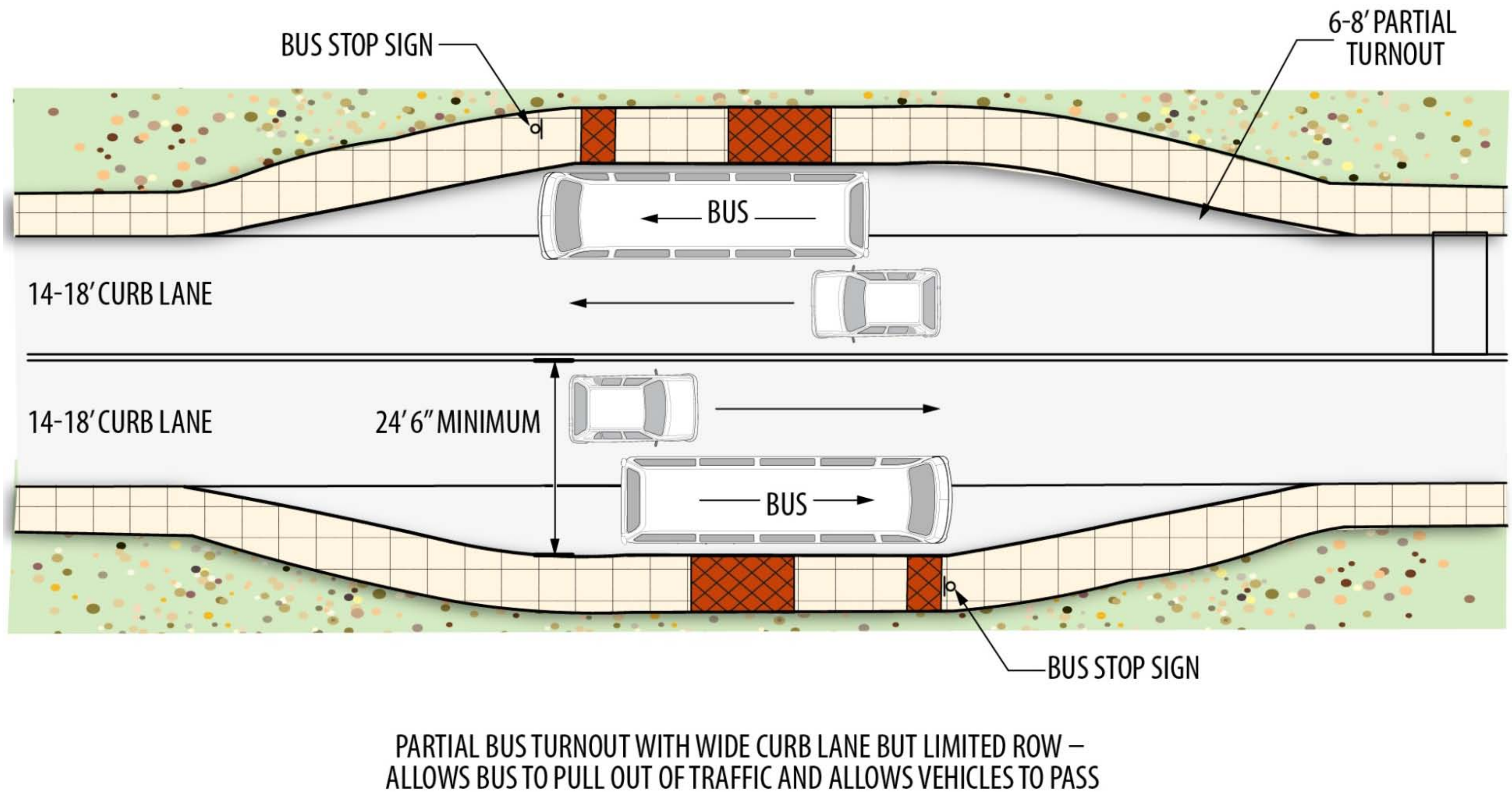


Figure 7-7: Partial Bus Turnout

7.2 Bus Bulbouts

Bus bulbouts, also known as nubs or curb extensions, solve the problem of locating bus patron amenities in dense urban environments with considerable pedestrian traffic. A nub is essentially a sidewalk extension through the parking lane that becomes directly adjacent to the travel lane. When used as a bus stop, a bus will stop in the traffic lane instead of weaving into the parking lane—therefore, they operate similarly to curb-side bus stops.

Moreover, when space limitations prevent the inclusion of amenities, curb extensions create additional space at a bus stop for shelters, benches, and other transit patron improvements along sidewalks. Curb extensions also provide enough space for bus patrons to comfortably board and alight from the bus away from nearby general pedestrian traffic. Finally, nubs shorten the pedestrian walking distance across a street, which reduces pedestrian exposure to on-street vehicles. Curb extensions should be considered at sites along crowded city sidewalks with high patron volumes, where parking along the curb is permitted.

Curb extensions should be considered at sites with the following characteristics:

- High pedestrian activity;
- Crowded sidewalks;
- A need to reduce pedestrian crossing distances; and
- Bus stops in travel lanes.

Curb extensions have particular application along streets with lower traffic speeds and/or low traffic volumes where it would be acceptable to stop buses in the travel lane. Collector streets in neighborhoods and designated pedestrian districts are good candidates for this type of bus stop. Curb extensions should be designed to accommodate vehicle turning movements to and from side streets. Major collector and arterial streets should be designed to accommodate larger bus turning radius and therefore would not be good candidates for bus bulbouts. Figures 7-8 and 7-9 shows typical curb extension design.

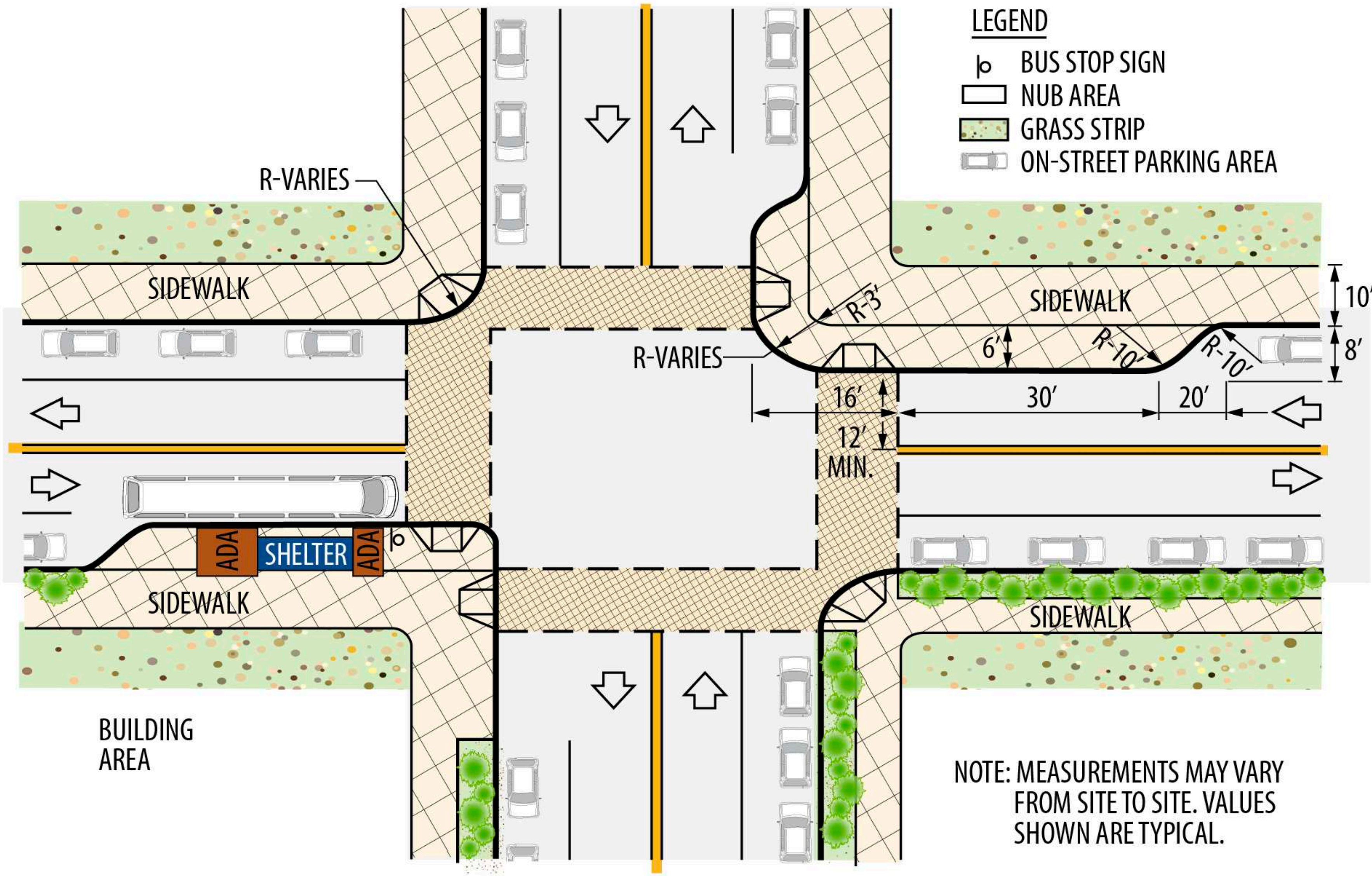


Figure 7-8: Extended Curb Installed at Intersection

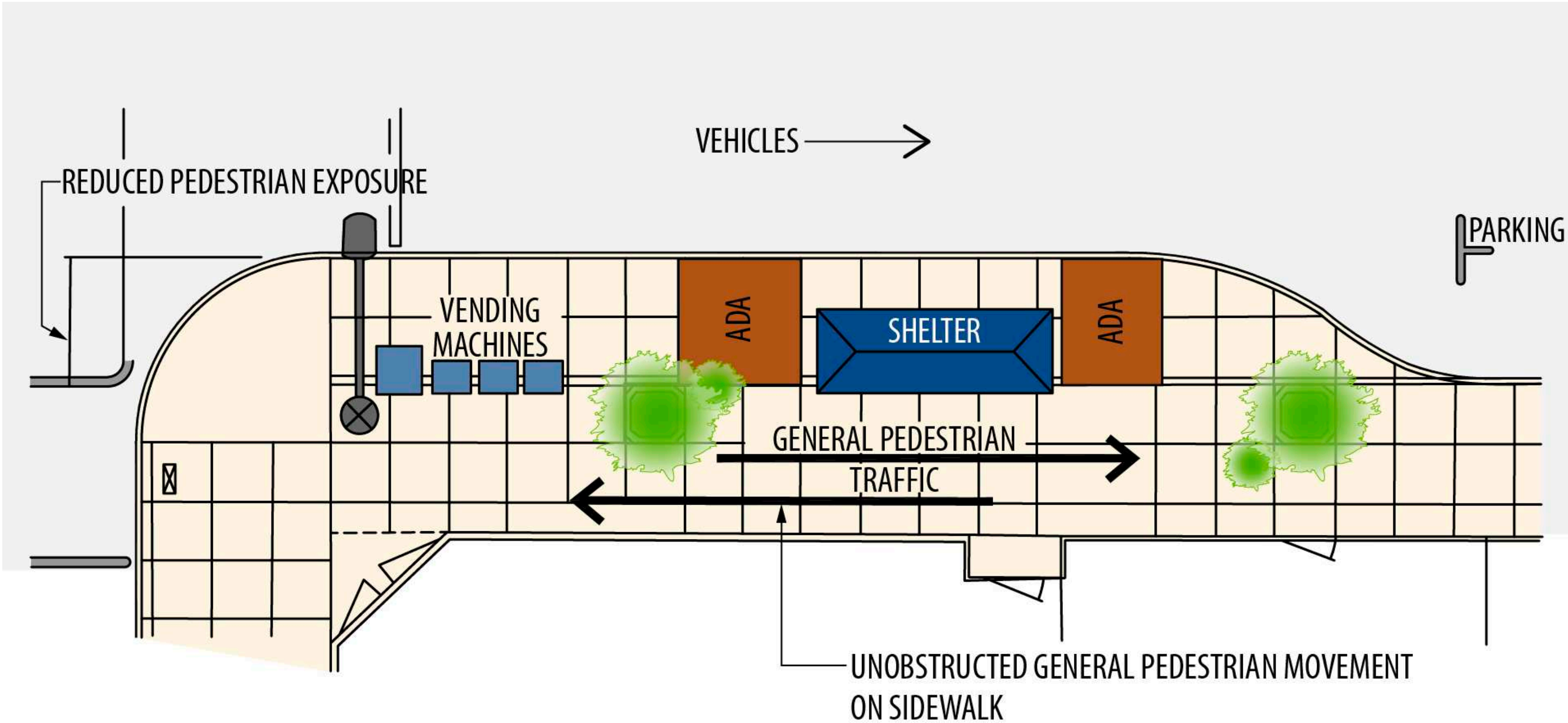
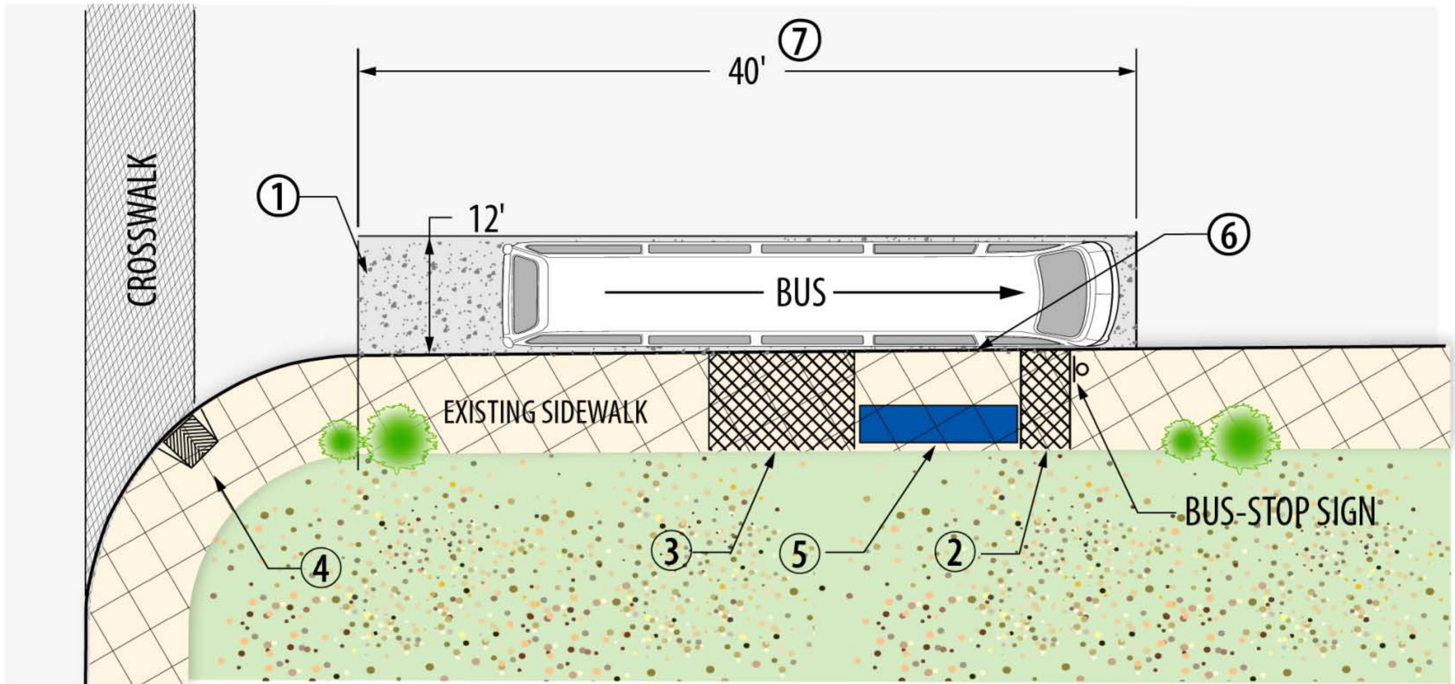


Figure 7-9: Extended Curb Installed at Intersection

7.3 Bus Pads

Roadway pavements (or shoulders, if that is where the buses stop) need to be of sufficient strength to accommodate repetitive bus axle loads of up to 25,000 pounds. Exact pavement designs will depend on site-specific soil conditions. Areas where buses start, stop, and turn are of particular concern because of the increased loads associated with these activities. Using reinforced concrete pavement pads (see Figures 7-10 and 7-11) in these areas reduces pavement failure problems that are common with asphalt. A minimum 8" thick reinforced concrete pad should be provided, with engineering consideration of the specific soil conditions. The pad should be 12' wide with a pavement section designed to accept anticipated loadings. The length of the pad should be based on the anticipated length of the bus that will use the bus stop and the number of buses that will be at the stop simultaneously.



① 12' WIDE BUS PAD – 9" DEEP WITHOUT RE-BAR, OR 8" DEEP WITH #3 RE-BAR AT 18" ON CENTER. EXACT PAD PLACEMENT WILL VARY BY LOCATION. CONTACT OMNITRANS BEFORE PLACING.
② 5' WIDE X 8' DEEP FRONT DOOR LANDING AREA.
③ 10' WIDE X 8' DEEP REAR DOOR LANDING AREA.
④ WHEELCHAIR ACCESS RAMP.
⑤ SHELTER (10' X 20' PREFERRED, 6' X 9' MINIMUM) OR BENCH LOCATION.
⑥ DRIVEWAYS SHOULD BE AVOIDED WITHIN TURNOUT/BUS ZONE.
⑦ LONGER WHERE MORE THAN ONE BUS EXPECTED.

Figure 7-10: Concrete Bus Pad Design

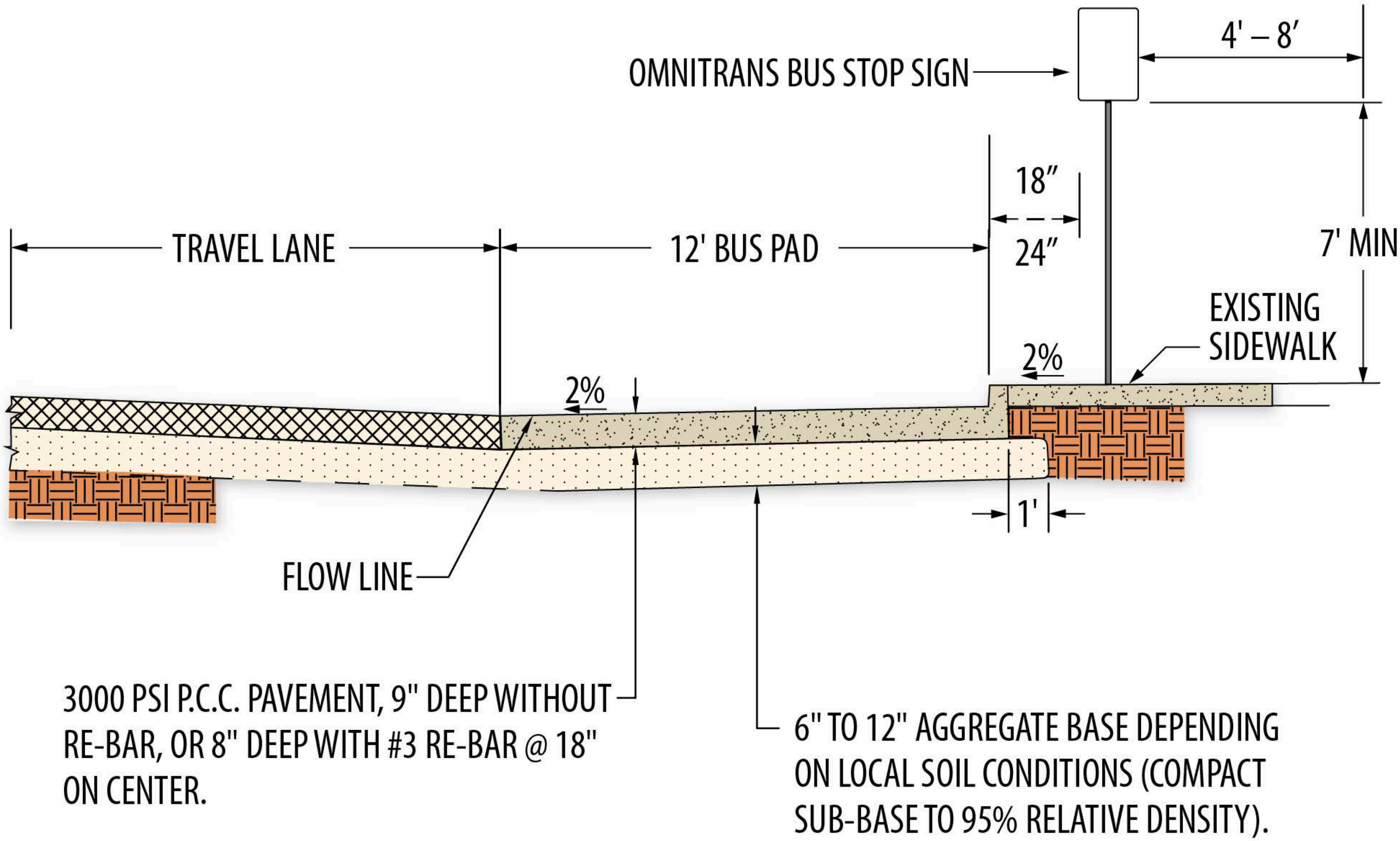


Figure 7-11: Concrete Bus Pad Cross-section Design

7.4 Street Design for Buses

The corner curb radii used at intersections can affect bus operations when the bus makes a right turn. Some advantages of a properly designed curb radius are as follows:

- Less bus/auto conflict at heavily used intersections (buses can make turns at higher speeds and with less encroachment);
- Higher bus operating speeds and reduced travel time;
- Improved bus patron comfort; and
- A trade-off in providing a large curb radius is that the crossing distance for pedestrians is increased. This greater crossing distance increases the pedestrians' exposure to on-street vehicles and can influence how pedestrians cross an intersection, both of which are safety concerns. The additional time that a pedestrian is in the street because of larger curb radii should be considered in signal timing and median treatment decisions.

The design of corner curb radii should be based on the following elements:

- Design vehicle characteristics, including bus turning radius;
- Width and number of lanes on the intersecting street;
- Allowable bus encroachment into other traffic lanes;
- On-street parking;
- Angle of intersection;
- Operating speed and speed reductions; and
- Pedestrian safety.

Figure 7-12 shows appropriate corner radii for transit vehicles and various combinations of lane widths. This figure can be used as a starting point; the radii values should be checked with an appropriate turning radius template before being incorporated into a final design.

Figures 7-13 and 7-14 provide specific information on bus dimensions and on bus turning radii needed for design. Appendix A provides specific information on the vehicles in the current Omnitrans fleet.

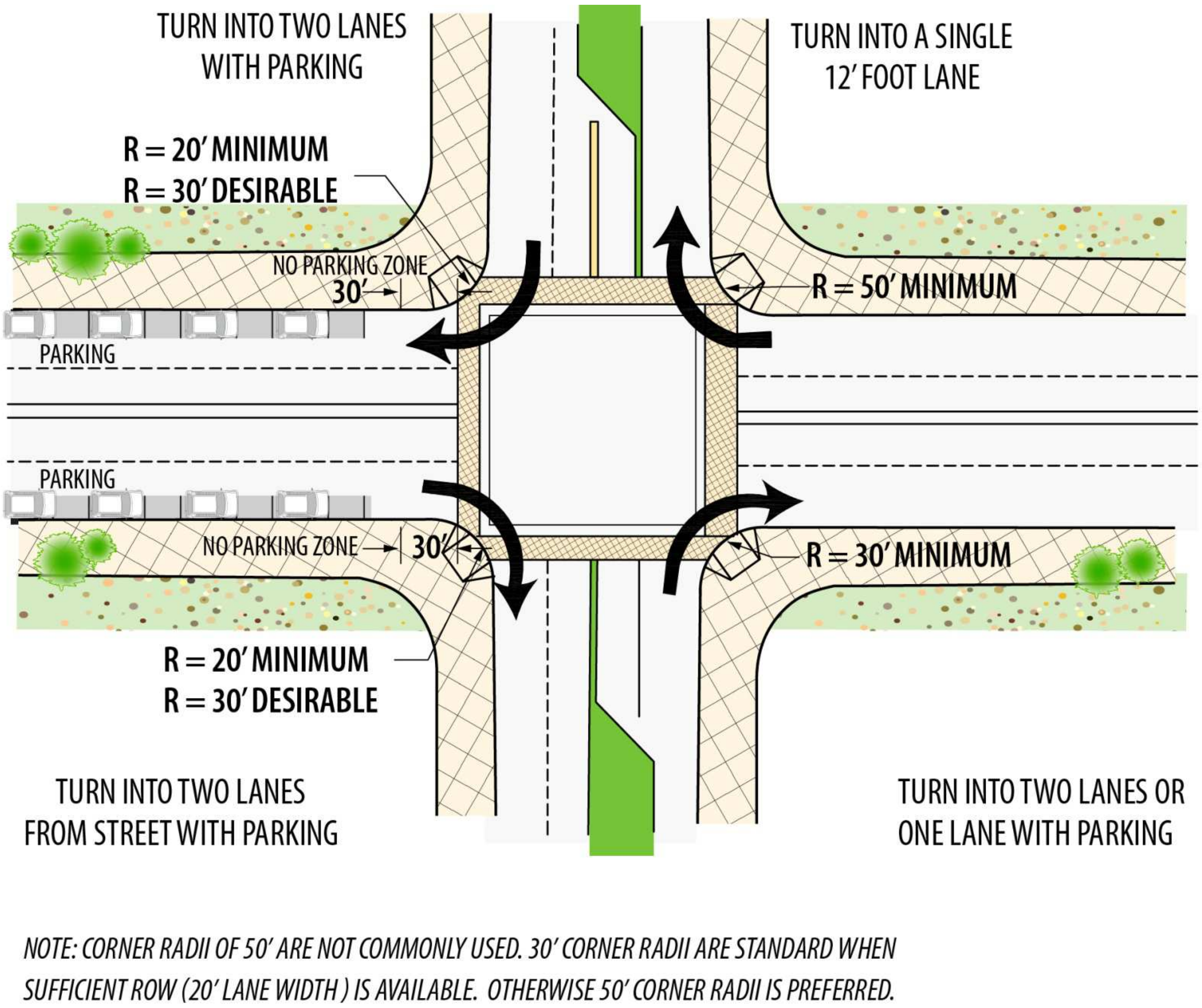


Figure 7-12: Curb Design for Bus Turning

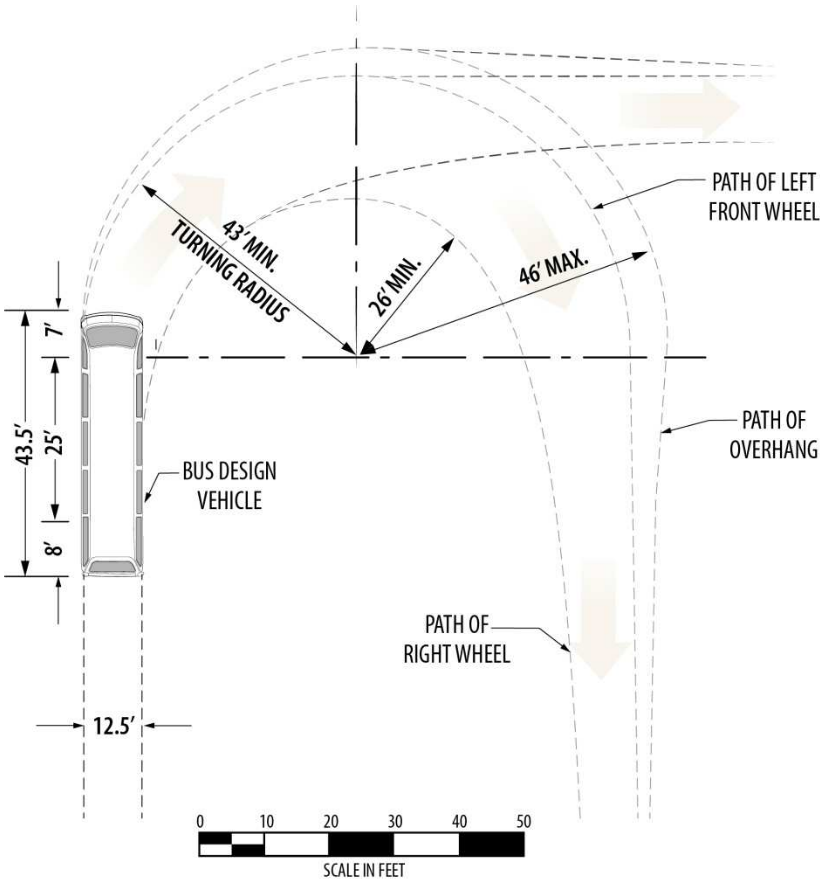


Figure 7-13: Design Turning Template for 40' Bus Design

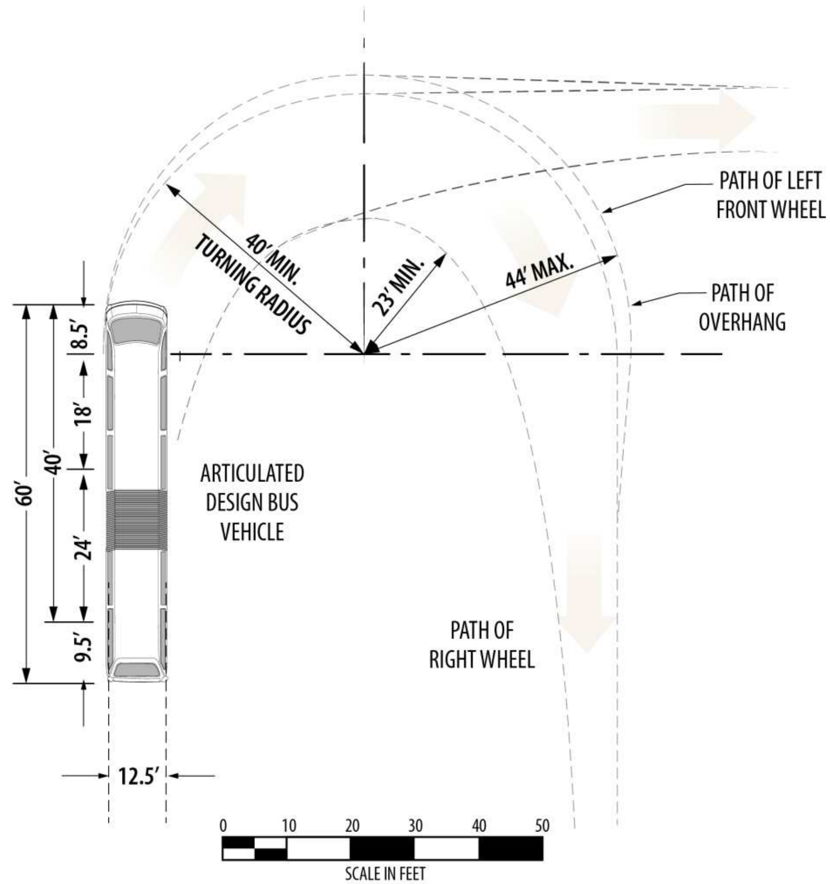


Figure 7-14: Design Turning Template for 60' Articulated Bus Design

8. PASSENGER AMENITIES

The design of bus stop waiting areas and the provision of amenities that enhance security and comfort play a significant role in a person's decision to use transit. Passenger amenities are installed at selected bus stops to improve passenger comfort and the relative attractiveness of transit as a transportation alternative. Selection of bus stops at which to install amenities takes into account a number of factors, including:

- Average daily boardings;
- Proximity to major trip generators;
- Passenger transfer activity;
- Planned neighborhood improvements;
- Transit corridor marketing efforts;
- Equity among communities in the County;
- Proximity of other nearby sheltered areas; and
- Customer and community requests.

Amenities should be considered for installation at the following types of stops:

- **Transfer or High Volume Stops** –Location of stops should be as close to the intersection as possible, near a marked crosswalk to encourage proper street crossing, within line of sight of each other, and should include a shelter. Route information needs to be provided for all routes, so an area for sign holder, kiosk or other information delivery systems needs to be provided. Besides all of the above, extra space for passenger waiting, along shelter or clear curb space, should be included in design. A standard of 8 to 10 square feet per peak load passenger should be used. Special care should be taken with placement of trash receptacles and vendor boxes to keep pedestrian pathways and landing area clear.
- **Key Stops or Express Stops** –In addition to the transfer or high volume bus stop elements, the shelter at these stops should be designed to cover a 10′ x 20′ area, with seating and overhanging roof. Trees must not block view of bus approach path. These stops should also include lighting, public information display systems, route maps, transit information, stop request and security call mechanisms, radiant heaters, ticket vending machines, and advertisements. Solar technology should be used where feasible.

Passenger amenities include shelters, bus benches, trash receptacles, lighting and bicycle parking.

8.1 Shelters

Transit shelters are installed at selected bus stops to provide weather protection as well as seating for waiting passengers. Bus stops with ridership exceeding 40 boardings per day are priority candidates for new shelters. Omnitrans provides and maintains shelters in jurisdictions who participate in the Omnitrans Passenger Amenity Program. Shelters can also be provided by local jurisdictions, and may be required of development in the area of the stop. Maintenance of shelters not provided by Omnitrans should be provided by the jurisdiction that constructs or requires the construction of the shelter.

The design factors for shelters should include:

- Strength and durability of structure and materials;
- Resistance of materials and paint treatments to weather conditions, graffiti, cutting, defacing, fire, and other forms of vandalism;
- Potential greenhouse effect of roof design during hot weather;
- Existence of, or provision of external lighting in the area, and provision of internal lighting for the shelter;

- Appropriateness of the design to the neighborhood (context sensitive);
- Required dimensions of the concrete pad landing area to ensure wheelchair accessibility;
- Accommodation of trash can and newspaper boxes within the location design;
- Easy maintenance of the shelter and other amenities;
- Provision of conduit for power and lighting;
- Semi-transparent enclosure that allows a coach operator to see inside the shelter;
- Crime Prevention Through Environmental Design guidelines should be considered when planning a shelter layout and materials; and
- Accommodations for solar power on the shelter roof that is integrated with design of shelter.

The following design and placement criteria will assist local jurisdictions after it has been determined a shelter will be placed at an existing bus stop:

- Shelters should not be placed such that they block sight distance at intersections or driveways. This can normally be accomplished by placing the shelter more than 25′ from the beginning or end of curb return of an intersection or driveway;
- Minimum overhead canopy of 72 square feet (6′ x 9′) with a minimum width of 6‘ is desired and a 10′ x 20′ overhead canopy is preferred;
- Minimum 7.5′ vertical clearance between underside of roof and sidewalk surface is desired;
- Minimum 2′ lateral clearance between overhead canopy and curb face is required;
- Shelter canopy should be waterproof with provisions for drainage away from waiting passengers and boarding area;
- Shelter should have owner's name and 24-hour telephone number displayed for emergency purposes;
- Seating for at least four people located under the shelter canopy is desired;
- A minimum space of 30" x 48" of clear floor space for people in wheelchairs is required within the shelter per ADA regulations;
- Accessories to be added to the transit shelter and passenger boarding area (such as telephone, water fountain, additional information panels, etc.) are a decision for the individual jurisdiction responsible for the shelter. Each item can be weighed to balance the concerns for greater passenger comfort and convenience versus concerns for security, maintenance and cost;
- The shelter should be located in reasonably proximity to where the front door of the bus will open to facilitate timely passenger loading;
- Shelter screens should keep a minimum 6" vertical clearance from sidewalk to avoid collection of trash and debris;
- The back of the shelter should be located at least 12" from a building face, wall, or other broad vertical surfaces to facilitate trash removal and panel cleaning;
- Shelters should not be placed between a regularly used building exit and the curb so that pedestrians retain direct access to the street from the building;
- Whenever possible, do not place shelters in front of building windows used for commercial purposes (e.g. advertising, display, business names, etc.);

- Shelters should be located to avoid exposing persons to splashing water from passing vehicles and runoff from adjacent buildings and landscaping;
- Shelters should be located so that their orientation provides as much protection as possible from wind and rain, and with consideration of the sun's angles to allow maximum shade during peak use in the morning and afternoon;
- Shelter pad should be 5′ x 13′, 6″ concrete (may be re-enforced with wire grid) with a sub base of blue stone. An additional 4′ to 6′ wide pad extension is recommended to accommodate newspaper boxes, trash can, etc.; and
- Shelter pad should be located minimum of 8′ behind curb adjacent to bus stop pole, to accommodate landing pad.

Figure 8-1 shows typical shelter layout, and Figure 8-2 shows shelter clearance dimensions. Placement of shelters for different sidewalk conditions is displayed in Figure 8-3. The design of Omnitrans modular shelters is shown in Figure 8-4.

8.2 Bus Benches

Benches are installed inside typical shelters. Benches may also be installed independently at bus stops that do not have shelters.

Local communities may also install benches as one element of an improved streetscape; in this case, efforts should be made to locate benches near bus stops where they do not create barriers to accessible bus boarding or sidewalk usage.

The design factors for benches should include the following:

- Benches should be placed on a pad facing the street. If located on the ADA landing pad, minimum of 8′ from curb; if outside ADA landing pad, minimum of 4′ from curb;
- Benches should be placed on the back side of sidewalk a minimum of 6′ to 9′ from the bus sign post, to allow pedestrians to move past people sitting on the bench;
- Ensure that there are no conflicts with wheelchair accessibility and loading at the bus stop;
- Benches should be anchored to prevent unauthorized movement;
- Construct furniture for easy relocation to allow for bus route changes, street improvement projects, etc.;
- Benches must have back supports that extend 18″ above the seat (ADA Accessibility Guidelines Section 4.37.4);
- bars or dividers between seats;
- Strength and durability of structure and materials;
- Resistance of materials and paint treatments to weather conditions, graffiti, cutting, defacing, fire, and other forms of vandalism; and
- Appropriateness of the design to the neighborhood (context sensitive).

Developers and local jurisdictions may design a special style of bench or shelter to fit into the landscape and complement the architectural style of their project or streetscape. However, benches and shelters that are provided through the private sector or local jurisdictions are to be maintained by the developer, land owner, or local jurisdiction. Omnitrans requests the opportunity to review the design of benches for any potential safety and security issues.

8.3 Trash Receptacles

Trash receptacles are typically provided at all stops that have shelters, and should also be provided at high-ridership stops or stops near locations that generate the need for a trash receptacle, such as fast food restaurants or convenience stores.

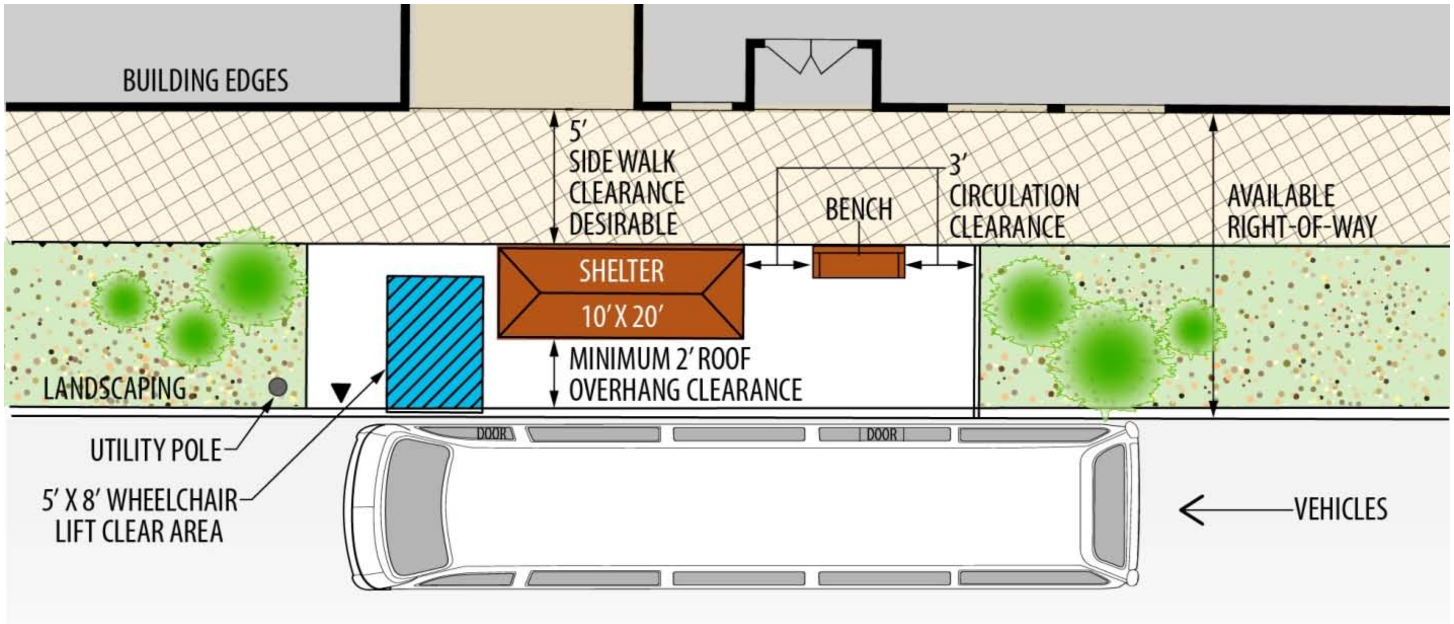


Figure 8-1: Typical Shelter Layout

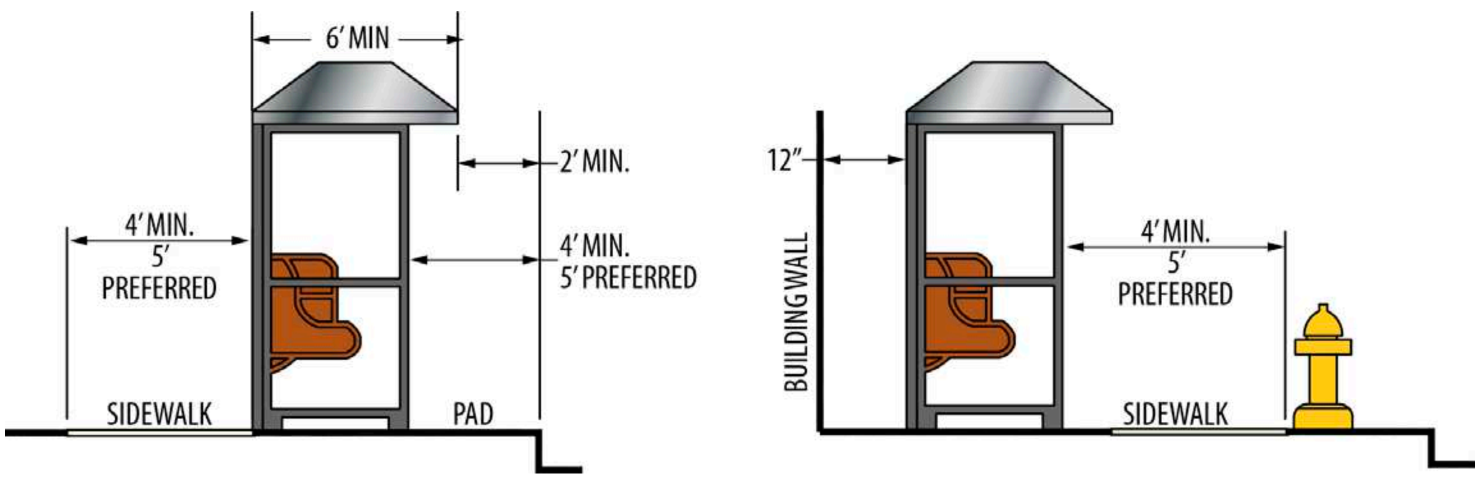


Figure 8-2: Shelter Clearance

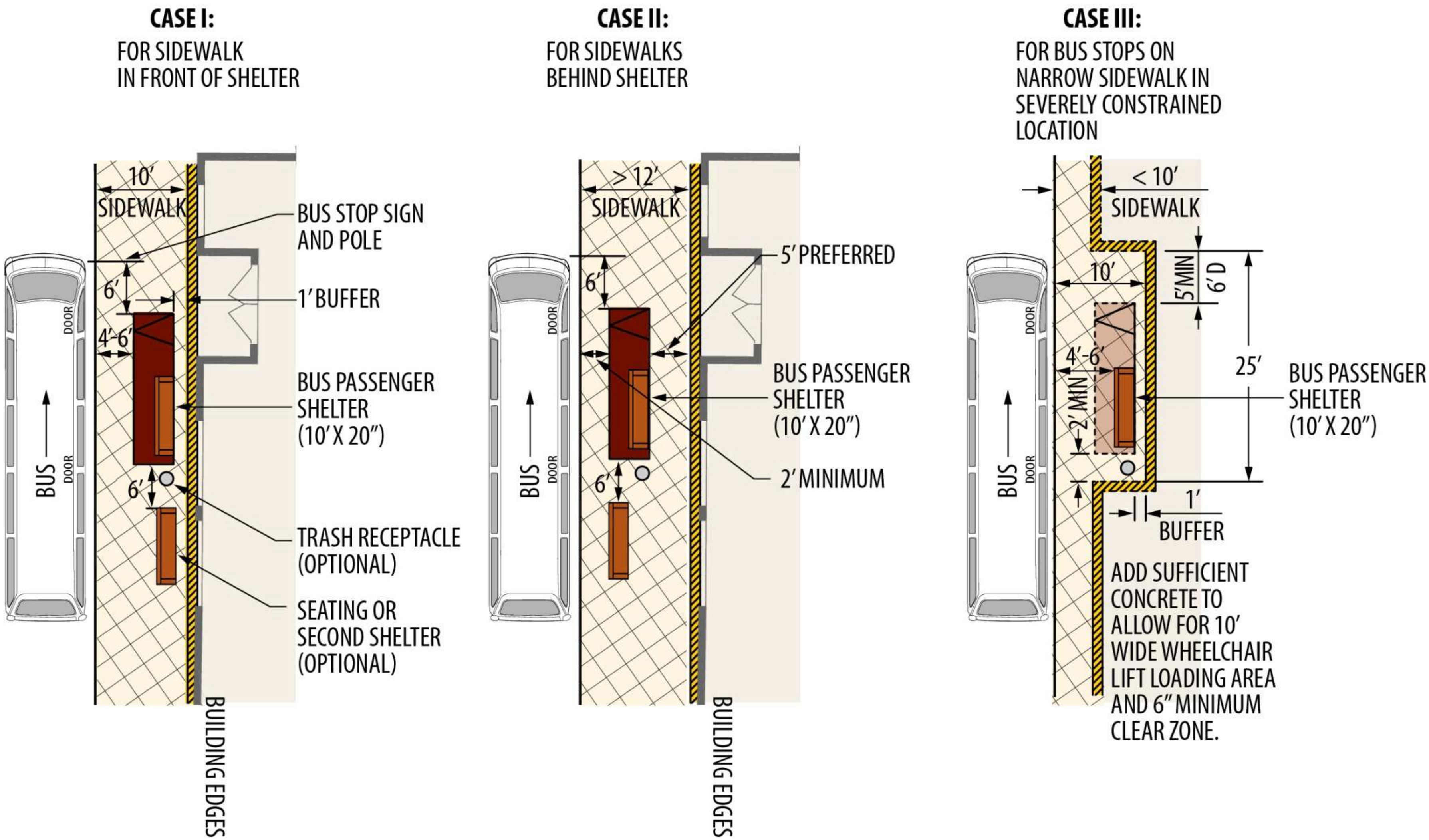


Figure 8-3: Shelter Placement Plan View

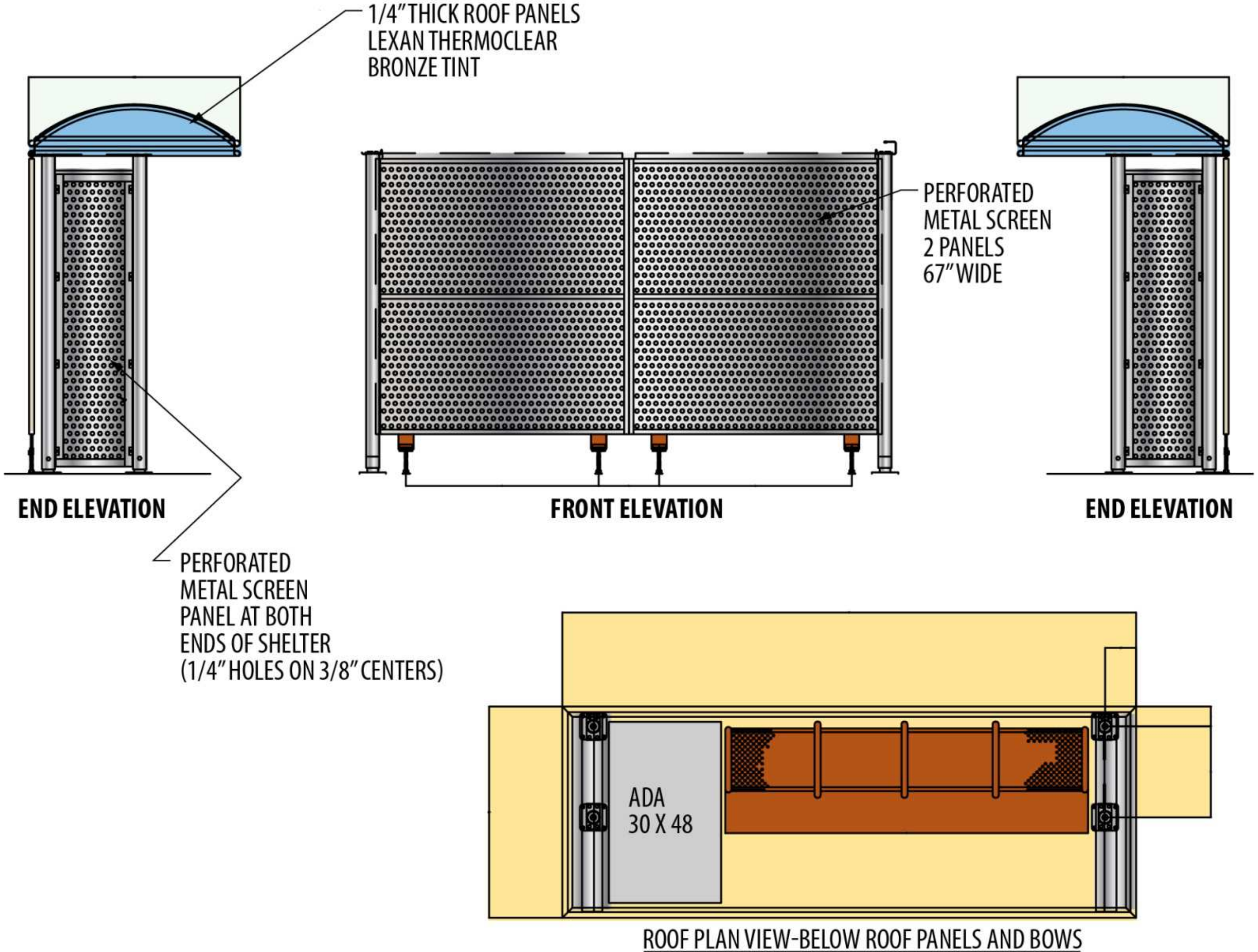


Figure 8-4: Typical Omnitrans Bus Shelter Plan

Local communities may also install receptacles as part of an improved streetscape; in this case, efforts should be made to locate them where they do not create barriers to accessible bus boarding or sidewalk usage. Trash receptacles are to be serviced by the entity that placed them.

The design factors for trash receptacles should include:

- Strength and durability of materials;
- Resistance of materials and paint treatments to weather conditions, graffiti, cutting, defacing, fire, and other forms of vandalism and allows for visibility;
- Appropriateness of the design to the neighborhood;
- Ensure that there are no conflicts with wheelchair accessibility and loading at the bus stop;
- Trash receptacles should be anchored to prevent unauthorized movement;
- Locate outside of curb clear zone or landing pad;
- Place behind pad or sidewalk, or at the end of the clear space;
- Avoid installing trash receptacles with design features that permit liquids to pool or remain near the receptacle and attract insects or rodents; and
- If possible, install trash receptacles in shaded areas a minimum of 3′ from a bench. When installed in areas that receive direct sunlight most of the day, the heat may cause foul odors to develop.

Omnitrans empties trash receptacles that are placed by Omnitrans, while local jurisdictions and developers are responsible for picking up trash from receptacle placed by them. Developers and local jurisdictions may design a special style of receptacle to fit into the landscape and complement the architectural style of their project or streetscape.

8.4 Lighting

Where feasible, bus stops should be located so that they will be illuminated by existing street lights. At bus stops where additional light is needed, ornamental streetlights are used. In addition to street lights, stops can be lit by backlighting from advertising installed at bus shelters. If a shelter is present, both interior and area lighting are recommended.

The placement and maintenance of lighting is normally the responsibility of the local jurisdiction, except at advertising shelters where the interior lighting is provided and maintained along with the shelter.

Solar technology should be used where feasible. Internal to shelter lighting should be 3 foot candles at 3′ above the ground; external to shelter, lighting should be 2 to 5 foot candles. Options also include stop call or sign illumination mechanism for signaling driver which route needs to stop.

8.5 Bicycle Parking

Bicycle parking facilities, such as bike racks and storage lockers as shown in Figure 8-5 and 8-6, may be provided at bus stops by local jurisdictions or adjacent property owners for the convenience of bicyclists using transit. Bicycle parking facilities help to maintain a clear ADA pathway, discourage the practice of locking bicycles onto bus facilities or onto adjacent property, and, reduce visual clutter. The guidelines for the placement of bicycle parking facilities are as follows:

- Locate bike rack or lockers at a convenient proximity to the bus stop and in sight of the transit passengers, but outside of the clear ADA pathway;
- Coordinate the location of bicycle parking facilities with existing on-site or street lighting;

- Ensure parked bikes are visible at all times. Do not locate bicycle parking where views are restricted by a bus shelter, landscaping, or existing site elements, such as walls;
- Design and placement of bicycle parking facilities should complement other transit furniture at bus stop; and
- Covered or weather protected parking locations are an important bonus to bicyclists.

When selecting bicycle bike rack or locker devices, consider the following:

- Provide ability to lock bicycle frame and at least one wheel;
- Support bicycle without pinching or bending the wheel. If the wheel slot is too narrow, a mountain bike tire will not fit;
- Avoid scratching the paint on the frame of the bike;
- Provide a place to lean the bike while locking the bike;
- Locking procedure should be quick and easy to identify;
- Design of bike rack or locker device should not trap debris; and
- Device should be easy to install but difficult to steal.

8.6 Newspaper and Vendor Boxes

Newspaper and vendor boxes can provide waiting transit customers with convenient access to reading material, but must be located outside of clear curb space and landing pad area. Newspaper boxes should not be chained or otherwise affixed to the bus stop sign pole, shelter, or bench. The preferred location is beside the shelter or with the trash receptacle at end of clear curb space.

Figure 8-5: Bicycle rack at Rialto Metrolink Station

Figure 8-6: BikeLids® at Rancho Cucamonga Metrolink station

Vendor boxes for free publications are discouraged as they contribute to trash related problems at bus stops.

Currently, laws or ordinance restricting placement of vendor boxes are instituted by the cities where they are located.

8.7 Landscape Features

Landscaping can enhance the level of passenger comfort and attractiveness of transit, but should be positioned and maintained so that safety, security and accessibility are not compromised by encroaching bushes, uneven grass surfaces, etc. Landscaping choices should be mindful of the likelihood of attracting bees.

Tree branches that extend into the roadway below 11′ should be trimmed back at least 2′ from the curb; otherwise, they become an obstacle that the bus driver may or may not be able to avoid hitting. The area between the sidewalk and the curb at bus boarding areas should not be planted for at least 5′ parallel to the street and 8′ perpendicular to the street to provide accessibility.

Trees for shade and lightning arrestors should not be placed within the clear curb area, and centerline 2-1/2′ of back of curb line. Trees may be placed immediately outside of clear curb area, or back of sidewalk. A bus bulbout or nub may be installed to accommodate the tree line and still give proper ADA landing pad and clear curb space.

All landscaping design should adhere to Crime Prevention through Environmental Design guidelines (see resources in Appendix C).

8.8 NextTrip System

The NextTrip system will be in place throughout Omnitrans' system by 2014. The goal of the NextTrip system is to provide the most accurate real time bus arrival information to riders via advanced technology solutions. This will include electronic signage at transit centers and high-ridership bus stops to let passengers know when buses will arrive.

The NextTrip system will use advanced technology solutions for mobile devices such as the iPhone, iPad, Android smart phones, Blackberry, Windows mobile, and tablets. Non-smart phone users will be able to receive arrival information via text messaging, IVR or a telephone information hotline. Quick response (QR) codes (barcodes) and stop ID numbers at each bus stop will allow passengers to obtain information only for their specific stop(s).

Because the NextTrip system will use GTFS data feed, Omnitrans intends to make the data available to general public as well. This will allow application developers to create mobile applications without requiring any investment from Omnitrans. The GTFS feed will also facilitate data sharing with Google Transit and Microsoft Bing for use in current and future web applications.

To be compatible with the NextTrip system, new bus stop locations and improvements to existing stops should provide conduit for power and lighting.

8.9 Developer Responsibilities

When a development is constructed adjacent to an existing or proposed bus stop location, the developer should be responsible for providing amenities as described in this section. Jurisdictions are encouraged to require the placement of shelters that conform to local standards for passenger recognition and ease of maintenance. Cities should submit a copy of all street improvement and development plans to Omnitrans to ensure proper coordination and placement of transit amenities (turnouts, bus pad, etc.—refer to Chapter 4, Bus Stop Policies). One example of a developer constructed and maintained bus stop is shown in Figure 8-7.

8.10 Bus Stop Maintenance

Maintenance of any transit infrastructure or amenities is the responsibility of the owner, or entity that constructs it or places it. This is typically Omnitrans, a city, or a private property owner/developer.

Well-maintained bus stops are crucial to the image of the transit system. Damaged street furniture and trash build-up should be tended to immediately to create a positive impression for transit patrons and the general public. Maintenance frequency of not less than once per week (except as noted) should include:

- Full wash-down of shelter and accessories at least once a month, or more often as needed;
- Removal of all dirt, graffiti, chewing gum and pasted material;
- Wipe-down of glass surfaces;
- Removal and replacement of trash bags once a week. Should be performed more than once a week if trash accumulates frequently;
- Litter pick up around stop or shelter/accessories to a distance of 15';
- Manual or chemical removal of weeds;
- Pruning of obstructing foliage;
- Insect control as needed;
- Touch up of marred paint; and
- Verify shelter lighting levels and replace bad bulbs and ballasts.

Repair of items that pose a safety or security problem should be performed as soon as possible.

Figure 8-7: Passengers using a bus stop constructed and maintained by a private developer, complete with bicycle parking, in Rancho Cucamonga, CA.

9. sbX STATION DESIGN CRITERIA

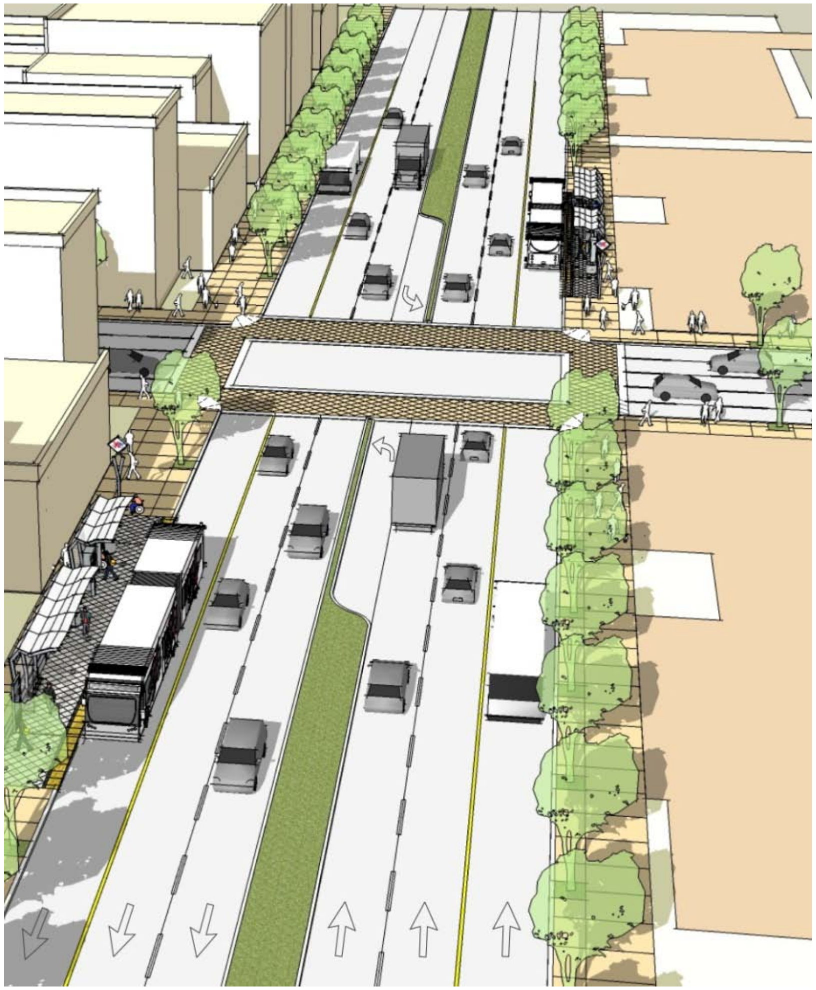


Figure 9-1: sbX Articulated Bus Operating on a Major Arterial

This section of the design criteria includes requirements for stations, design of platforms, amenities, and platform access guidelines for sbX corridors. The goal of the criteria is to provide comfortable and convenient high quality facilities at sbX bus stations, while considering the operational needs of Omnitrans, and the requirements of the governing codes. Facilities shall be designed in consideration of the safety of bus passengers and the general public, system reliability, passenger comfort, ease of maintenance, and connection to and future accommodation for transit-oriented development. Figure 9-1 shows an sbX articulated bus operating on a major arterial with sbX stations near a street intersection. The overall design criteria are described in several categories: station location, image, sense of place and security, station accessibility, site development, passenger circulations, local bus interface, architectural kit-of-parts, transit and passenger followed by criteria related to types of stations.

9.1 Design Objectives

These design guidelines and criteria have been developed using the following overall design objectives for stations:

- A location which is integrated with other modes of transportation and has linkages with adjacent land uses;
- A distinctive image or brand that emphasizes motion and technology;
- A sense of place provided at stations;
- Protection from the sun, wind and rain;
- Accessibility for persons with disabilities and services incorporated into the design of the station;
- Safety and security of patrons;

- System and neighborhood information available at stations;
- Design modularity to respond to individual site conditions such as narrow sidewalks and for flexibility in expansion;
- Ease of maintenance and parts replacement;
- Rapid multiple door boarding and alighting through slightly raised platforms, low floor vehicles, and fare prepayment; and
- Sustainability considerations.

9.2 Design Considerations

An important element influencing sbX station design is the type of transit vehicle. BRT stations are to be served by manually operated buses running along mixed flow lanes or a dedicated busway. A prototypical BRT bus has been assumed that incorporates basic features of the standard articulated bus; however, a variety of bus types may be considered. A center running station, for example, will utilize a unique feature on the specialized sbX bus allowing left-side boarding. In addition, split-direction median stations are an option where there is not enough right-of-way to build the wider bi-directional center running median stations (Figure 9-2). As bus characteristics can change over time (the useful life of a bus is 12 years although many are refurbished and retained for longer periods) and several bus types may be operated along the project alignment during the course of its lifetime, stations must be able to accommodate vehicle features that change (e.g., door locations and sizes, lift designs, etc.). Therefore, station architecture would be kept open and flexible to accommodate desired flexibility in the "design vehicle."

Figure 9-2: Split-direction Median Station, Las Vegas, NV

The design and construction of public transit stations are subject to several local, state, and national codes and statutes. Compliance with these codes and statutes in the development of the station models ensures a high degree of public safety and affords accessibility for all transit patrons. Of the several codes and statutes applicable to the proposed improvements, the primary ones are listed below. When the requirements of two codes differ, the more stringent requirement should govern.

- California Building Code Title 24)
- U.S. Department of Transportation guidelines for major capital investments

- U.S. Department of Transportation, Transportation for Individuals with Disabilities: 49 CFR Parts 27, and 37
- National Fire Protection Association documents NFPA 101

9.3 Station Spacing and Location

For faster and more efficient premium service, sbX stations are generally located farther apart than local bus stops; however, they interface with local bus service, as shown in Figure 9-3. sbX stations should generally be located 1 mile apart and be adjacent to major activity centers (major trip generators), existing and future higher density or intensity uses, bus transfer system transfer points and/or intermodal transfer centers. The stations could be located closer together in areas with several existing and future activity centers or be spaced further apart if existing or future land uses would not produce ridership or other considerations.

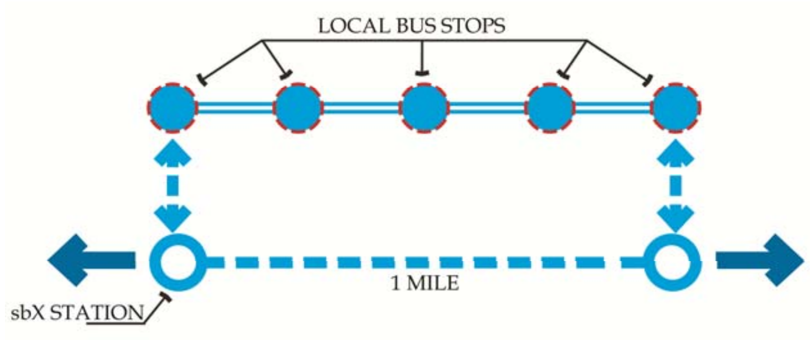


Figure 9-3: Spacing of sbX and Local Bus

BRT systems in dense urban areas can include: 1) grade separated stations including in freeway medians such as the El Monte Busway in Los Angeles County and busways in Ottawa and Pittsburgh; 2) at-grade exclusive stations and busways on former railroad rights-of-way such as the Metro Orange Line in Los Angeles; and 3) within arterial streets such as Eugene, Oregon and Cleveland, Ohio. Stations in conditions 1 and 2 often include passing lanes in each direction allowing for express bus service to bypass a bus at a station; however, the stations occupy considerable right-of-way, and therefore may add considerable cost to the project.

As a more cost-effective system, the sbX BRT is planned to be located primarily within arterial streets with street-level stations and premium bus service that operates with some exclusive lanes and in mixed flow lanes (buses and automobile share lanes). Mixed flow lanes operate as passing lanes at stations.

On-street arterial sbX station considerations include the following:

- Proximity to existing and future trip generators;
- Proximity to nearby pedestrian circulation system;
- Convenient passenger transfers to local bus and other transit routes;
- Near existing or proposed intersections to allow for crossing at signalized crosswalks;
- Pedestrian safety and access to station from surrounding areas;
- Adequate widths available for station platform, accessible sidewalks, curb ramps, passenger amenities, and if necessary, any required bus bays;
- Sight distances at adjacent intersections and driveways;
- An adequate curb or median length for the number of buses expected to stop at any one time and for sloped ramps, a transition to the intersection and without driveway interference;

- Ability to restrict or relocate parking, if needed;
- Street and sidewalk grade;
- Easy for bus to re-enter traffic stream if located in a bus pull-out;
- Proximity to rail crossings or emergency driveways;
- Adequate space to achieve bus route turns before stopping at a station; and
- Left turn and right turn movements and other traffic conditions.

sbX stations are either located curb side (side running as shown in Figure 9-1), in the median (center running as shown in Figure 9-4) or in specialty situations such as a terminus station with a turnaround or a major transfer center. Side-running (curbside) station platforms are most often used along arterial routes as they are compatible with conventional bus designs which have doors on the right side of the bus. The sbX Green Line includes new articulated sbX buses with dual doors on both sides of the bus allowing for center median station platforms in addition to side running station platforms.

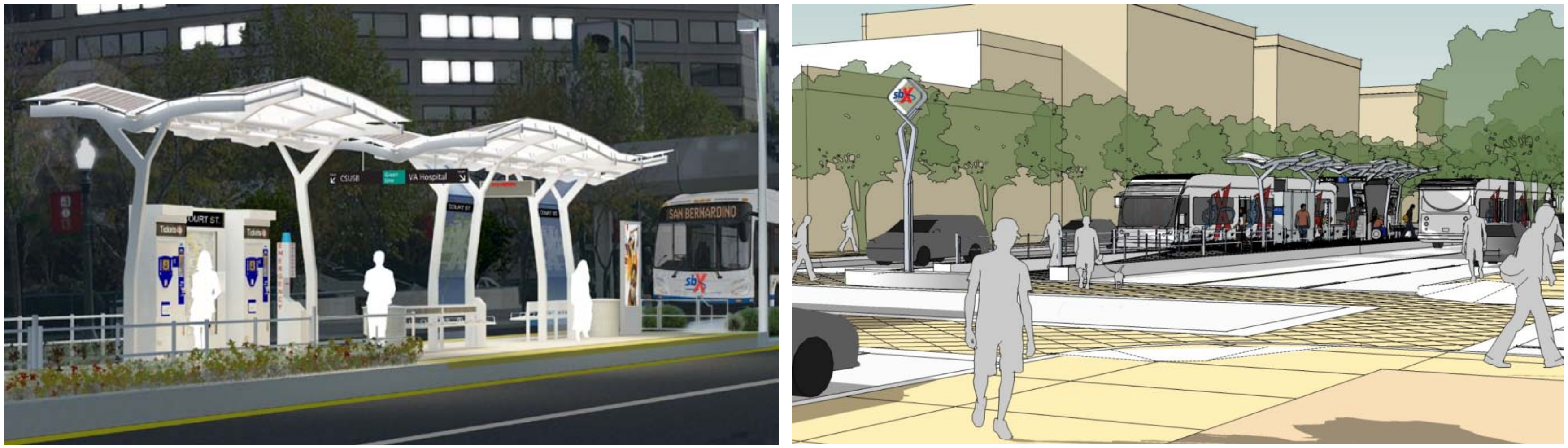


Figure 9-4: Views of an sbX Station in the Center of a Major Arterial

9.4 Image and Branding

A distinctive image for the premium transit service should be helpful in marketing the new services to existing and new riders as mentioned in Section 3. A unique progressive image should also differentiate the faster service from existing local services assisting in attracting choice riders. Some of the other considerations include:

- sbX stations with more amenities for waiting patrons than a local bus stop;
- sbX stations as beacons to transit users and automobile drivers on the street looking for alternatives to their daily vehicular commute;
- A logo and color consistent with an overall branding concept for the system;
- Consistent design for each station with some variations due to context and to accommodate local needs; and
- Advertising, if provided and consistent with City policy, should be high quality and not detract from the system branding.

9.5 Sense of Place

Careful placement of stations and transit amenities can create a sense of place along a streetscape providing a comfortable safe space for waiting passengers and an attractive visual element in the environment for those that pass by the station. Considerations include the following:

- The station as a public room providing a sense of safety and enclosure;
- Special paving to define the station location and special zones;
- A human scale through design of stations, placement of amenities and landscaping;
- Visibility of patrons to arriving buses; and
- Transparency of materials for security.

9.6 Station Accessibility

The station design should comply with relevant accessibility standards. All accessible entrances should, to the maximum extent practicable, coincide with those used by the majority of the general public. Sidewalks for general public circulation should separate from the station wherever feasible to avoid conflict with those waiting at the sbX Stations and to maintain access to buildings with their entrances onto the existing sidewalk. Where the accessible path differs, signage should be provided that identifies the accessible route and provides direction to the accessible entrance.

Station accessibility can be enhanced by improving the accessibility of the larger pedestrian environment surrounding the stations. This should enable passengers to easily and safely travel between the station, residences, shopping, employment sites, and other destinations.

Platform design is integral to the issue of accessibility. A difference in heights of the vehicle floor and platform creates a "vertical gap" or level change that passengers experience when moving between the platform and the vehicle. Distance between the vehicle and the platform is called the "horizontal gap." To reduce these gaps so that all passengers can walk or wheel across the vehicle threshold without a noticeable change in level or surface continuity the proposed project should have approximately a 12" to 15" curb height at the station platform for "level or near-level" boarding as shown in Figure 9-5. The precise height should depend on vehicle selected and if multiple types of vehicles stop at a station. Transition from standard 6" high curbs should comply with accessibility standards. 1:20 maximum sloped walks should be used; however 1:12 maximum slope ramps with railings may be used where field conditions require them.

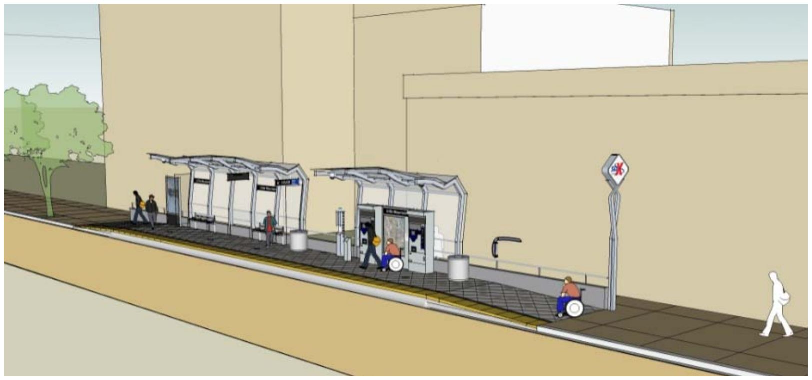


Figure 9-5: Accessible sloped walk and curb height at station platform

9.7 Site Development

The integration of transportation and land use contributes to the success of a transportation facility. The station site plans should take into consideration the relationship between the station location and the existing buildings, future potential joint development opportunities, and existing neighborhood characteristics. The development of adjoining properties around a transportation facility with transit-supportive mixed-use development can increase ridership. In turn, a transportation facility can act as a catalyst for revitalization and improvement of an area. For more detail, see Section 18.

9.8 Passenger Circulation

Key accessibility issues should consider station placement in relation to intersections, pedestrian crossing locations and timing, and overall pedestrian facilities surrounding stations. Some basic principles which should be considered in planning station circulation are as follows:

- Stations should be configured to avoid cross-flow of passengers at all times;
- Walkways and pathways for passengers with and without disabilities should be the same, so that this distinction between the two customer groups is eliminated;
- Dead-end conditions should be avoided wherever possible;
- Design of entries and exits should attempt to eliminate long waiting lines.
- Circulation patterns and station layouts should enable passengers to know where they are, and should have easy to understand directional signage to guide users along; and
- For safe environments, adequate lighting and shelter should be provided.

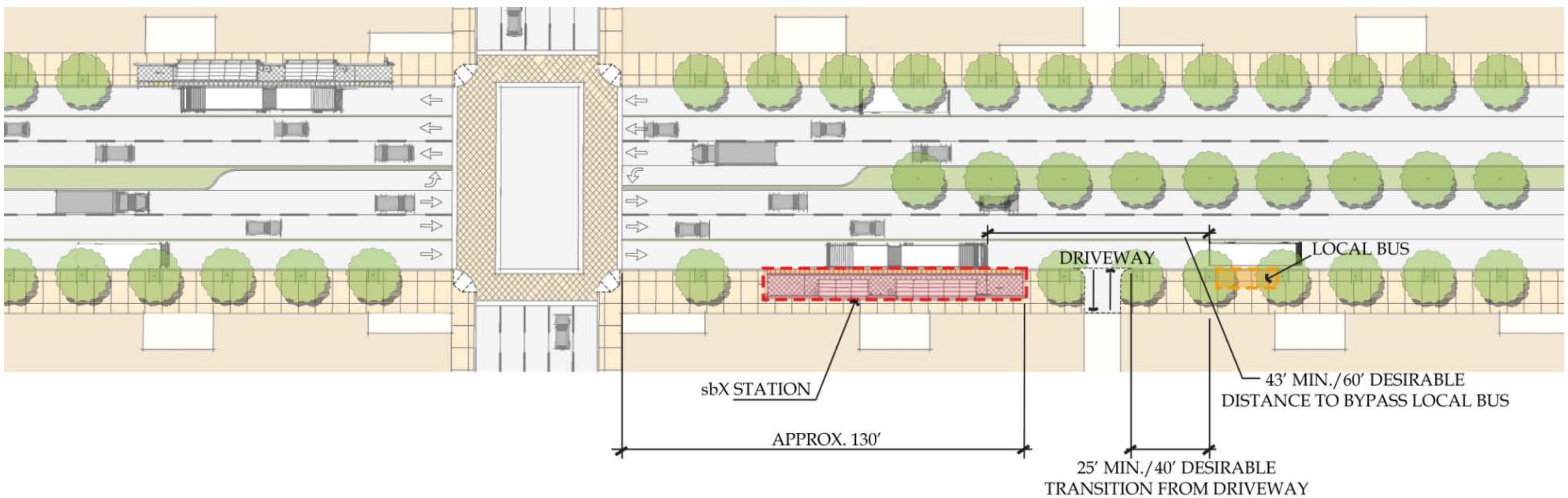
9.9 Local Bus Interface with sbX

Local bus interface with sbX is designed to ensure passage of sbX buses without slowing down the routes. Center running sbX routes will incorporate dedicated center running lanes and will be unaffected by local bus which stop at the curb lanes. Side running sbX stops are primarily in mixed-flow bus/traffic lanes. Mixed-flow traffic lanes, which are general purpose traffic lanes to be used by sbX vehicles, local buses and regular traffic, give sbX the advantage of having the opportunity to pass up a local bus on the adjacent lane. This favorable scenario will allow sbX to bypass the multiple stops local bus will have to make along its route. This is especially beneficial when having multiple traffic lanes traffic lanes along the route which will be the typical case along most sbX routes (typically 2-4 lanes of traffic in one direction).

Transition distances between sbX stations, driveways, and local bus stops need to have critical dimensions to ensure sbX buses to conveniently pull out and pass local buses (see Figures 9-6, 9-28 to 9-29, and 9-32 to 9-33).

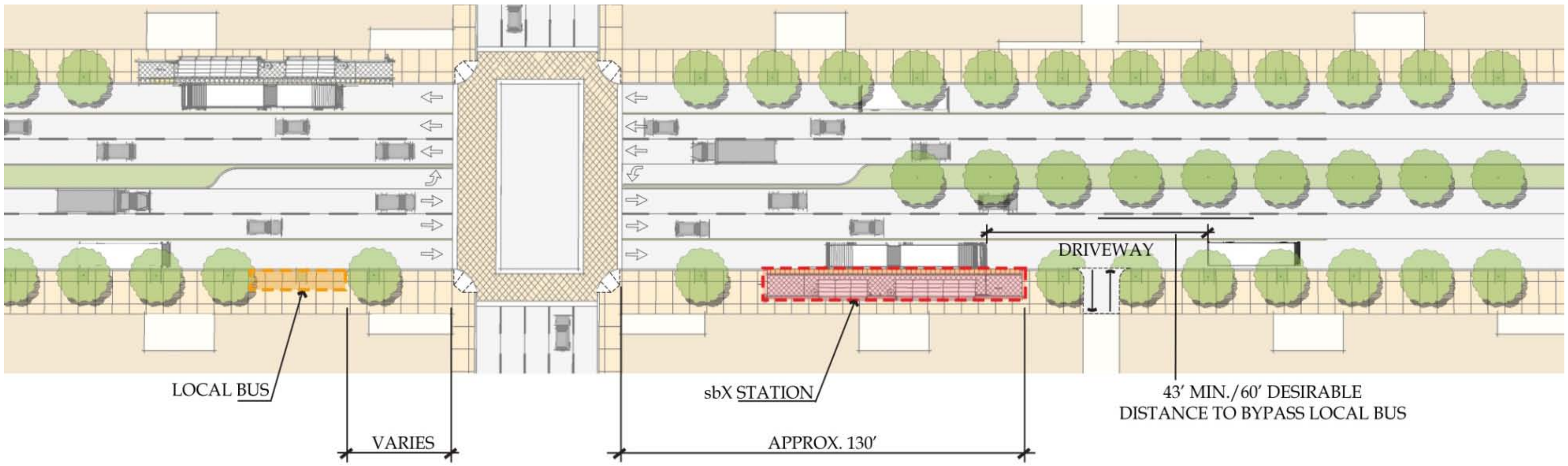
The local bus stops in relation to the sbX stations should be located as follows, as shown in Figure 9-6:

- Local bus stops preferred adjacent to sbX stations on the farside of intersection where there is space. The bus stops and stations could be separated by a curb cut or local street; and
- When there is not space for both local bus and sbX station on the same side of an intersection, the local bus stop may be at the opposite side of the intersection connected by a crosswalk.

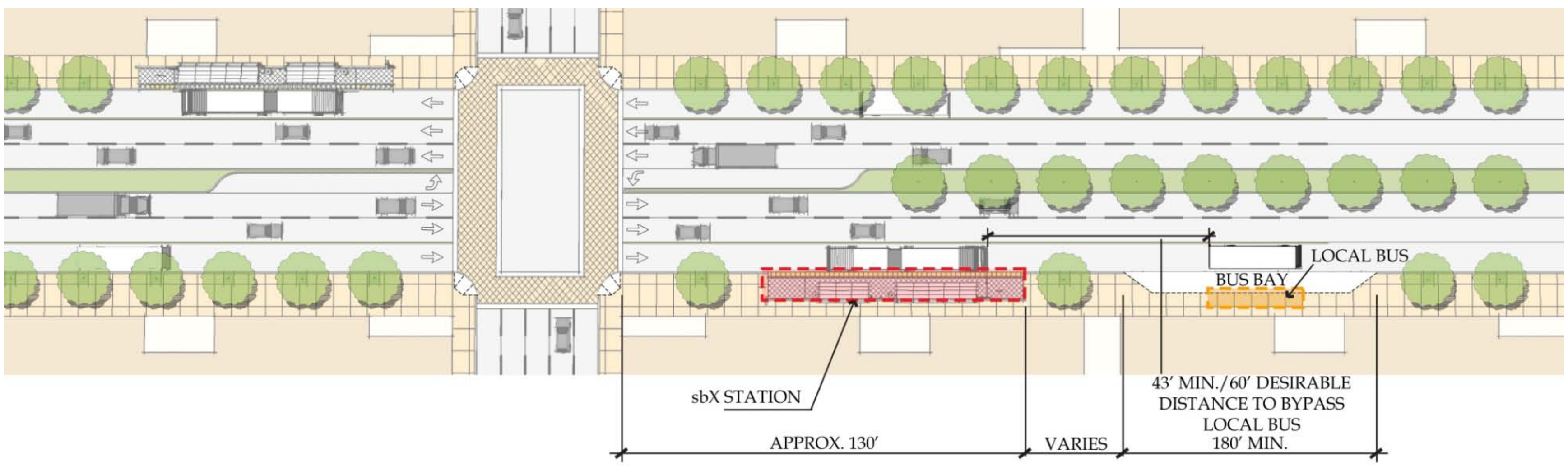


A. Local bus adjacent to a farside sbX station

Figure 9-6: Various conditions for side running farside sbX stations and local bus



B. Local bus on nearside with farside sbX Station



C. Local bus in bus bay adjacent to an sbX farside station

Figure 9-6: Various conditions for side running farside sbX stations and local bus (continued)

9.10 Physical Security

Physical security describes measures that prevent or deter damage to a facility, resource, or individual and guidance on how to design structures to resist various hostile acts. This includes protection from fire, natural disasters, burglary, theft, vandalism, and/or terrorism. It can be as simple as a locked door or as elaborate as a security guard. In addressing the physical security required for BRT stations, it is important to determine the potential threats that are present and the level of security that is feasible and/or needed. Once the threats are identified, the placement and design of platform elements are evaluated to enhance and provide a physical barrier between station users and operators and these potential threats. Following is a list of specific concerns that have been considered and the countermeasures that were integrated into the station design.

- **Safety of passengers from vehicles while waiting at a station.** Platforms should be raised above the street for level boarding and providing a natural barrier between traffic and the platform where possible. A 2'-6" wide textured and colored surface (a detectable warning strip) should be provided to passengers at waiting areas back from the curb. In other areas of the platform and access ramps a combination of curbs, railings and planting should provide a barrier between street traffic and transit user.

- **Ensure passengers cross safely in crosswalk to access to a center running station platform.** Through a series of railings, planters, and the platform elevation, the station should be designed to ensure that passengers enter through the marked crosswalk from a signalized intersection, especially on major arterials. Railings or low fences should be provided along the sloped walk leading from the crosswalk to the station platform. This should serve as a deterrent for crossing the street along the length of the walk. Planters and/or railings could be provided at the sidewalk side of the street opposite the open platform or in the median. This curbside barrier and the elevated platform height serve as deterrents for crossing the street at the platform itself. Figures 9-7 and 9-8 illustrate safety barriers.

- **Wire Mesh Trash Containers and Bicycle Rack Placement.** Wire mesh trash containers should be placed on either end of the station platform. Bicycle racks are to be placed within easy access of the station platform while maintaining a clear, accessible pathway to/from the station waiting area. Omnitrans is developing a policy that should limit the length of time a bicycle can be left at a rack, e.g., not longer than 24 hours.

- **Burglary, Theft, and Other Crime.** Overall visibility of the platform is one of the primary deterrents to crime. To this end, stations should be open and visible from the street. The extent of visibility from the adjacent sidewalks and surrounding business are examined on a case by case basis to balance station visibility with protection from the elements and providing a sense of place. Station landscape elements should be low growing to minimize hiding places and improve visibility. Where planting is higher, it should be lacy in nature or placed away from the station. Station elements and equipment should be placed to avoid obstructing views. Materials such as polycarbonate and glass address visibility concerns. Sufficient lighting levels should also be provided to ensure good visibility at night.

In addition to the physical considerations that have been made, station security is supplemented with electronic monitoring and routine inspections, as discussed in Section 15.

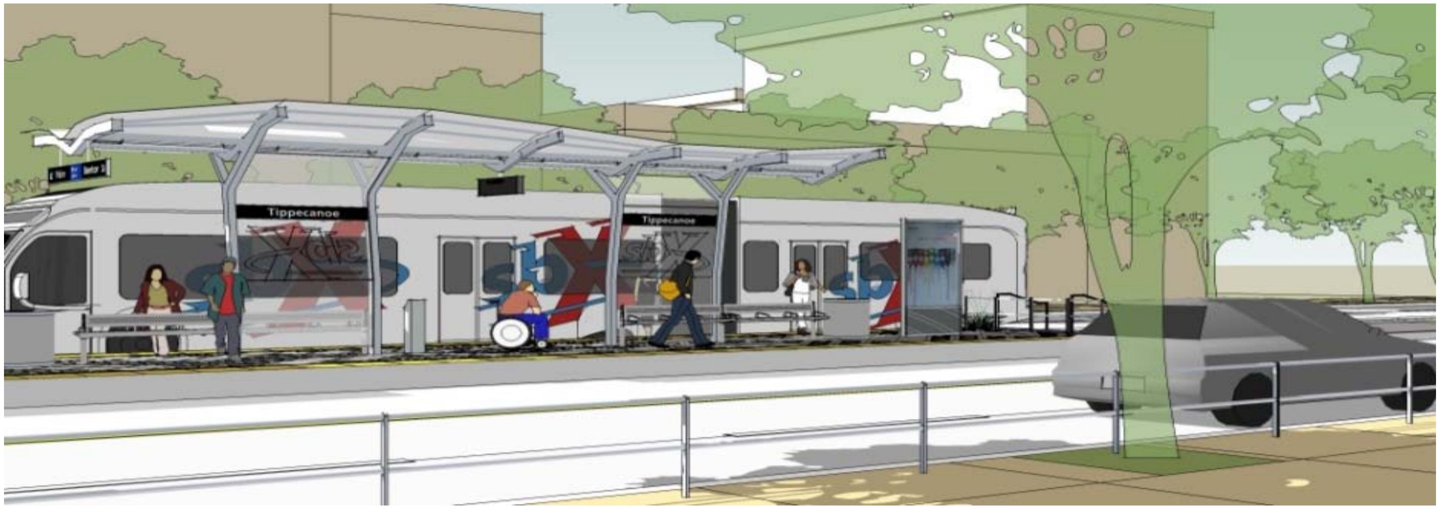


Figure 9-7: Railings or low fences or planters direct pedestrians to cross in the legal crosswalk to the platform

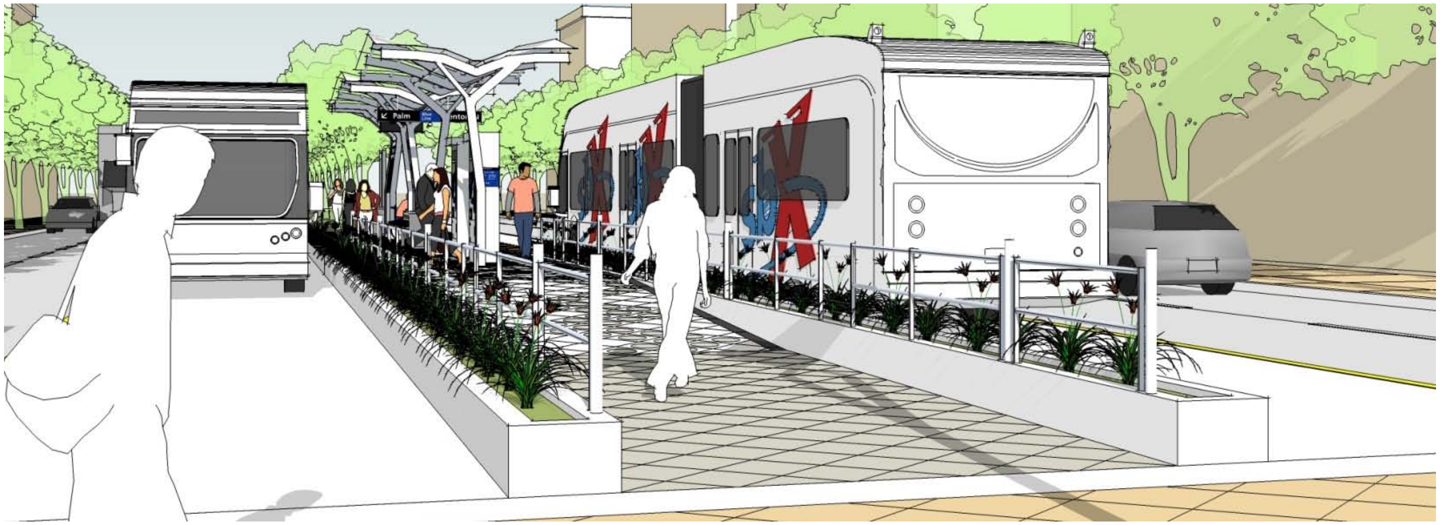


Figure 9-8: Railings or low fences or planters along sloped walk to prevent crossing of the street along the length of the sloped walk

9.11 Architectural Kit-of-parts

As illustrated in Figure 9-9, the sbX station architecture includes a kit-of-parts that are combined in various ways depending on unique site conditions, ridership, and adjoining uses. Major vertical components of the sbX station are the pylon with the sbX logo and the shelter. Other design considerations for the station include the following:

- Modular components that may be combined to respond to ridership and special conditions at each station and for cost effectiveness. Compliance with accessibility requirements including a raised platform to allow for "near-level or level" boarding and a wheelchair area under the shelter;
- Layout to accommodate simultaneous use of all bus doors for boarding and alighting (multi-level boarding);
- Low maintenance and vandal resistant materials such as stainless steel, polycarbonate, concrete, glass, and performance coated metal;
- Sufficient illumination at all times;
- Device to alert drivers of waiting passengers;
- The incorporation of passenger and transit advance travelers information systems;
- The sbX logo incorporated into the shelter;
- The station entrance location, to the maximum extent practicable, coincides with access routes used by the majority of the general public; and
- Incorporation of design elements such as art work responding to local character.

The basic station kit-of-parts shown in Figure 9-9 consists of the following:

The following lists the kit-of-parts:

- **Pylon** – To identify and mark the sbX station entries to customers and the community, a pylon should be provided at each station. The pylon shall be a logo pole and signature light acting as a beacon identifying sbX to existing and future patrons.
- A minimum of one pylon should be provided at each station (Figure 9-10). If appropriate, the beacon location should be visible from at least two cross streets or roads bisecting the station entrance, so that patrons may recognize and locate the entrance on approach by foot or vehicle. This pylon should be approximately 15' to 20' tall. For the center running station, the pylon is mounted in a concrete raised area in front of the sbX station entry, located within the crosswalk.
- **Seating/Bench –** A minimum of 6 seats per station should be provided at the station and designed to minimize accessibility requirements. Seats should be arranged so that they do not interfere with passenger circulation or emergency exiting. Seats and/or seating should be designed to discourage individuals from lying down, sleeping or loitering (Figure 9-11). The Design should be compatible with station architecture.

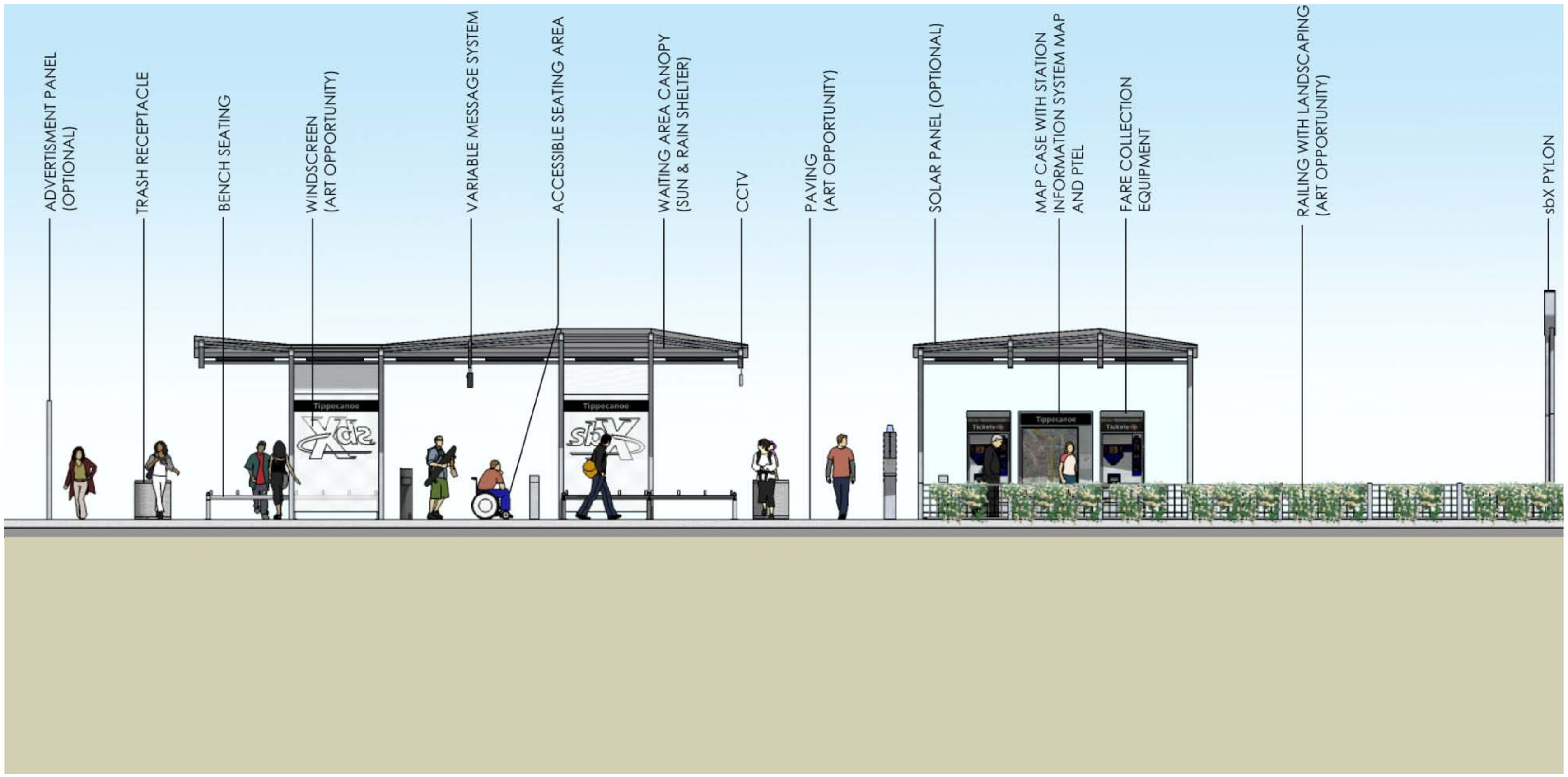


Figure 9-9: sbX Kit-of-Parts for a center running station

Figure 9-10: Station Pylon

Figure 9-11: Station Seating

- **Shelter** – The shelter is the principal element protecting passengers from wind, sun and rain and considers image, modularity, universal design and function. Shelters should be large enough to accommodate a sufficient number of people, and should be primarily open-sided to allow air circulation and flow of prevailing breezes. The bus shelters should be safe, the canopies hovering above 11′ to deter climbing on them. The bus shelters are utilitarian, understated, and shall be of sufficient canopy size to afford adequate protection from inclement weather and sun exposure. They shall provide an architectural statement and distinguish the sbX from other bus services. The shelters, regardless of area of canopy or capacity, should be of the same architectural design character. Shelter structures should cover the fare equipment and some of the seating areas. The overhead shelter should not extend closer than 2′-0″ from the edge of the curb. Shelters shall be provided to a minimum of 30 percent of the boarding area of the station. Components of the shelter to consider are as follows:

- **Structural columns/wall supporting the roof** – The number of structural columns supporting the shelter should vary depending on the module for different station types. Glass or polycarbonate vertical panels are added to the column elements to provide sun, rain, or wind protection on a site-by-site basis (Figure 9-12).

Figure 9-12: Structural columns and undulating roof shelter

- **A cantilever shelter roof frame** – The roof of the shelter undulates to provide both a visible branding to the sbX station but also to provide varied protection from the elements. Translucent polycarbonate panels sit atop a steel frame, providing protection from the sun and rain.
- **Solar panels –** Where feasible, solar panels may be provided in lieu of or in conjunction with polycarbonate panels on the roof frame to provide both protection and a means to collect solar power.
- **Optional wind and sun screens–** Where needed, wind and sun screens can be added independently from the shelter (Figure 9-13).
- **Optional foundation wall with steel pipe railings** – The foundation element should provide enclosure to the prepayment area, provide support for seating, and wind protection. The foundation wall shall be typically 1′-6″ topped with steel pipe rail for a total height of 2′-6″ in height and is appropriate in some station types (Figure 9-14).

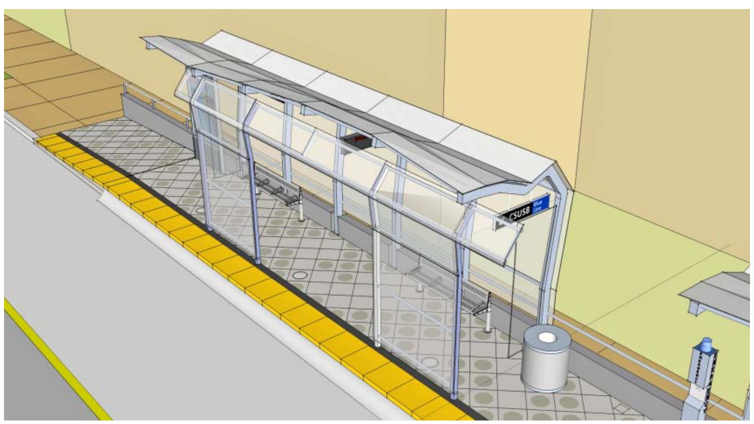


Figure 9-13: Wind and Sun Screen for a side running station

Figure 9-14: Side running station foundation wall

9.12 Transit and Passenger Amenities

In addition to the above architectural kit-of-parts, the following passenger amenities should be provided at each station:

- **Signage and graphics –** Signage and graphics should be uniform throughout the Project. All signs and graphics provided at stations should conform to the following principles:
  - Signs should be simple, clear and concise;
  - Critical signs such as those with regulatory and emergency information shall have messages in both English and Spanish;
  - Certain signs with priority should be distinguished from others by using different sizes, color, or location;
  - Signs should have precedence over artwork with regard to their location and prominence; and
  - Artwork, if incorporated into the station design, should be coordinated with the locations of signs to avoid conflict.

- **Map Case(s)** - Map case(s) should be provided at stations to guide passengers and to provide up-to-date route information. Other information such as fares, and holiday schedules could be provided at station along with schedule information.
- **Directional "Wayfinding" Signage -** Directional "wayfinding" signage should be provided at each station to guide the patrons using the system. Station signage can be tactile (Braille) as required by Americans with Disabilities Act (ADA) and Title 24, Part 2, Volume 1, Section 1117B.5 Signs and identification. When appropriate, signs should be installed to direct vehicular traffic to the park-and-ride sites. If necessary, subsequent wayfinding signs should be placed along the access route to instruct drivers where to turn. All such sign placement must be coordinated with local municipalities as appropriate. Other signage and graphics at stations could include neighborhood maps and an advertisement panel, if permitted by an individual city.
- **Electronic Display Signs (Variable Message Signs) Subsystem -** The electronic display signs (Variable Message Signs) subsystem should be provided at each station platform to provide bus information including estimated arrival time for the coming of buses and limited advertisement in compliance with the ADA. All station message sign units should be environmentally housed to prevent damage from moisture, dust, and vandalism.
- **Devices for pre-purchase of fare media (Fare Collection Equipment)** – Preferably, Ticket Vending Machines (TVMs) and Stand Alone Validators (SAV) should be located at entrances to the station closest to the intersection where there is a transfer. Shelter coverage shall be provided for TVMs and SAVs to provide weather protection for passengers using the equipment (Figure 9-15). TVM and SAV locations need to allow for sufficient clear space to comply with front and side wheelchair access requirements. The equipment should allow for front door swing opening and should be considered in locating fare collection equipment near support columns, and other vertical elements in station design. The location should account for patron sight distance of buses and vehicles at intersections. Although these vary with manufacturers, the maximum expected dimensions are as follows:

TVM – 32″ wide X 24″ deep x 72″ high

SAV – 21″ wide X 24″ deep X 60″ high

An additional side clearance of 18″ minimum, back clearance of 6″ minimum and front clearance of 48″ should be provided for both the TVMs and SAVs. Shelter coverage should be provided for TVMs and SAVs for protection of equipment and an area 24″ in front for weather protection for passengers using the equipment.

Adequate space should be provided around the fare collection equipment to allow passengers to buy their tickets without undue crowding and exiting through this space in case of emergencies. Minimum queuing distance requirements are 8′-0″ at high ridership stations and 6′-0″ at stations with low to medium ridership. A minimum of 3′ x 3′ should be provided in front of the equipment and map viewing area.

The specifics of Fare Collection Equipment are addressed elsewhere in Section 16. For actual fare collection equipment selected for the sbX Green Line which is smaller than the above dimensions, see Section 16.

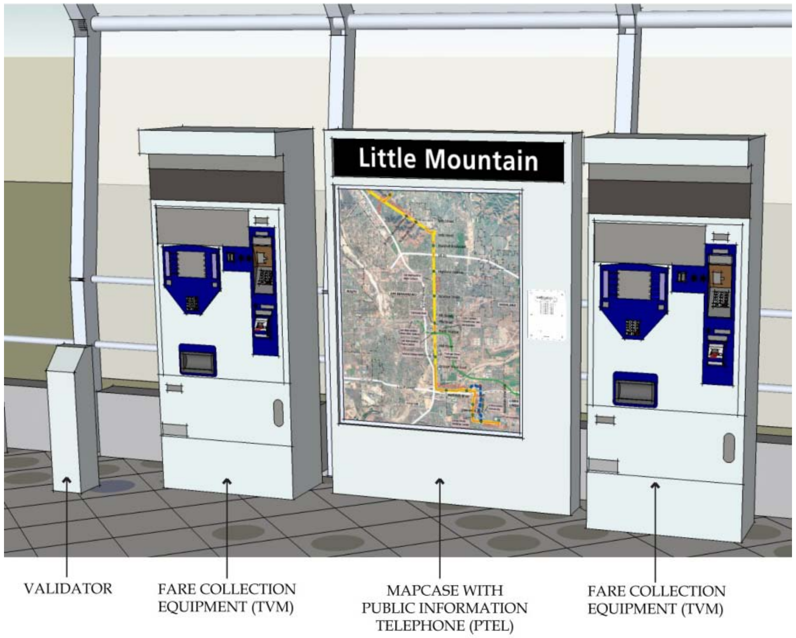


Figure 9-15: Map case and fare collection equipment (TVM and SAV) at entrances to the station

- **Public Information Telephone (PTEL)** – The PTEL subsystem should provide point-to-point voice communication from platform fare collection areas to IT control room during normal business hours. This system could be integrated with the map case.
- **Closed-Circuit Television (CCTV) –** The CCTV subsystem should provide visual surveillance of designated passenger platform areas, fare equipment, and intersections near platforms to aid security control and assistance to passengers. The subsystem should provide video recording locally via a DVR. Remote monitoring should be provided via the CTS (Figure 9-16).
- **Variable Message Sign (VMS)** – The VMS subsystem should provide estimated arrival time information of the coming buses for the waiting passengers (Figure 9-17).

Figure 9-16: CCTV Subsystem

Figure 9-17: Variable Message Sign (VMS)

- **Trash receptacles –** Trash receptacles at stations should be provided near the fare collection equipment and the boarding area. Trash receptacles should be wire mesh and vandal resistant (Figure 9-18**)**. As transit stations/ platforms are major waste generation points, the proposed stations should consider providing recycling/litter bins. This should help segregate waste at the source, thus saving the processing cost.

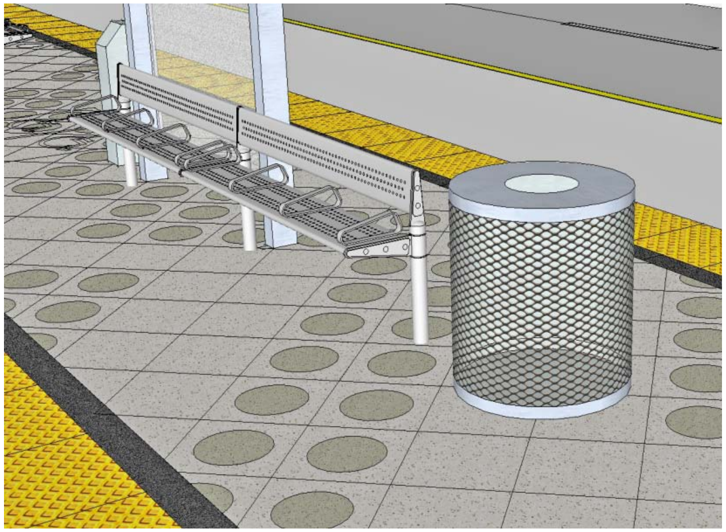


Figure 9-18: Trash Receptacles

- **Bike racks** – Bike racks should be provided at stations depending on the available space at each station to accommodate transit riders who bike, and to encourage them to use the system. A minimum of two bicycle parking spaces should be provided and four spaces are desirable at each station. Bicycle parking spaces should be placed at each station in a visible location (Figure 9-19).

Local communities may have a variety of off-street paths or on-street bike lanes that should factor into determining the demand for bike parking facilities. When developing site layouts for a bus transit facility, the design engineer should investigate and consider such bicycle connections.

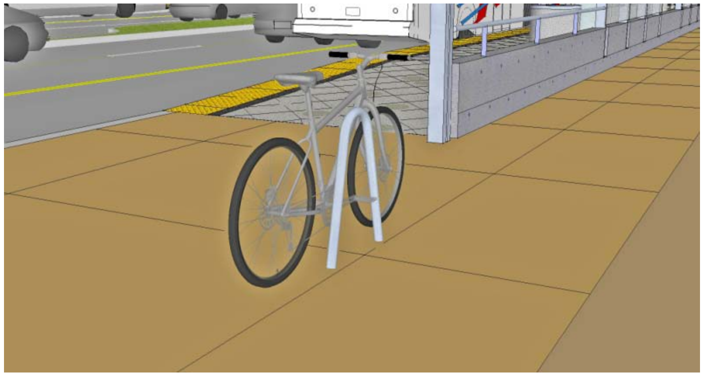


Figure 9-19: Bike Racks

- **Lighting**– Adequate area lighting is important for passenger comfort and security as well as for visibility of waiting passengers to the bus and other oncoming traffic. Station lighting should include emergency, station, and ticketing area lights. The station canopy is designed for slender lights mounted into the canopy (Figure 9-20). The placement of lighting fixtures should be unique to each site and should be coordinated with the design engineer. A combination of light distributions should be utilized to efficiently meet photometric requirements. Passenger shelters at bus transit facilities should be lit by “spill-light” that emanates from lighting that is placed in passenger waiting areas. The illumination levels for different kind of lighting at the station are specified in Section 14.

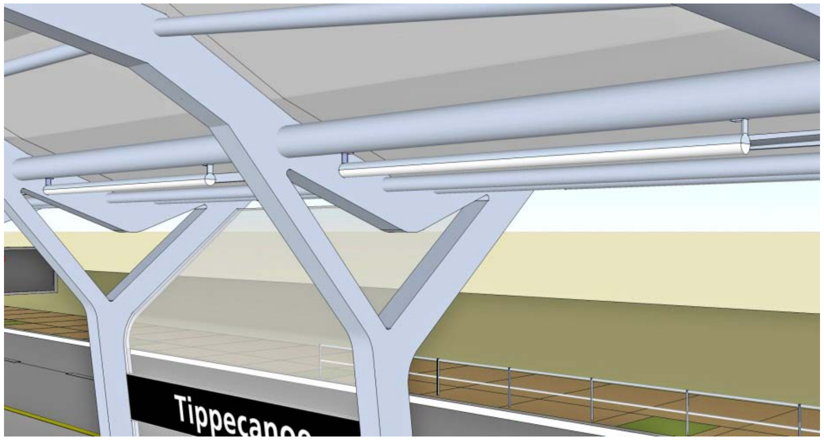


Figure 9-20: Lighting

- **Handrails and Guardrails** – When required, handrails and/or guardrails should be provided and should be located 2′ from the curb edge at its roadside edge (Figure 9-21).

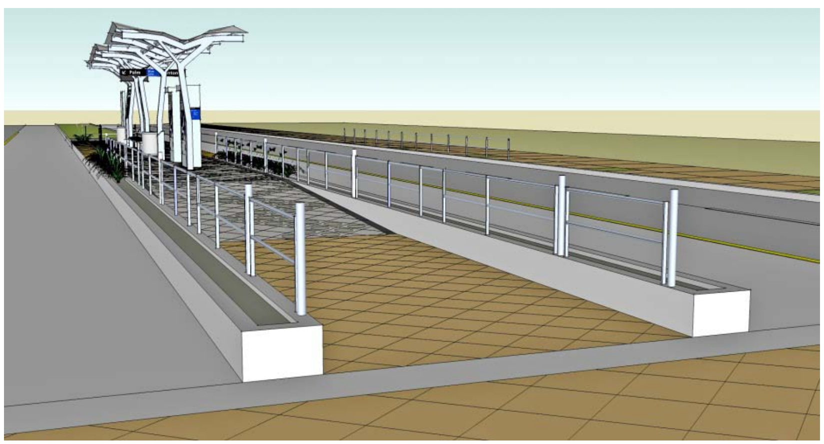


Figure 9-21: Handrails and Guardrails

- **Restrooms** – Public restrooms should not be provided at stations. A staff toilet should be provided for bus drivers at the major transportation centers or terminus stations (Figure 9-22).

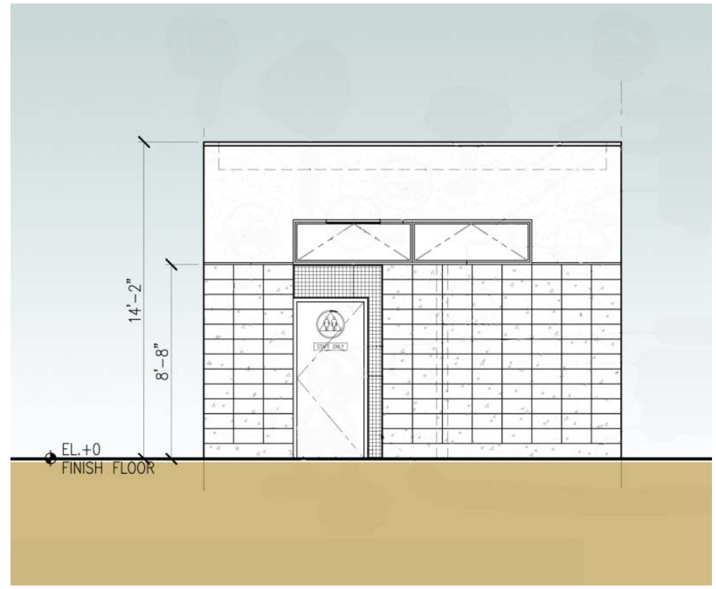


Figure 9-22: A restroom for bus drivers on the sbX Green Line

- **Water Hook-up** – For cleaning and irrigation, a water hook-up should be provided at all stations.

- **Public Art** – The incorporation of art is an integral part of the station concept. Public art that varies at different stop locations could be provided to create a unique visual identity for each station and express the uniqueness of a city or neighborhood. Public art should be site specific and would be integrated into the design of each site (Figure 9-23). Art materials should be chosen for durability, maintainability, and longevity. Artwork should meet fire/life safety requirements with regard to fabrication and installation. Artwork selection would be in collaboration with each individual city.

Following is a list of selected station components that will be considered as possibilities for art or artistic enhancement and may vary from standard to reflect the individual historic and cultural character of a city or neighborhood:

- Stations and Park & Ride Facilities
  - Paving – platform, parking, crosswalks;
  - Wall-vertical materials-finishes;
  - Lighting – station or site. Attachments to standard light poles;
  - Windscreens;
  - Storm water design or artwork integrated into landscaping;
  - Fencing and railings;
  - Bicycle storage/racks;
  - Site-specific, freestanding artwork that serves as marker or community identifier;
  - Tree grates;
  - Community connections / historical references;
  - Art in shelter polycarbonate or glass (sandblasting, placement of artwork on translucent film between two panes);
  - Signage (as part of station design such as an attachment/marker on top of standard poles, i.e. whirligigs or specialty designed poles to reflect history/culture of an area;
- Within the Right-of-Way
  - Finishes/coverings for mechanical sheds/boxes;
  - Artwork integrated into the landscaping;
- Temporary Art during Construction
  - Installations;
  - Displays;
  - Performances; and
  - Publications.

Source: Cliff Garten

Source: Kyungmi Shin

Figure 9-23: Public Art Examples from sbX Green Line

Other considerations for kit-of-parts at stations may include:

- Decorative paving patterns and materials to provide durability and a low maintenance and cost-effective way of creating texture and visual interest at stations. Paving materials and patterns to consider include pre-cast concrete pavers and scored colored concrete with aggregates (Figure 9-24) at the stations. Scored/stamped concrete or street print, not pavers should be used at crosswalks.
- Materials for ease of cleaning and maintenance, such as high gloss tile, stainless steel, powder-coated metal, glass, concrete, and polycarbonate.
- Curb extensions or curb nubs, where possible, which extend the width of the sidewalk into the street for more waiting space, special paving, preferably colored, to delineate waiting and boarding area and to create a sense of place (Figure 9-25).
- Shelter components and the sbX logo should remain consistent per station. Railings, art panels, sculptures, paving may vary per station.

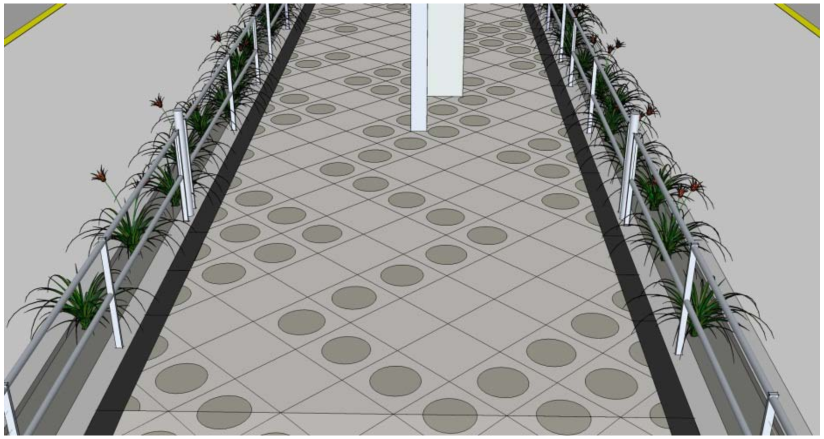


Figure 9-24: Typical Paving Pattern for sbX Green Line

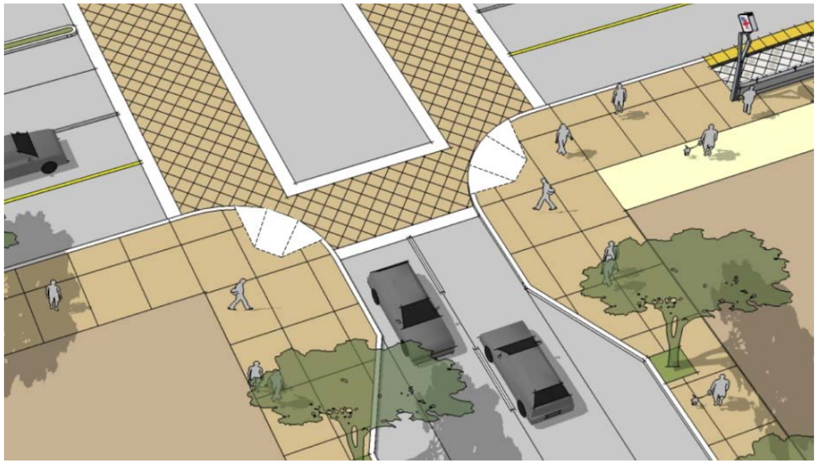


Figure 9-25: Curb Extension

- Landscaping including street trees at curbs, tree grates in some locations and shrubs with irrigation are optional unless disturbed by construction (Figure 9-26);

Figure 9-26: Landscaping

9.12.1 Material Selections

Regardless of where a station is located, the unifying elements of the station design remain consistent. Materials were chosen for their durability. Dimensional standards are indicated on the construction drawings and are not repeated within this report.

- Optional elements depending on the station location such as drinking fountains, pedestrian lighting, limited vending machines, news rack organizer, bollard lighting, shrubs with irrigation;

- Fencing for security and to discourage crossing of streets outside of crosswalks;
- Optional misting system at one end of the station or another method for cooling;

9.13 Design Criteria Related to Station Type

Stations should vary in size and location based on sidewalk/parkway constraints, ROW constraints, ridership, and surrounding uses. As previously mentioned, there are three types of stations that may be considered on a BRT corridor:

- **Typical On-Street Side Running Stations.** These stations should typically be located on-street at curb side and include both an sbX stop and a local stop on the far side of an intersection, where feasible. These stations may have an adjoining park-and-ride. Each station area would be comprised of two separate side platforms such as a northbound and a southbound platform. Side running stations could be located on mixed flow or exclusive lanes.
- **Center Running Stations**. These stations would be in the center of the existing roadway or median with boarding from center running exclusive bus lanes.
- **Specialty Stations**. Some station locations may be determined to warrant a special configuration. These stations may be located at the terminus of the sbX or at a unique activity center along the route. They could include a park-and-ride lot or a transfer center for other modes of transportation. Station canopies and amenities should be determined on a case by case basis from amongst the architectural kit-of-parts.

9.13.1 On-Street Side Running Station

On-street side running stations should be located to create a comfortable, efficient transit place which fits into the community fabric and which avoids the taking of buildings, where possible. It is preferred for on-street side running stations to be located on the farside of an intersection in order to facilitate transit priority and to avoid a stopped bus from blocking right turns from the sbX Corridor. Although due to other considerations, a nearside station may be appropriate. The number and type of transit amenities should depend on varying site conditions, ridership and surrounding uses. Amenity components at each station may vary, see Figure 9-27.

Platforms

- **Platform Configuration** – Platform configuration should primarily depend on the available distance between intersections and/or distance of existing driveways from the intersection. Optimally, sbX stations should be located in areas with the least number of constraints. The optimum on-street side running sbX Station should be located 43’ minimum and 60’ desirable from the edge of the intersection crosswalk to provide clearance at the intersection, illustrated in Figure 9-28. The station entry points preferably should be located at both ends of the platform to reduce congestion and travel distance. The fare collection/entry canopy should be a minimum of 45’ from the edge of the intersection’s street curb to provide adequate sight distance.

Figure 9-27: Side Running Station

A minimum station should fit in situations with the next intersection or existing driveway located within 135′ of the intersection crosswalk assuming entry from both ends of the platform. If access is provided only on one end of the platform, a minimum station would fit within 120′.

The minimum station option should accommodate one 60′ articulated bus at the platform and provide clearance at the intersection, as shown in Figure 9-29.

It is important to note the different platform heights for local bus versus sbX bus. Local bus uses a 6″ curb height whereas sbX uses a 15″ curb height at the platform. Due to the difference in platform height, the stations cannot be shared between local bus and sbX bus.

- **Platform Area –** Station platforms should be sized to accommodate site specific passenger projections developed by operations planners.

- **Platform Width –** Platform width should primarily depend on the available sidewalk/parkway width at each location and potential for right-of-way expansion. An optimum station should be provided where the existing sidewalk/parkway width or any expanded sidewalk/parkway width is 18′ from the curb to the ROW line in order to accommodate a shelter with its seating area and fare collection equipment, maintain at least 4′ in front of the shelter to meet code requirements, and provide a 6′ walkway behind the shelter. With the sidewalk behind the station, those walking on the sidewalk to various destinations should not conflict with those waiting for the sbX, as shown in Figure 9-30.

  However, in constricted conditions the minimum station shelter should fit in a 13′-6″ sidewalk area including a 4′ walkway behind the shelter (see Figure 9-31). At building entrances, the minimum station shelter platform width is 14′-6″ allowing for a 5′ sidewalk.

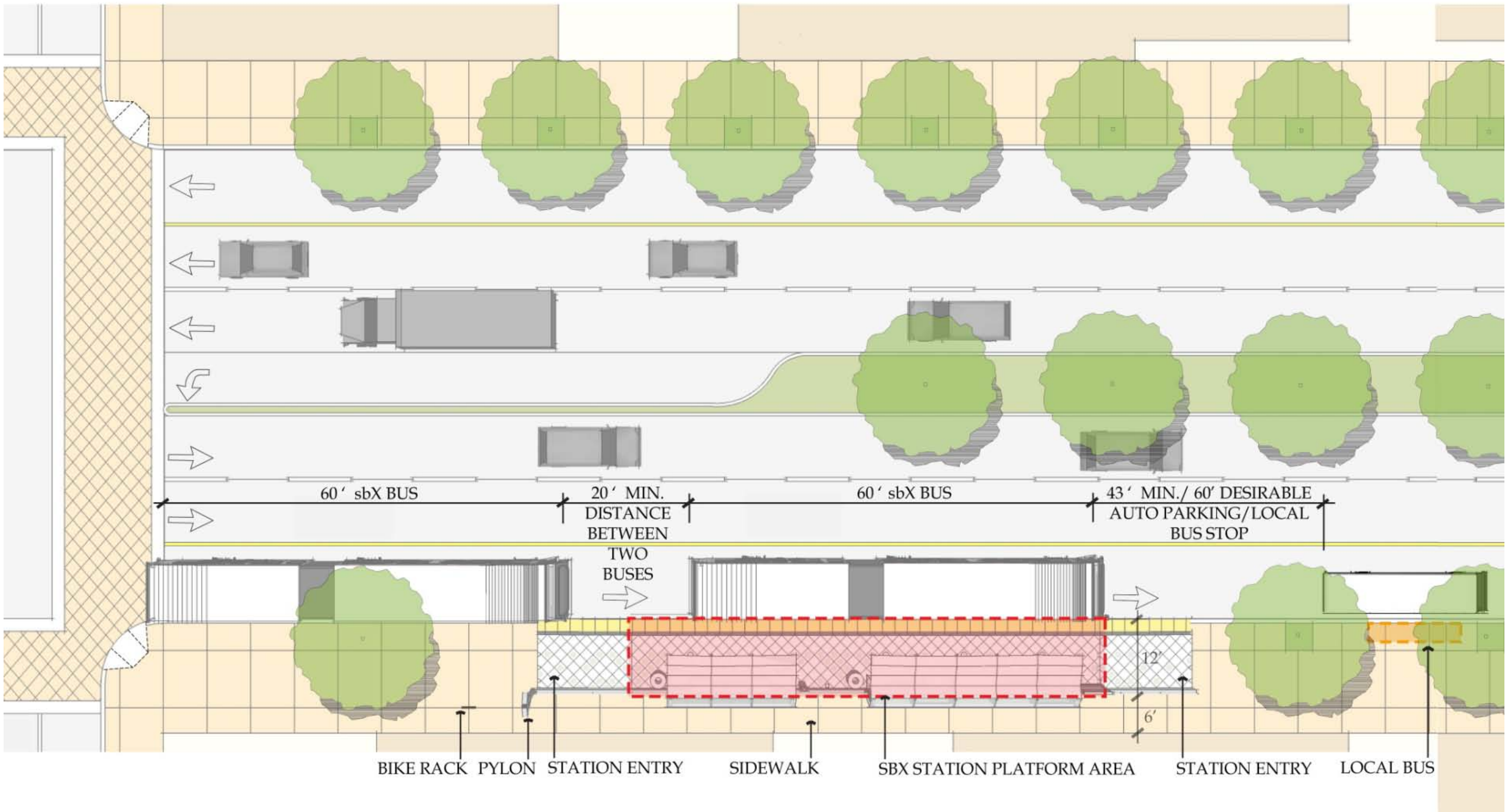


Figure 9-28: Optimum On-Street Side Running Stations Configuration

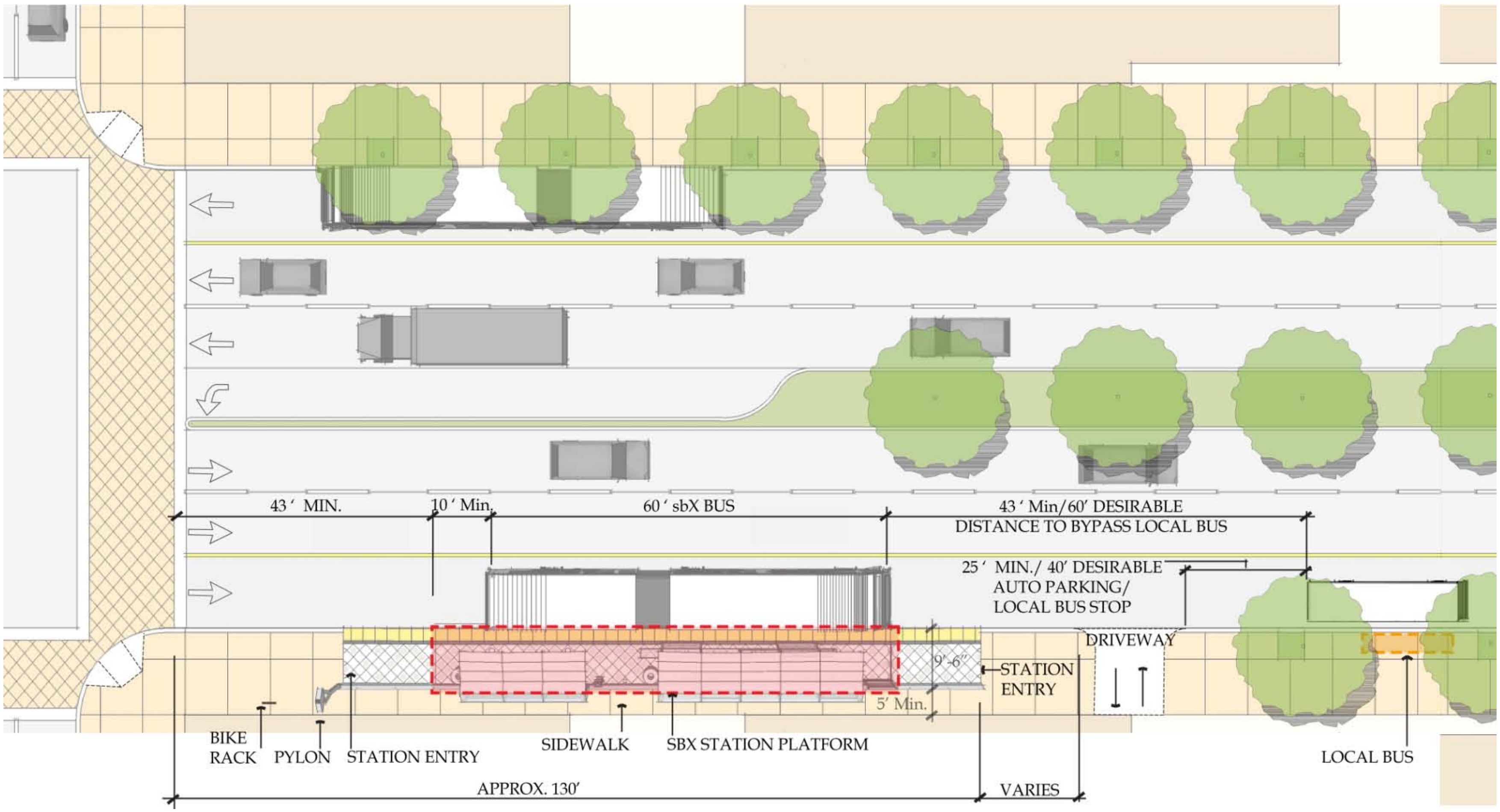


Figure 9-29: Minimum On-Street Side Running Stations Configuration

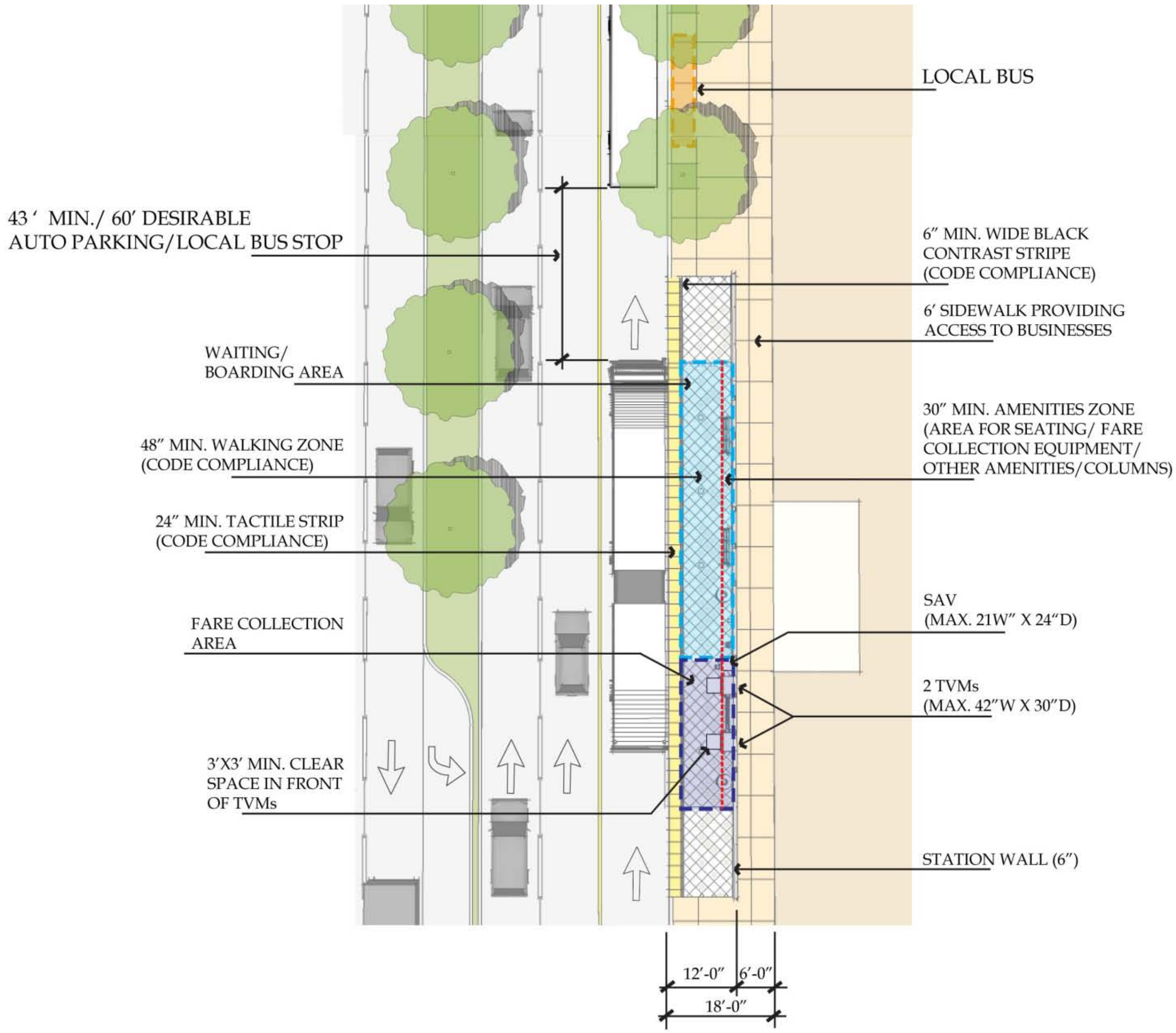


Figure 9-30: Optimum Side-Running Station Platform Plan

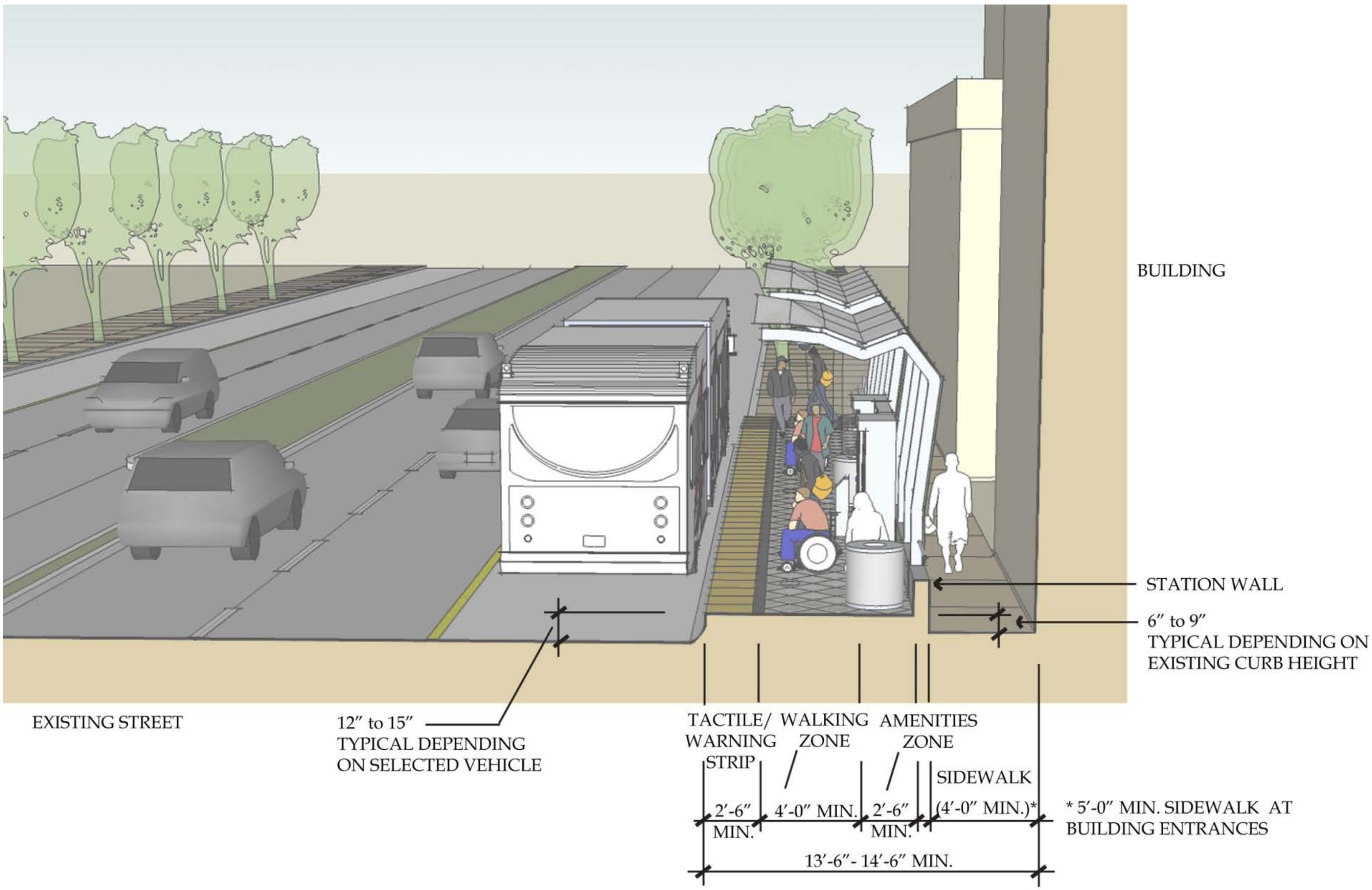


Figure 9-31: Minimum Side-Running Station Platform Section

- **Platform length** – The length of the platform shall vary depending on the site conditions. The length of the platform includes the station entry, fare collection/equipment area, boarding/unloading, and waiting area.

  For the optimum station, the length of the platform including entry ramps on both sides should be approximately 130′ (Refer to Figure 9-32) which should include:

  - a nominal 15′ sloped walk (1:20) for both entries located on each side of the station platform; the incline or slope should vary depending on the curb height
  - 26′ minimum fare collection area
  - 70′ boarding/unloading and waiting area

  Whereas, for the minimum station, the length of the platform including entry ramps on both sides should be approximately 96′ (Figure 9-33) which should include:

  - a nominal 10′ ramp (1:12) slope for entry on both sides; the incline or slope should vary depending on the curb height
  - 26′ minimum fare collection area
  - 50′ boarding/unloading and waiting area

- **Platform cross-slopes** –Platforms should have minimum and maximum cross-slopes of 1% and 2% respectively sloping towards the roadway (bus lanes or mixed-flow lanes), and a maximum longitudinal slope of 2%.

- **Bus Bays** – Bus bays for sbX may be considered for side running stations but generally are not recommended as it is difficult for the bus to efficiently enter moving traffic after the bus is stopped. There are some advantages for a slower running local bus to use a stop at a bus bay so that the faster sbX service may bypass it when necessary. See Section 6 for a discussion of advantages and disadvantages of local bus pull-outs.

9.13.2 Architectural Character

As mentioned previously, the architectural character at stations should retain a similar appearance to brand the service with a unified design and for ease of long-term maintenance. The canopy is the most visible element at stations, contemporary in design with lighted roof, curved canopy, and structural columns. Glass and polycarbonate panels are added to the column elements to provide sun, rain, or wind protection on a site-by-site basis depending on the direction of the sun and wind at specific locations. Sun and wind studies should be prepared by designers to identify the need and location of the sun or wind panels at each station.

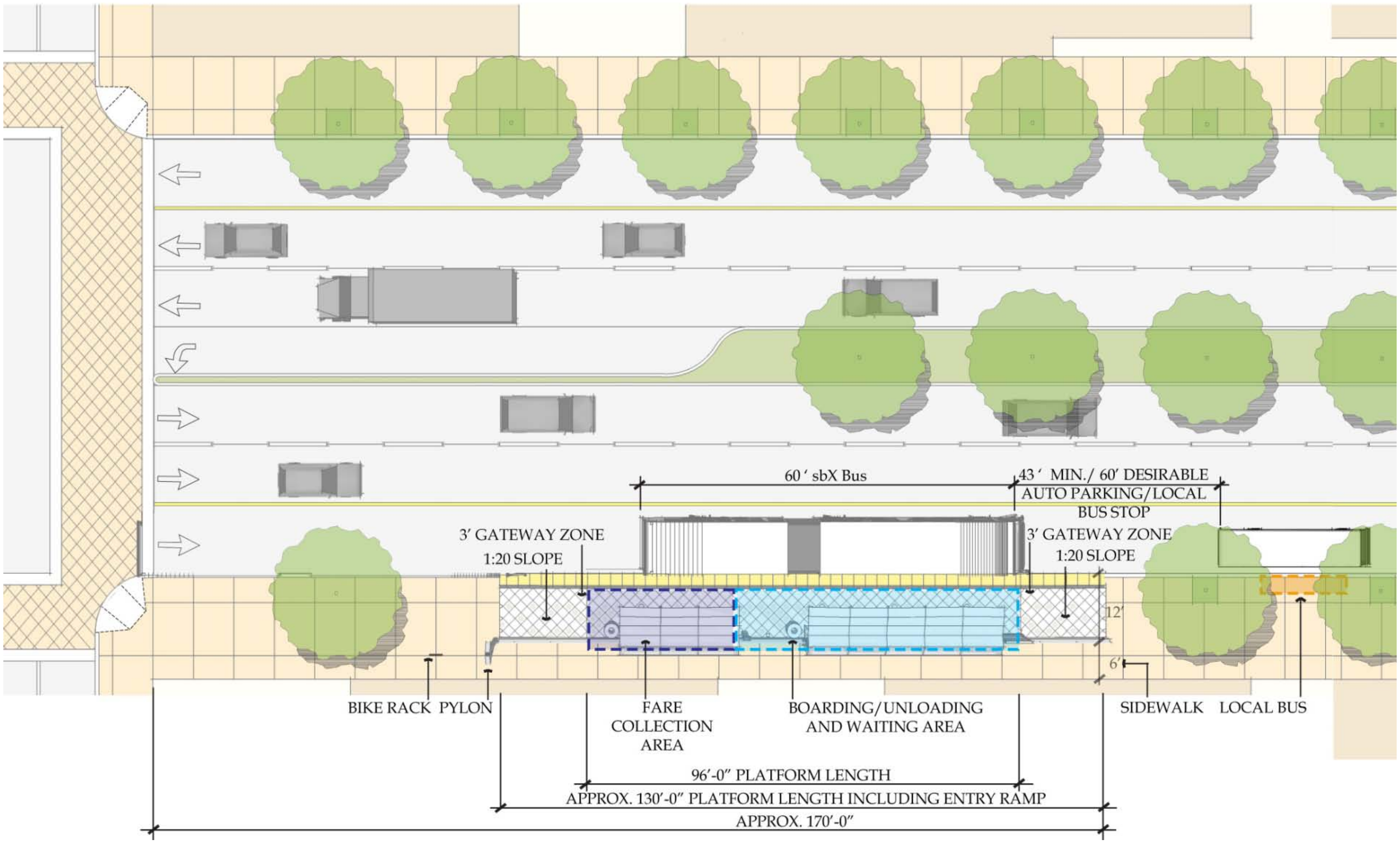


Figure 9-32: Optimum On-Street Side Running Stations Platform Length

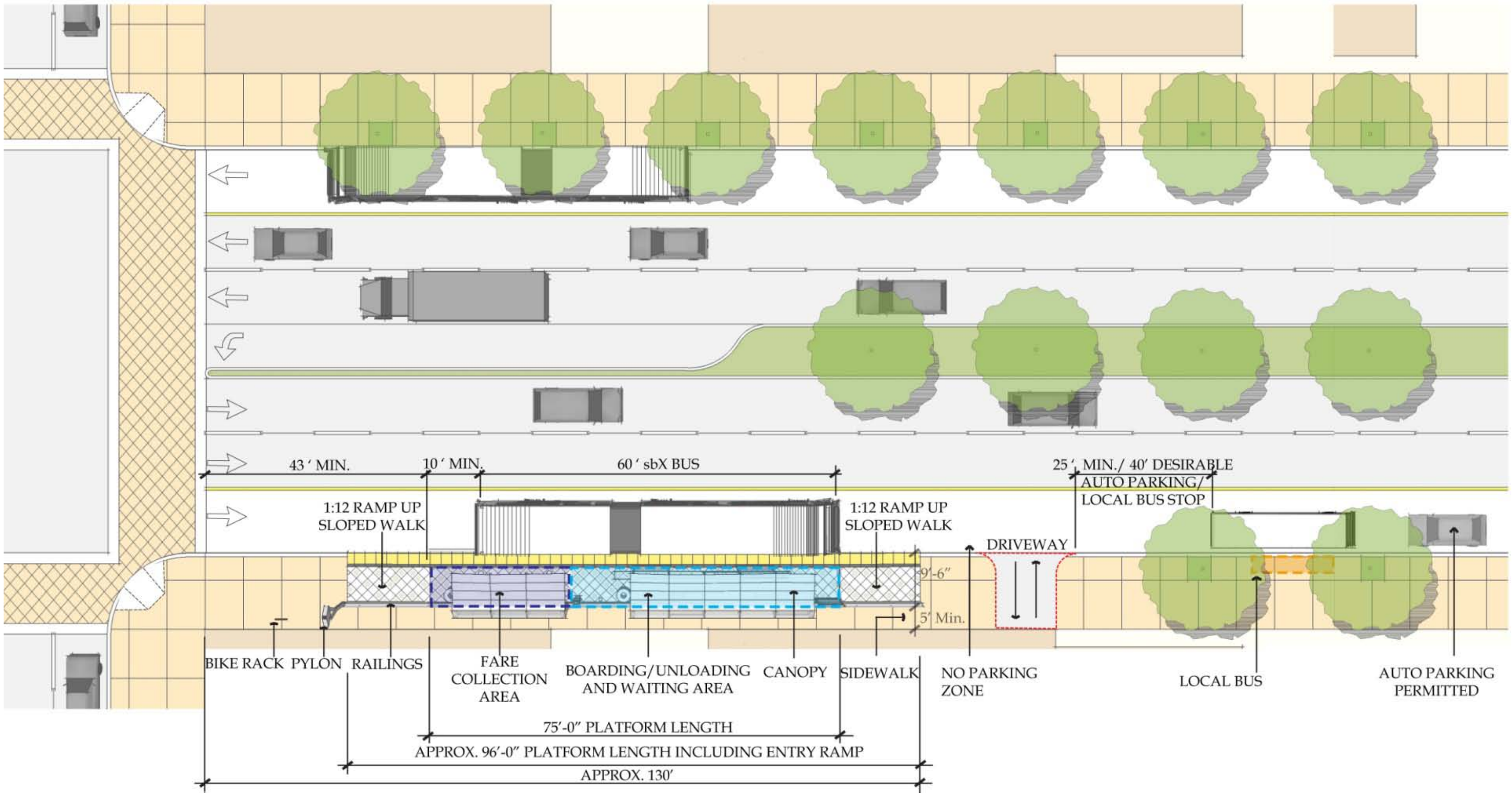


Figure 9-33: Minimum On-Street Side Running Stations Platform Length

9.13.3 Center Running Station

A center running station is located within the median or center of the roadway with boarding from center running bus lanes, as shown in Figure 9-34. The number and type of transit amenities will differ from on-street side running station and depend on varying site conditions, ridership, and surrounding uses. In addition to the shelter components, amenity components at each station should include:

Platforms

- **Platform Configuration** – Station entry points should be located near the intersection from a crosswalk. Platforms should be designed to load passengers headed in both directions. The optimum platform should accommodate a minimum of two 60′ articulated bus traveling in each direction and should be located to accommodate a sloped walk or ramp and refuge area in the median from the edge of the crosswalk. The minimum platform should accommodate one 60′ bus.

- **Platform Area** – Station platforms should be sized to accommodate site specific passenger projections in both directions.

- **Platform Width** – In the optimum condition, the width of the station should be 15′ in order to accommodate fare collection and seating areas and maintain at least 4′ clear walking zone in front of the seating area, illustrated in Figure 9-35 and 9-36.

- **Platform length** – The length of the platform should vary depending on the site conditions. The length of the platform includes the station entry, fare collection/equipment area, boarding/unloading, and waiting area.

  For a desired minimum station, the length of the platform including entry ramp shall be approximately 130′ plus additional length for site distance considerations (Figure 9-37) which should include:

  - 20′ to 30′ incline (1:20) slope for entry close to the intersection; this should vary depending on the curb height
  - 25′ minimum fare collection area
  - 70′ boarding/unloading and waiting area
  - 3′ gateway zone

  When there is a left turn at the intersection the length of the platform including entry ramp shall be approximately 200′ or greater (Refer to Figure 9-38) which should include:

  - 25′ incline (1:20 slope) for entry close to the intersection; this should vary depending on the curb height
  - 25′ minimum area for bike racks/lockers
  - 25′ minimum fare collection area
  - 120′ boarding/unloading and waiting area
  - 3′ gateway zone

Figure 9-39 includes an optimum center running station platform accommodating two articulated buses in each direction.

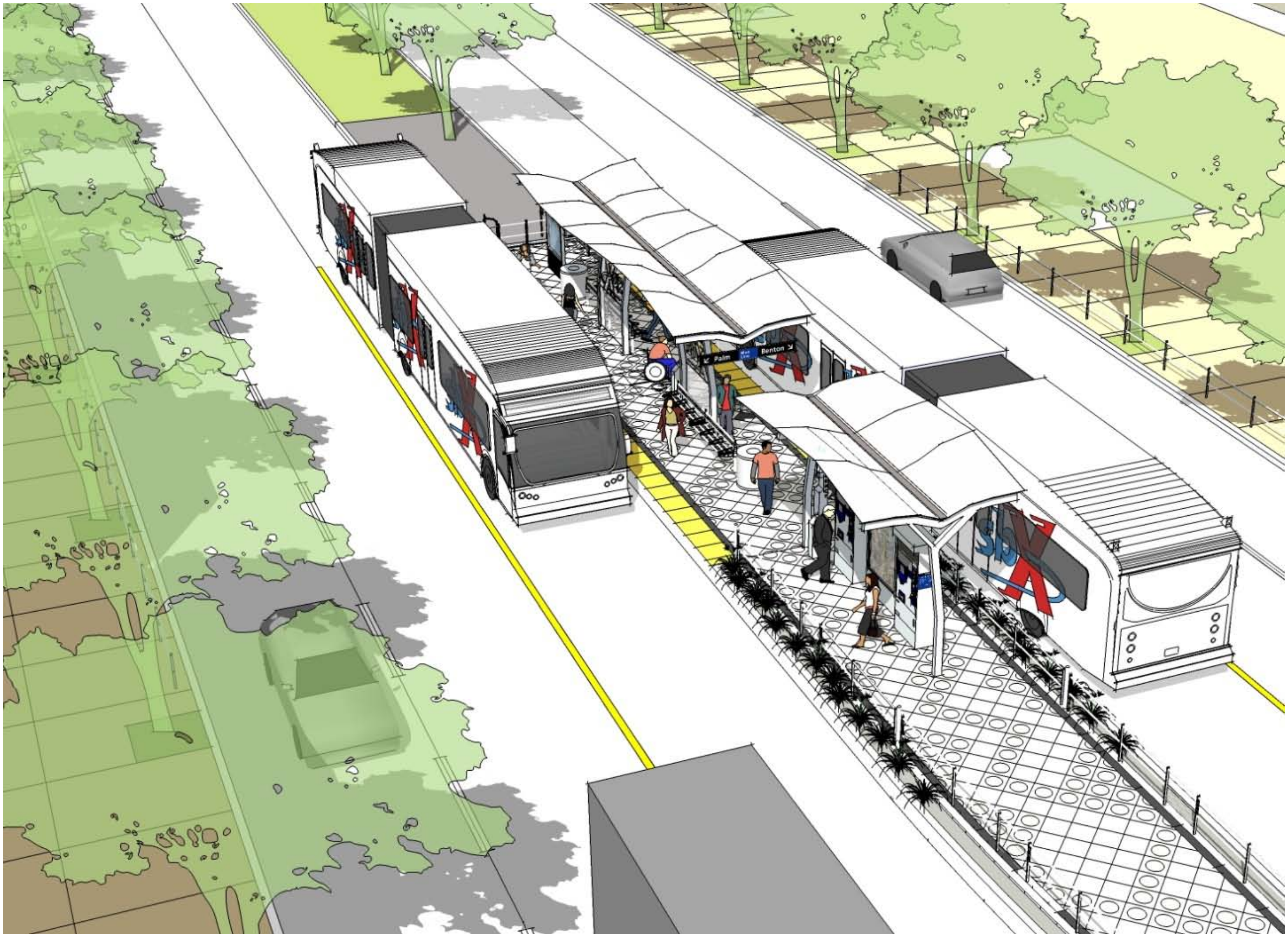


Figure 9-34: Center Running Station Location

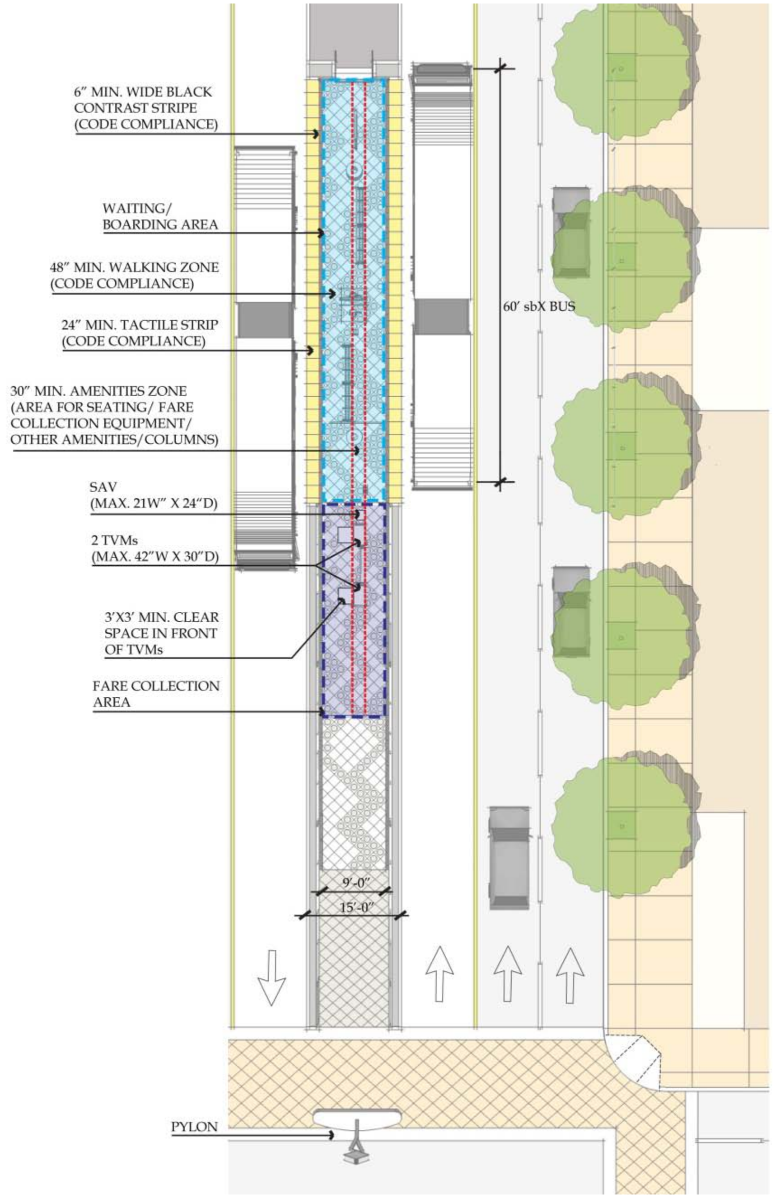


Figure 9-35: Optimum Center-Running Station Platform Plan

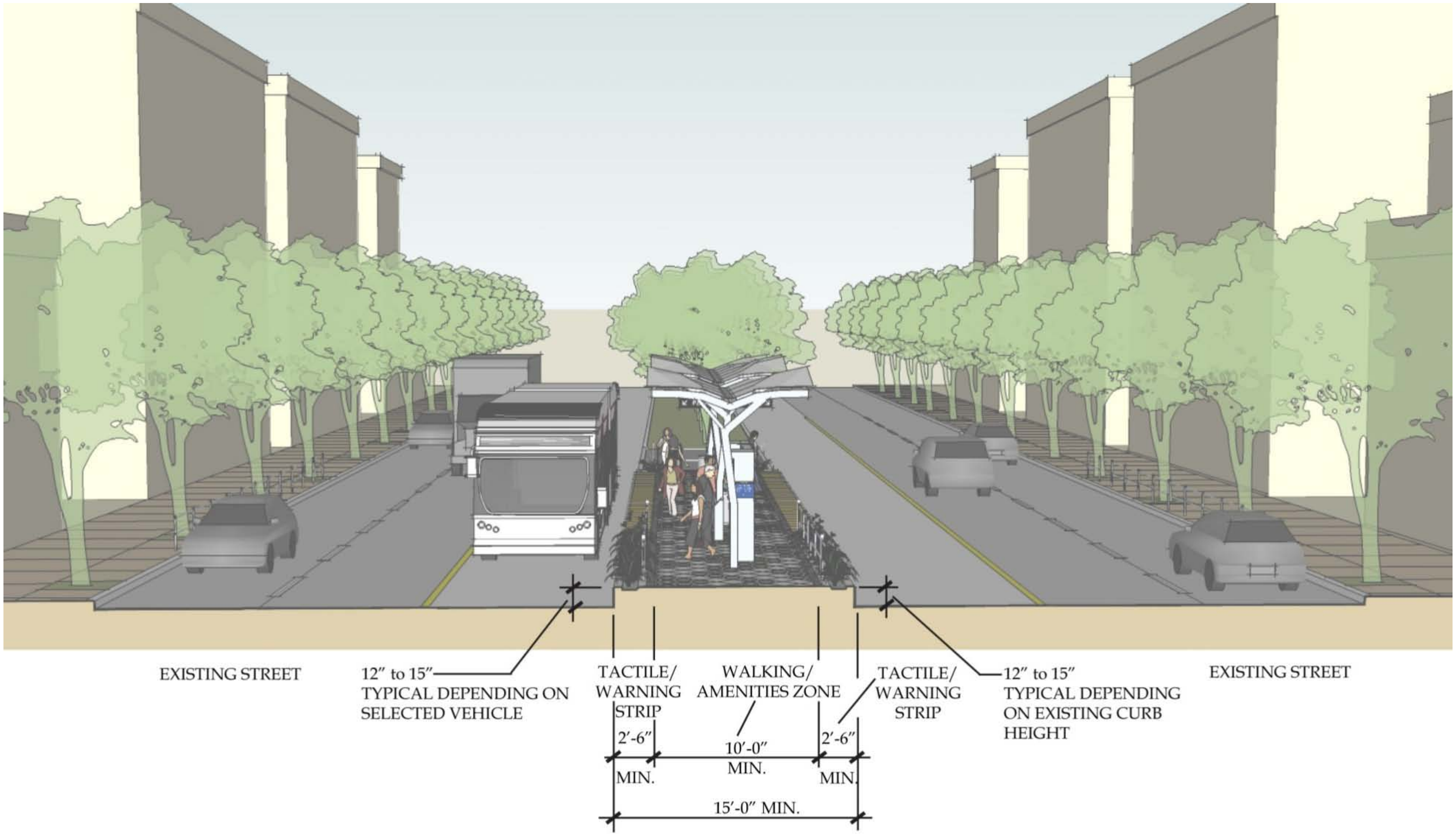


Figure 9-36: Optimum Center-Running Station Platform Section

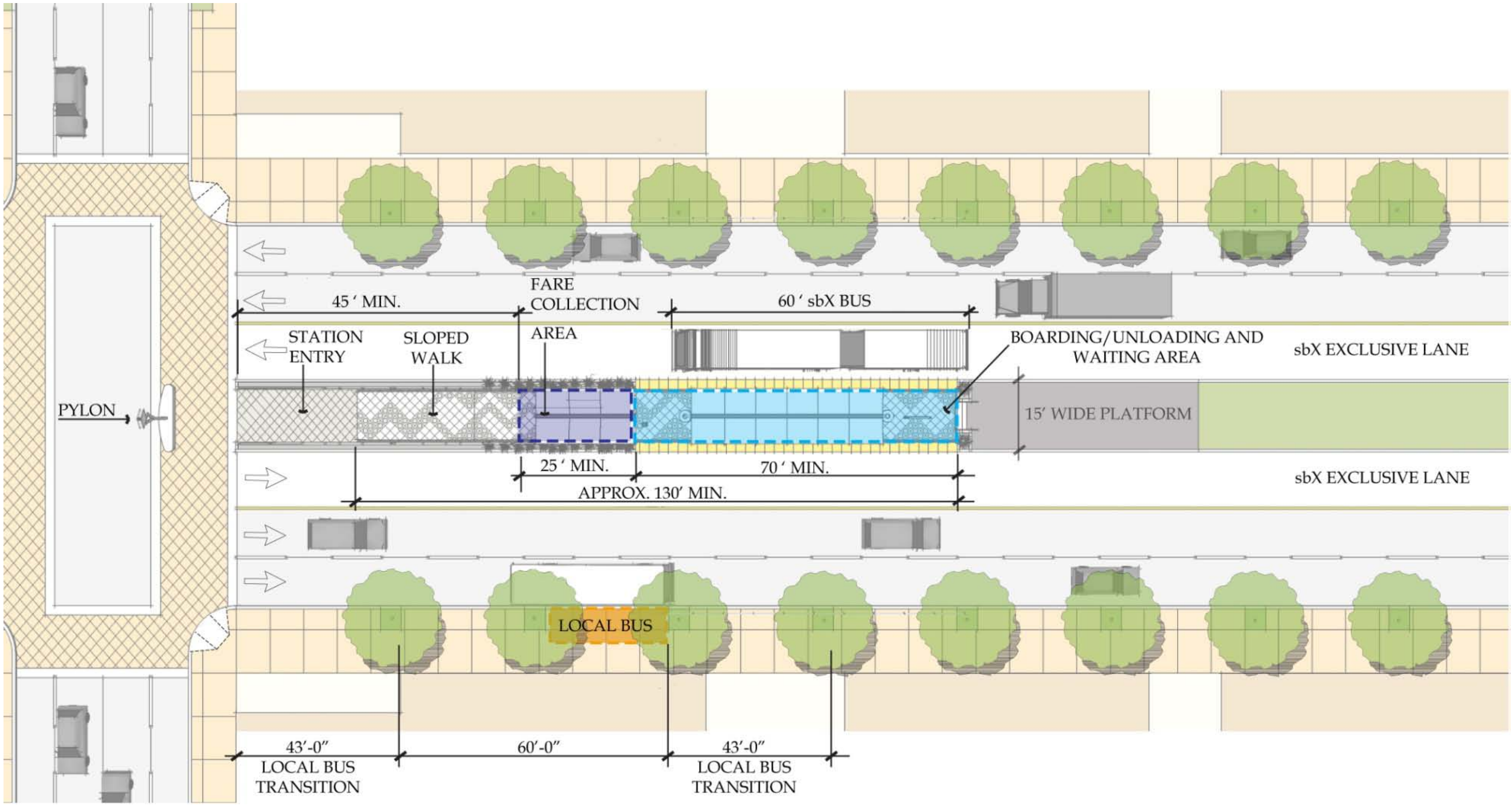


Figure 9-37: Desired Center Running Station Platform length for one sbX bus

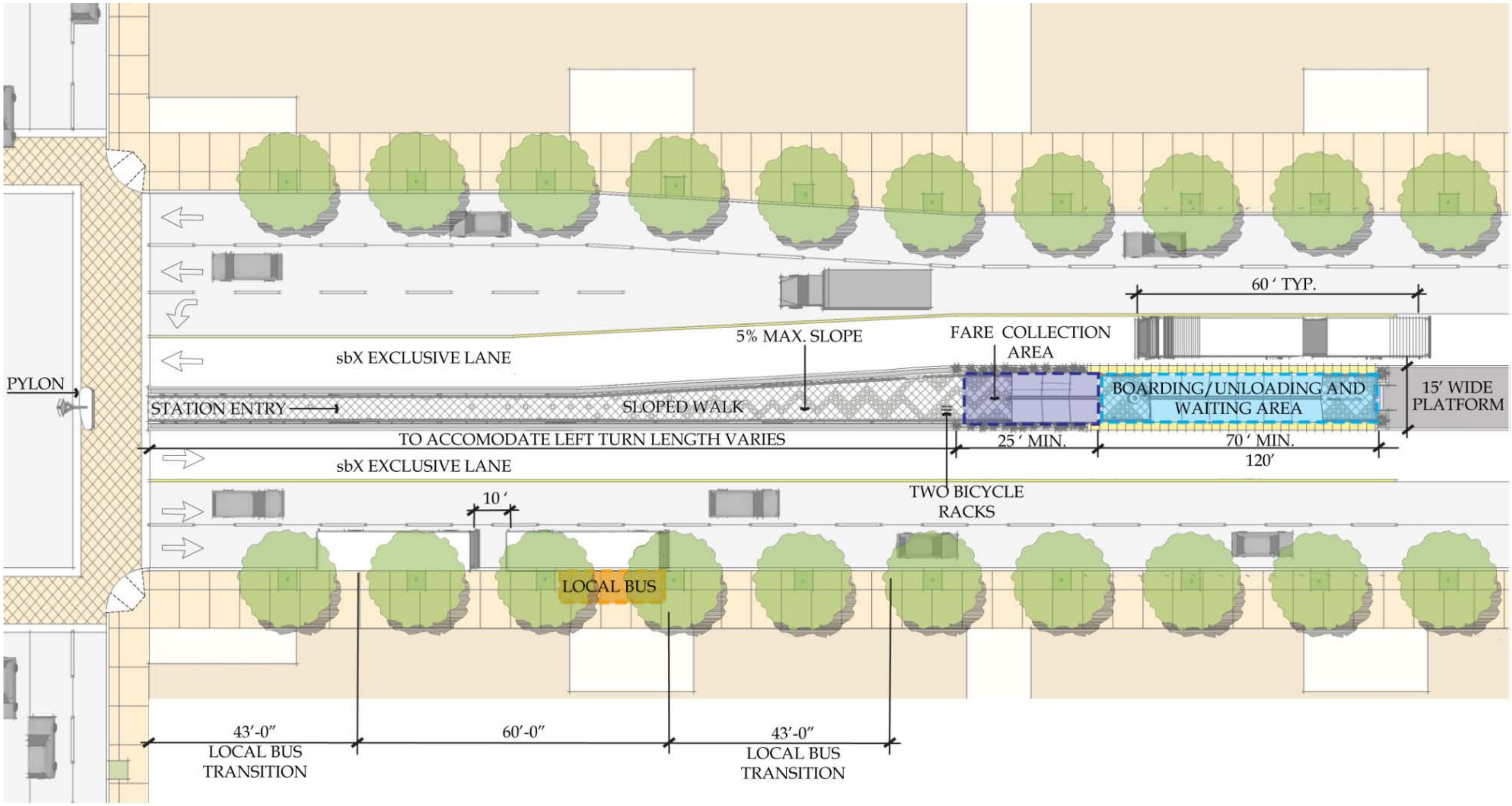


Figure 9-38: Center Running Stations Platform length with left turn at intersection

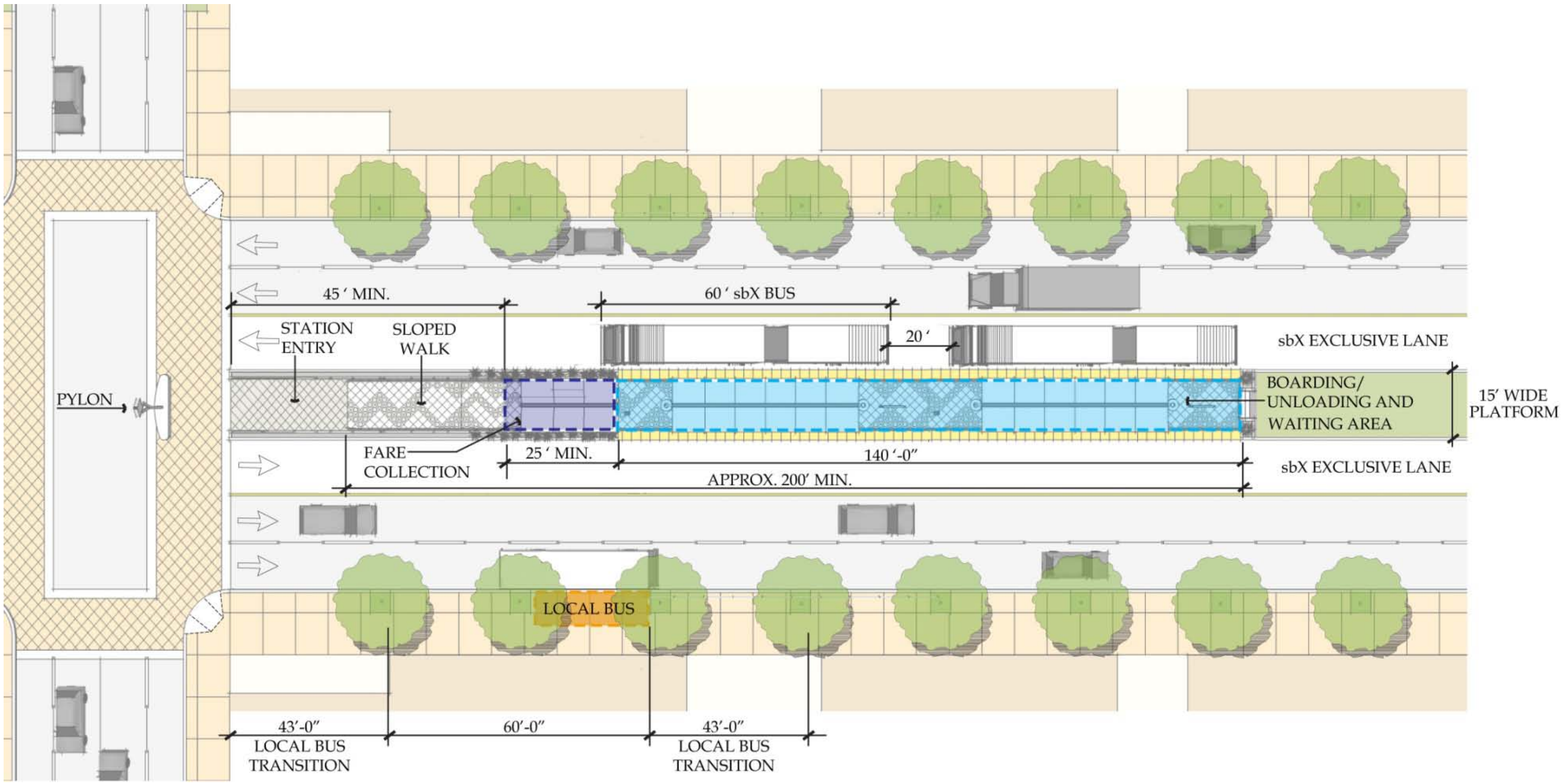


Figure 9-39: Optimum Center Running Stations Platform length to accommodate two buses at the platform

- **Ramp adjacent to the left turn lane** – To accommodate a left-turn lane, the walking distance from an intersection to the center running station is often 100′ (Figure 9-38). To discourage passengers from walking across the street outside the crosswalk, consideration should be given for:
    - A fence located 18″ from the curb on both sides of the ramp. Planting would be provided in the 18″ area
    - A low solid barrier 18″ from the curb on both sides
    - Trees planted on one side with a fence or barrier on other
- **Platform cross-slopes** –Platforms should have minimum and maximum cross-slopes of 1% and 2% respectively sloping towards the roadway (bus lanes or mixed-flow lanes), and a maximum longitudinal slope of 2%.

Architectural Character

The center running station pylon and contemporary curved canopy and supporting tree-like columns in the center of the platform brand the sbX system. Wind and shade panels between the center column contain the sbX logo, the station name and in some cases individual artwork. Decorative paving, benches, a low transparent fence landscape planting and other transit amenities add to the sense of place. Figures 9-40 and 9-41 show the architectural character of a center running station.

Photos of Green Line when constructed	Photos of Green Line when constructed

Figure 9-40: Photos of Constructed Green Line

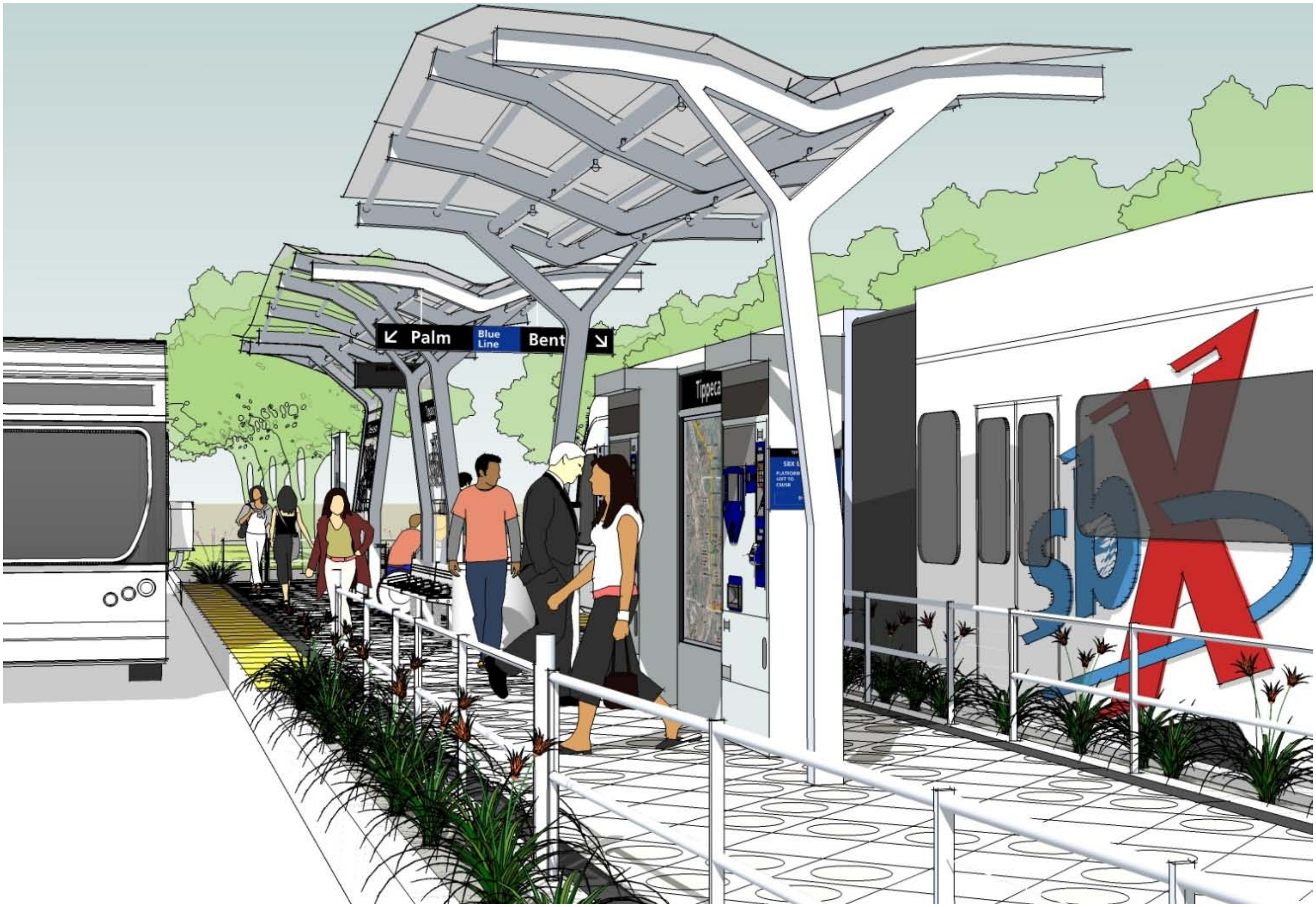


Figure 9-41: Architectural Character of Center Running Station

9.13.4 Specialty Stations

Platforms

- Specialty stations should be a custom design using the kit-of parts and platform components from the side and center running stations.

Station Amenities

- Station amenities should be determined based on the individual station requirements using the side and center running station requirements listed in Table 9-1, as guidelines.

Table 9-1: Comparison of Amenity Components at Each Station

	On-Street Side Running Split Platform Station		Center Running Station	
	Optimum	Minimum	Optimum	Minimum
Platform Length including entry ramp	130′ per split station	96′to 107′ per split station	200′	130′, may be greater to address site distances
Platform Length	95′	75′	145′	95′
Platform Width	18′ including a 6′ walkway behind shelter per split station	13′- 6″ including a 4′ walkway behind shelter per split station	15′	15′
Fare Collection Equipment	Two TVMs and One SAV per split station	Two TVMs and One SAV per split station	Two TVMs and One SAV	Two TVMs and One SAV
Trash Receptacle	Two per split station	Two per split station	Three	Two
Advertising Panel	One double -sided back lit per split station	One double-sided back lit per split station	One double-sided back lit	One double-sided back lit
Signage	One single -sided back lit map case per split station	One single-sided back lit map case per split station	One double sided and one single-sided back lit map case	One single sided map case
Bike Racks	Located near station platforms on existing sidewalks or transit plaza to facilitate easy transfer	Located near station platforms on existing sidewalks or transit plaza to facilitate easy transfer.	Located near station platforms on existing sidewalks or transit plaza to facilitate easy transfer.	Located near station platforms on existing sidewalks or transit plaza to facilitate easy transfer.

9.13.5 Station Structural Design

The major structural components include boarding canopy, fare collection canopy, wind/shade screen, spread footing, PCC platform, and pylon footing. Other minor structural components include concrete formed planter, precast wall panel, stairway, and etc. The "kit-of-parts" modular design of the stations benefits cost effectiveness in design, construction and future maintenance.

The station structural design will conform to 2007 California Building Code as stated in the Codes and Standards Section of this document. A list of frequently cited design codes and standard by the 2007 CBC is as follows:

- **ASEC 7-05** – Minimum Design Loads for Buildings and Other Structures by American Society of Civil Engineers
- **AISC 360-05** – Specification for Structural Steel Buildings by American Institute of Steel Construction
- **ACI 308R-06** – Design of Slabs-on-Ground by American Concrete Institute
- **ACI 318-05** – Building Code Requirements for Structural Concrete by American Concrete Institute

The important design classifications and parameters for station structures are listed as followed:

- Structural Occupancy Category II – Important Factor (I) of 1 for all design loads.
- Live load: Platform – 100 psf; Roof – 5 psf or one 300 pound concentrate load whichever is greater
- Wind Load (per Project Site): Basic Wind Speed is 85 mph (3 second gust); Exposure Category C per ground surface condition; station structural profile is less than 15' height above ground; structural type is classified as rigid and open structure with mono-sloped or troughed roofs.
- Seismic Load (per Project Site): Seismic Site Class D; Seismic Response Spectrum per Geotechnical recommendation; structural type is classified as Cantilever Column System.

9.13.6 Designing sbX Stations

In designing an sbX line and its stations, some of the key decisions will be the station location, the type of running-way, and the number of vehicular lanes. Another consideration is whether the station will be a temporary station or a high ridership station, and the appropriate level of amenities to be provided.

Once preliminary station locations are determined and if the station is to be located close to a major intersection, the next step is to investigate site conditions at each of the four quadrants of the intersection. This assessment includes right-of-way availability, adjoining uses, and platform and distance criteria to determine a more likely precise location for the station. If a specialty station, site conditions and the above also will need to be explored in addition to unique elements.

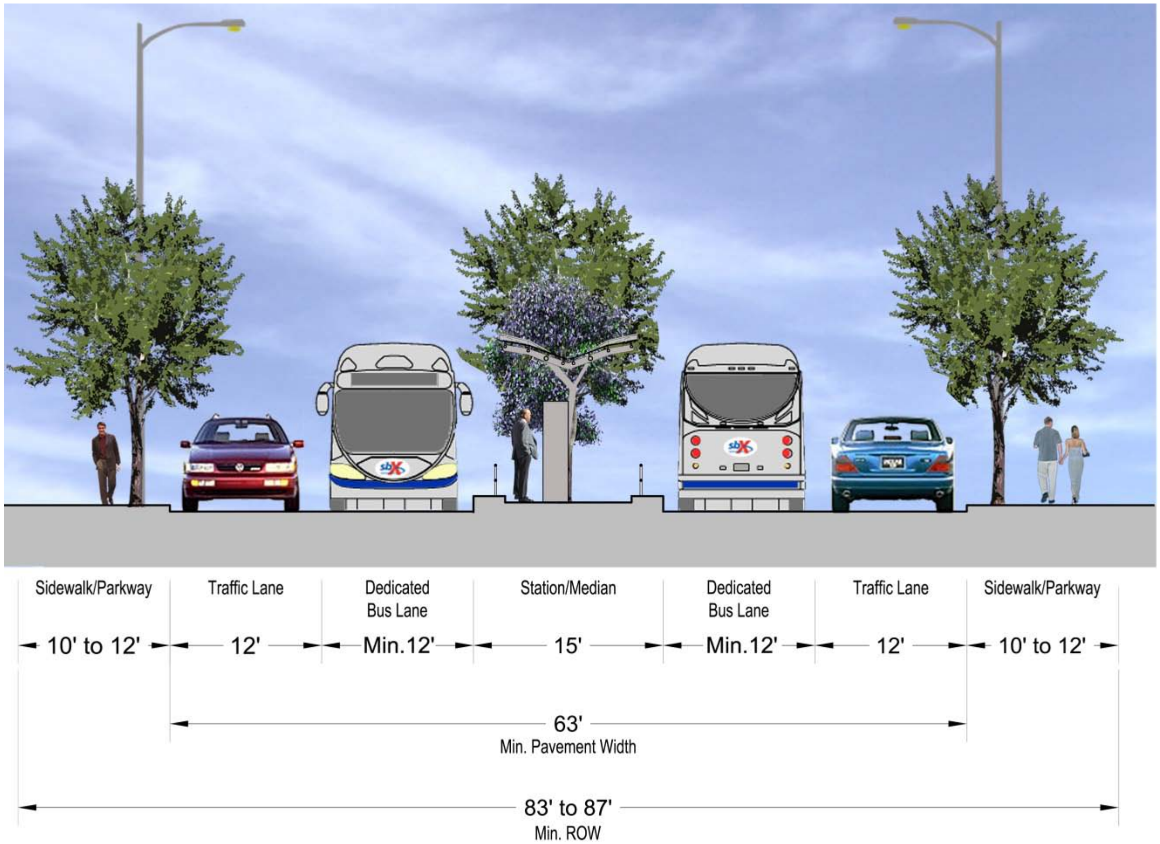
Next, the desired station type and kit-of-parts would be considered for each station site. Appendix B lists the station types and the components of the kit-of-parts that can be used by Omnitrans, the City and the station designers in determining the appropriate components. Site conditions, sun orientation, wind condition and unique community requirements and input effect the selection of a kit-of-parts. For example, the City may have an ordinance not permitting advertising that would eliminate the advertising panel.

The actual design for the station will require the procurement by the transit agency for architectural design and engineering to prepare preliminary through final construction drawings. Cities and developers would provide input into the process. Figure 9-42 includes photos of the constructed Green Line. Figures 9-44 through 9-59 are sections showing conceptually the minimum amount of right-of-way to accommodate sbX at stations under various conditions.

Future Photos of Constructed Green Line	Future Photos of Constructed Green Line

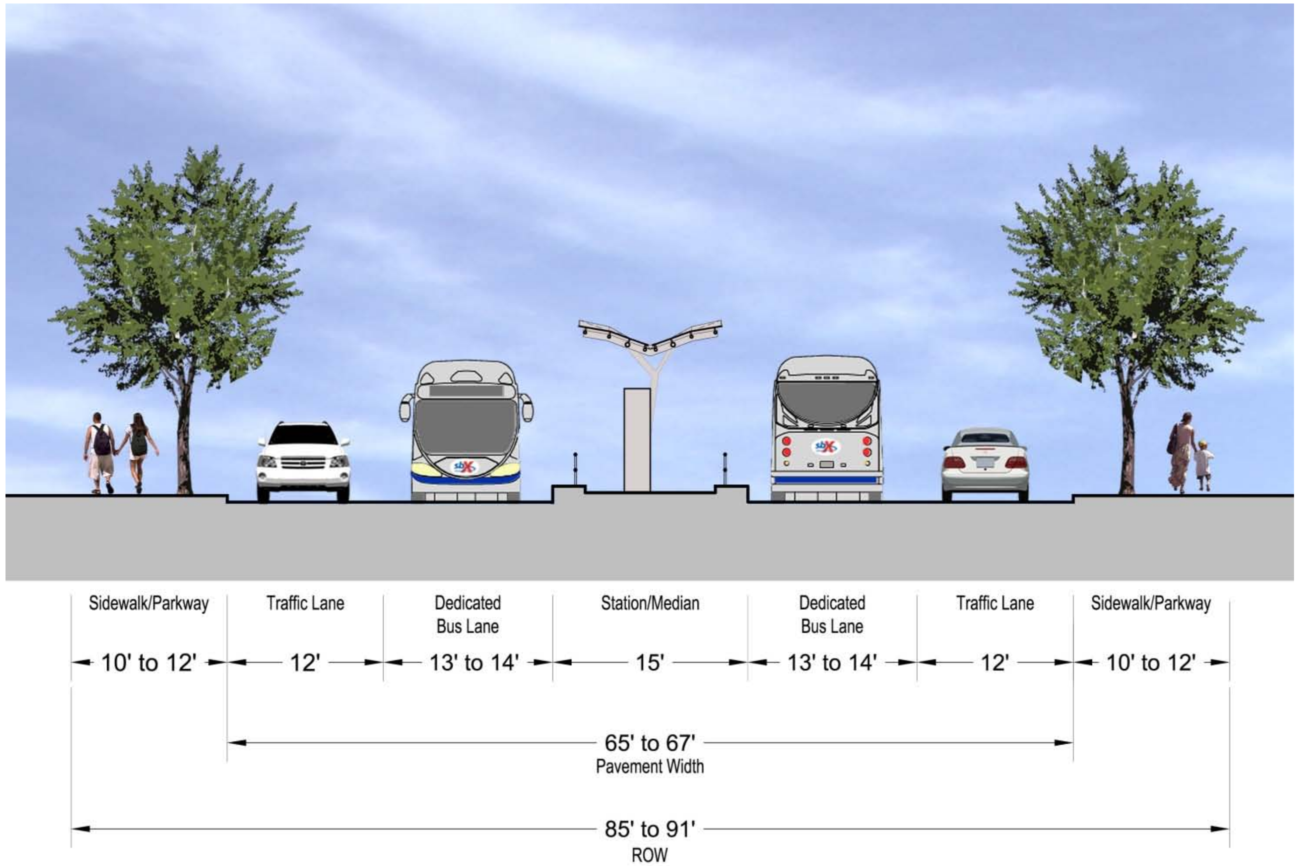
Figure 9-42: Photos of Constructed Green Line

CENTER RUNNING CONFIGURATION AT STATION



*Note: At local bus stops pavement width and right-of-way may be greater than shown.

Figure 9-43: Option 1 – Minimum Center Running right-of-way with consolidated station configuration, min. 12′ dedicated bus lane and with one lane of traffic in each direction



*Note: At local bus stops pavement width and right-of-way may be greater than shown.

Figure 9-44: Option 1 – Optimum Center Running right-of-way with consolidated station configuration, max. 13′ to 14′ dedicated bus lane and with one lane of traffic in each direction

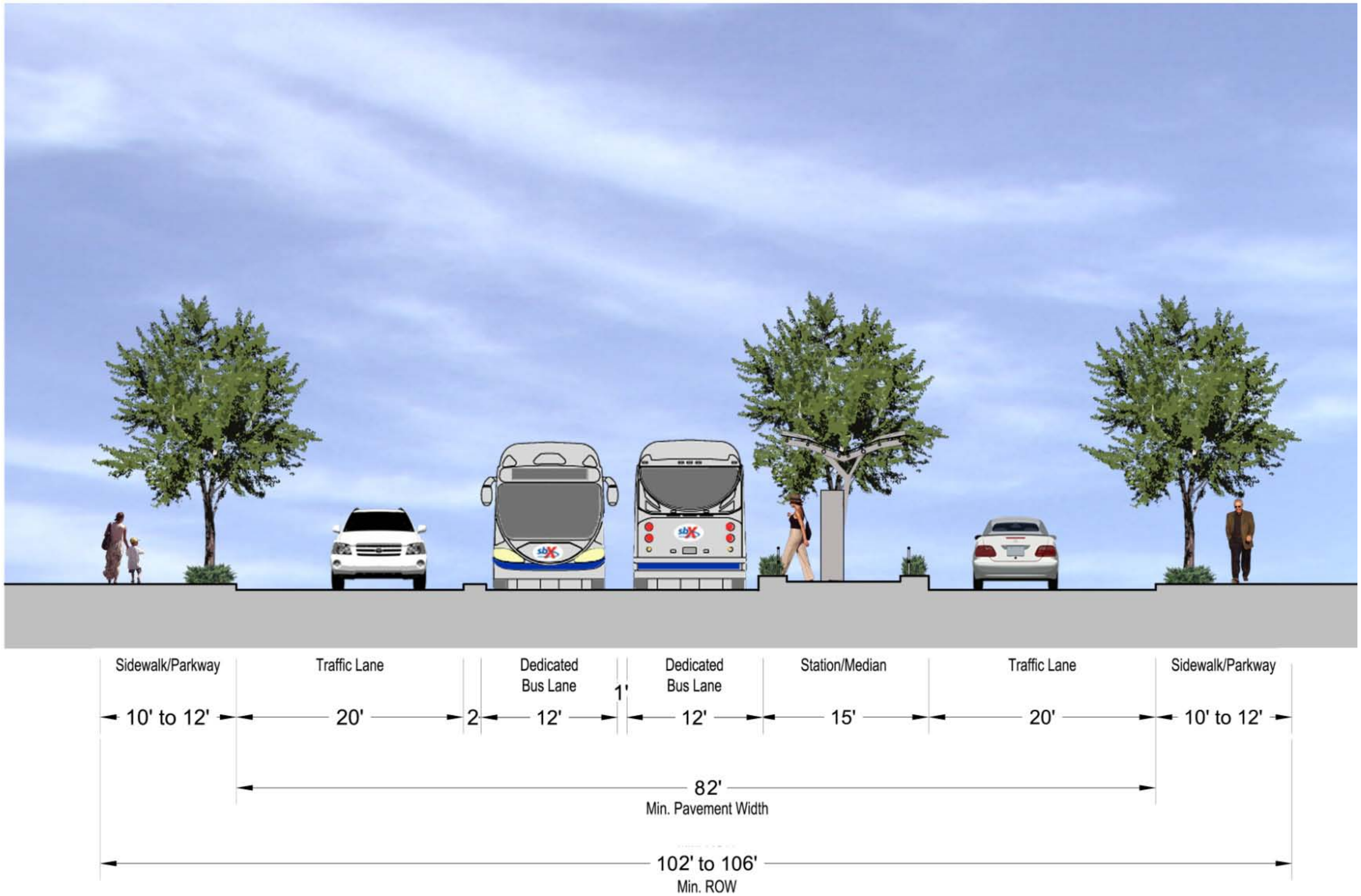


Figure 9-45: Option 2 – Minimum Center Running right-of-way with split station configuration, min. 12′ dedicated bus lane and with one lane of traffic in each direction. Add 12′ for each additional lane of traffic in each direction.

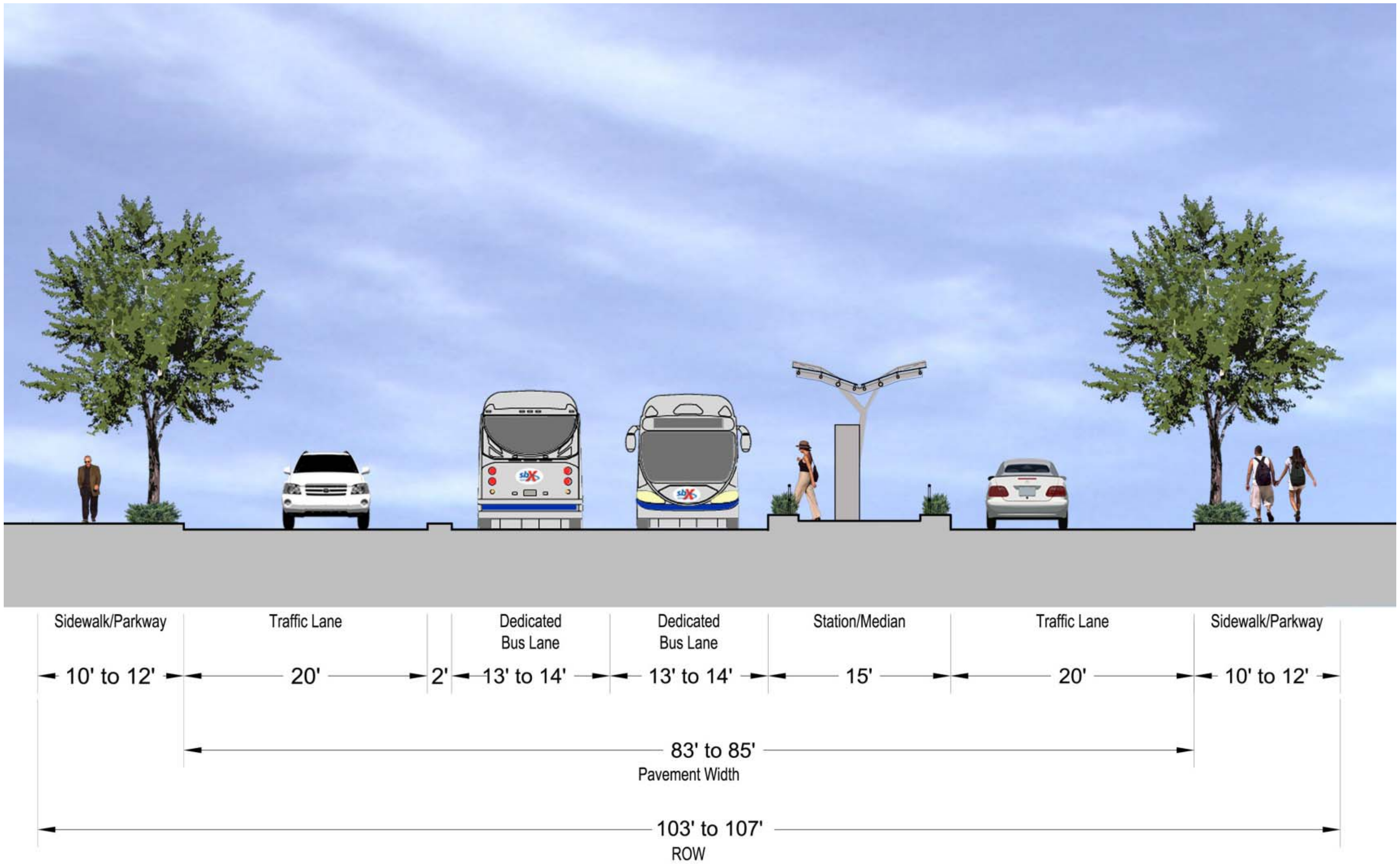


Figure 9-46: Option 2 – Optimum Center Running right-of-way with split station configuration, max. 13′ to 14′ dedicated bus lane, and with one lane of traffic in each direction. Add 12′ for each additional lane of traffic in each direction.

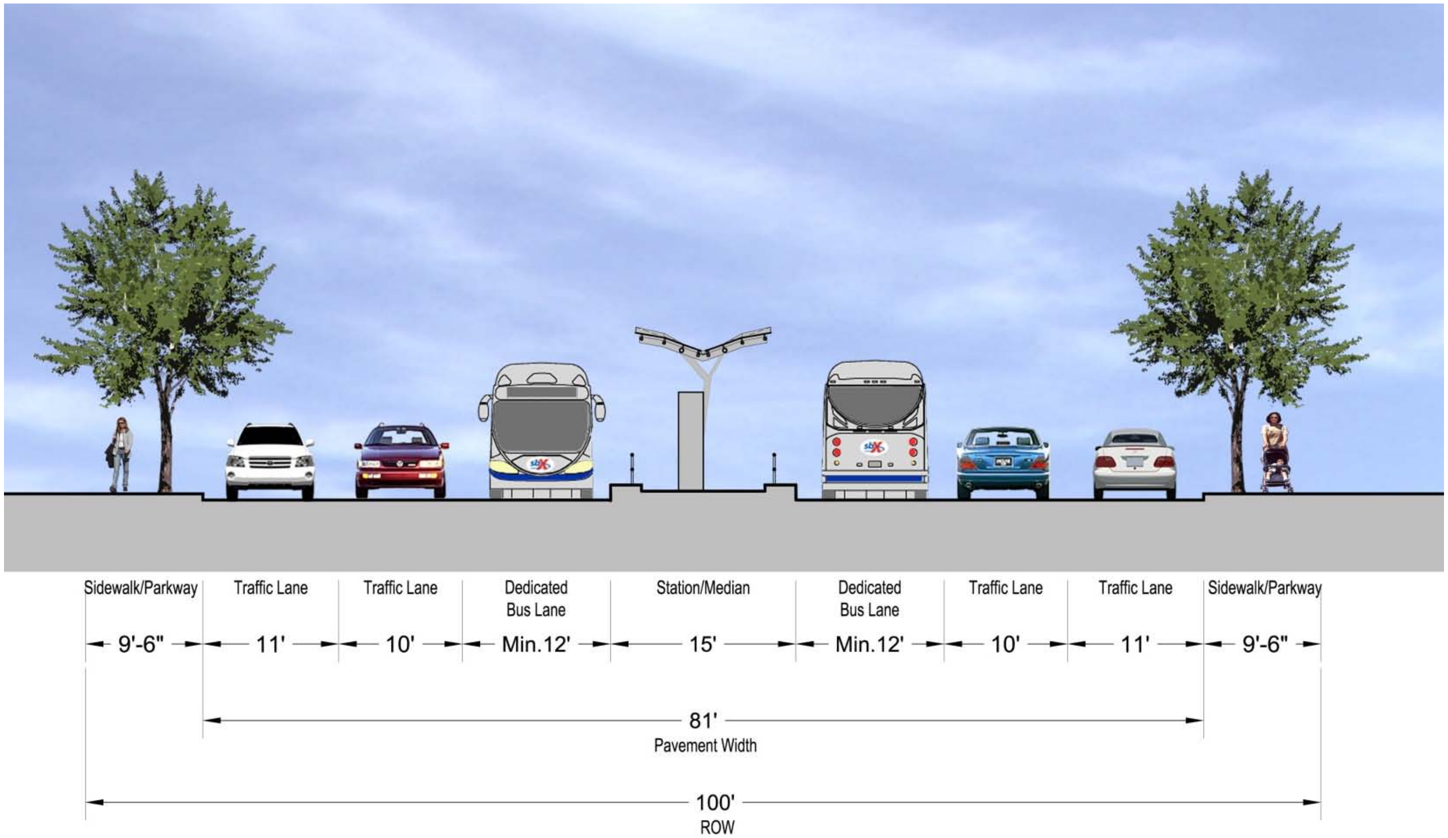
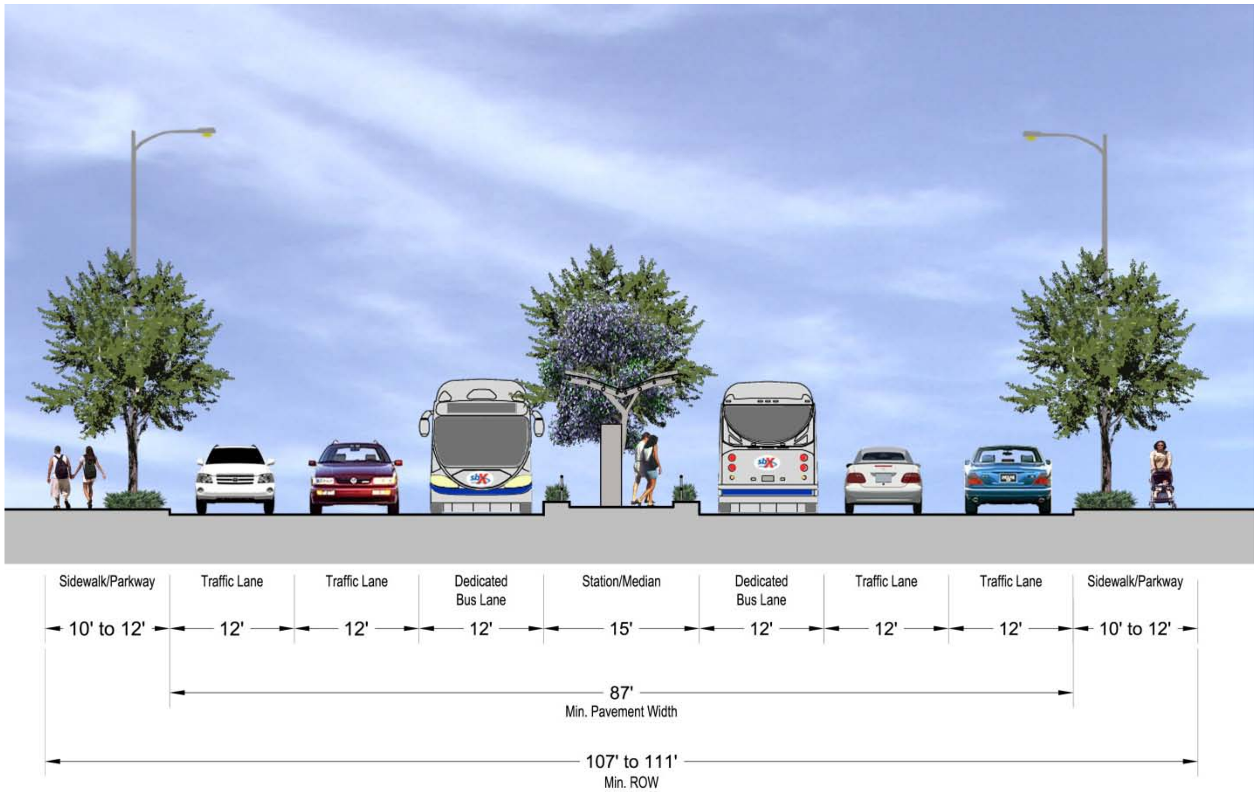


Figure 9-47: Option 1 - Center Running Consolidated station configuration within 100' ROW, min. 12' dedicated bus lane and two lanes of traffic (with reduced standard lane widths) in each direction



*Note: At local bus stops pavement width and right-of-way may be greater than shown.

Figure 9-48: Option 1 – Optimum Center Running Consolidated station configuration, min. 12′ dedicated bus lane and two lanes of traffic in each direction

CENTER RUNNING CONFIGURATION BETWEEN STATIONS

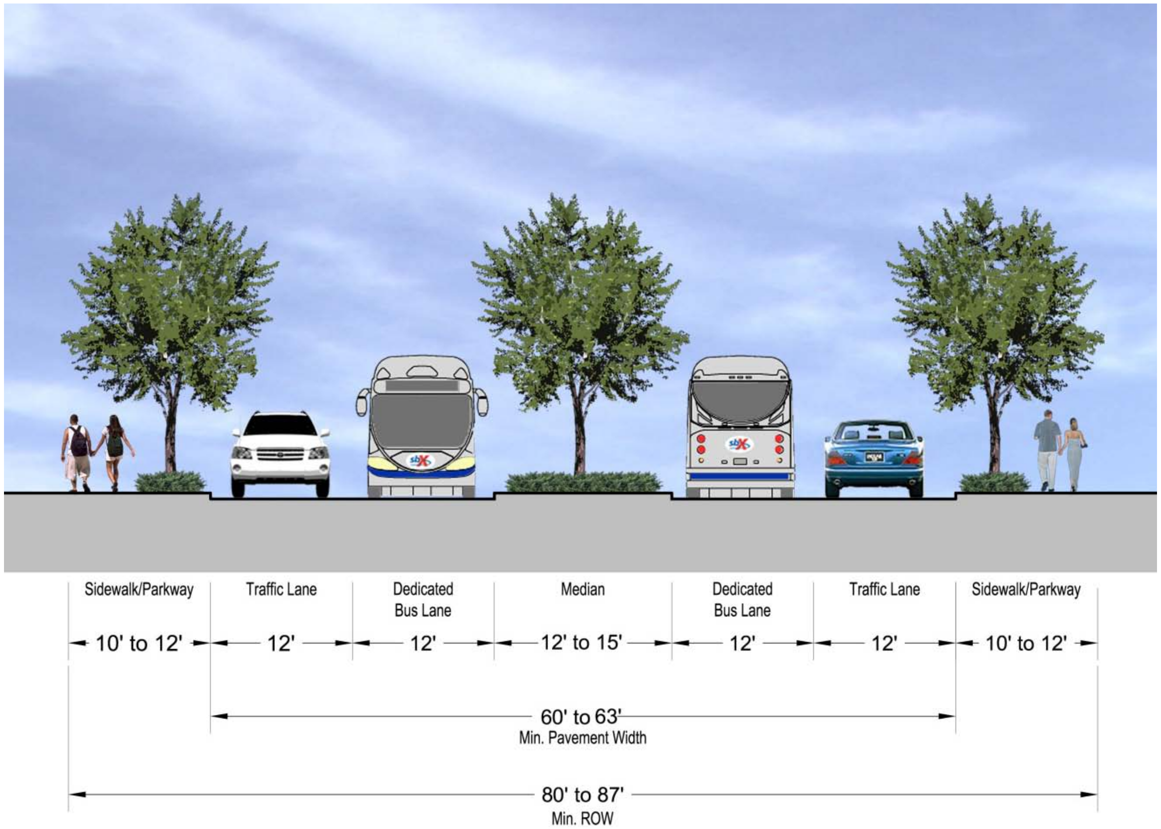
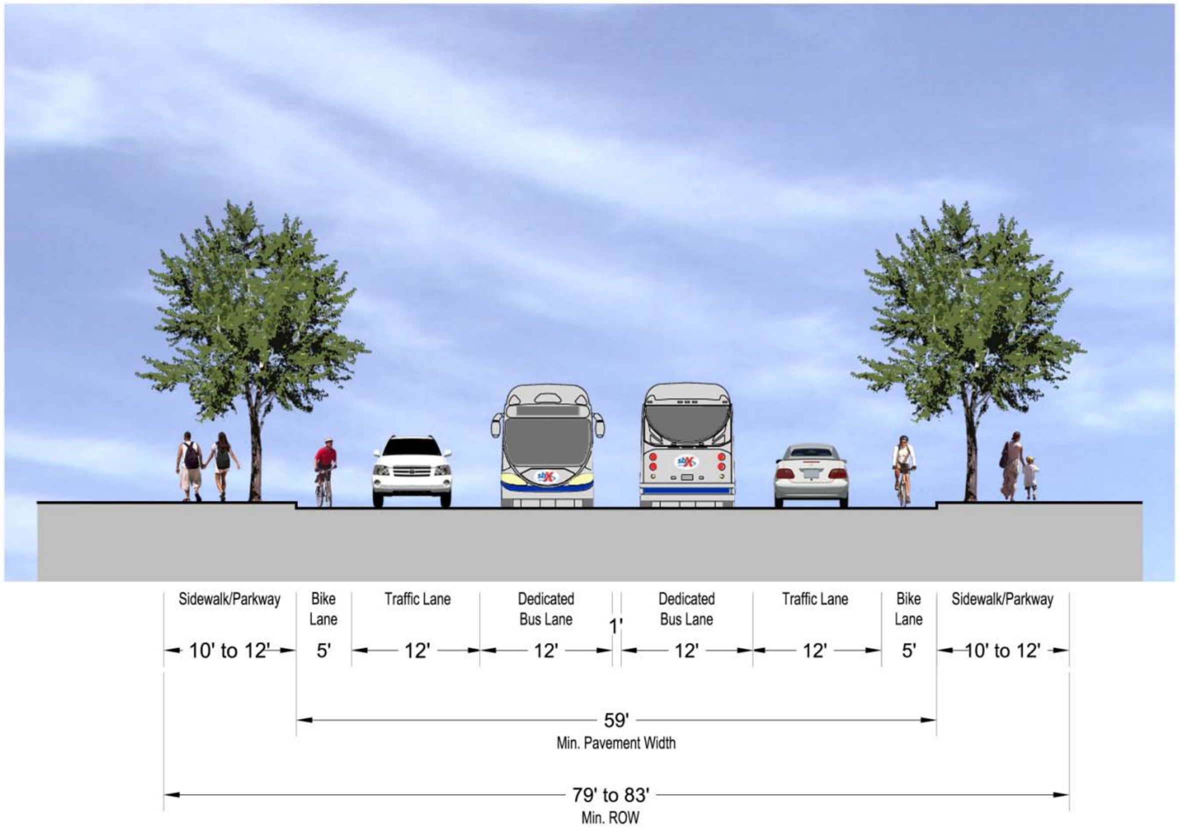
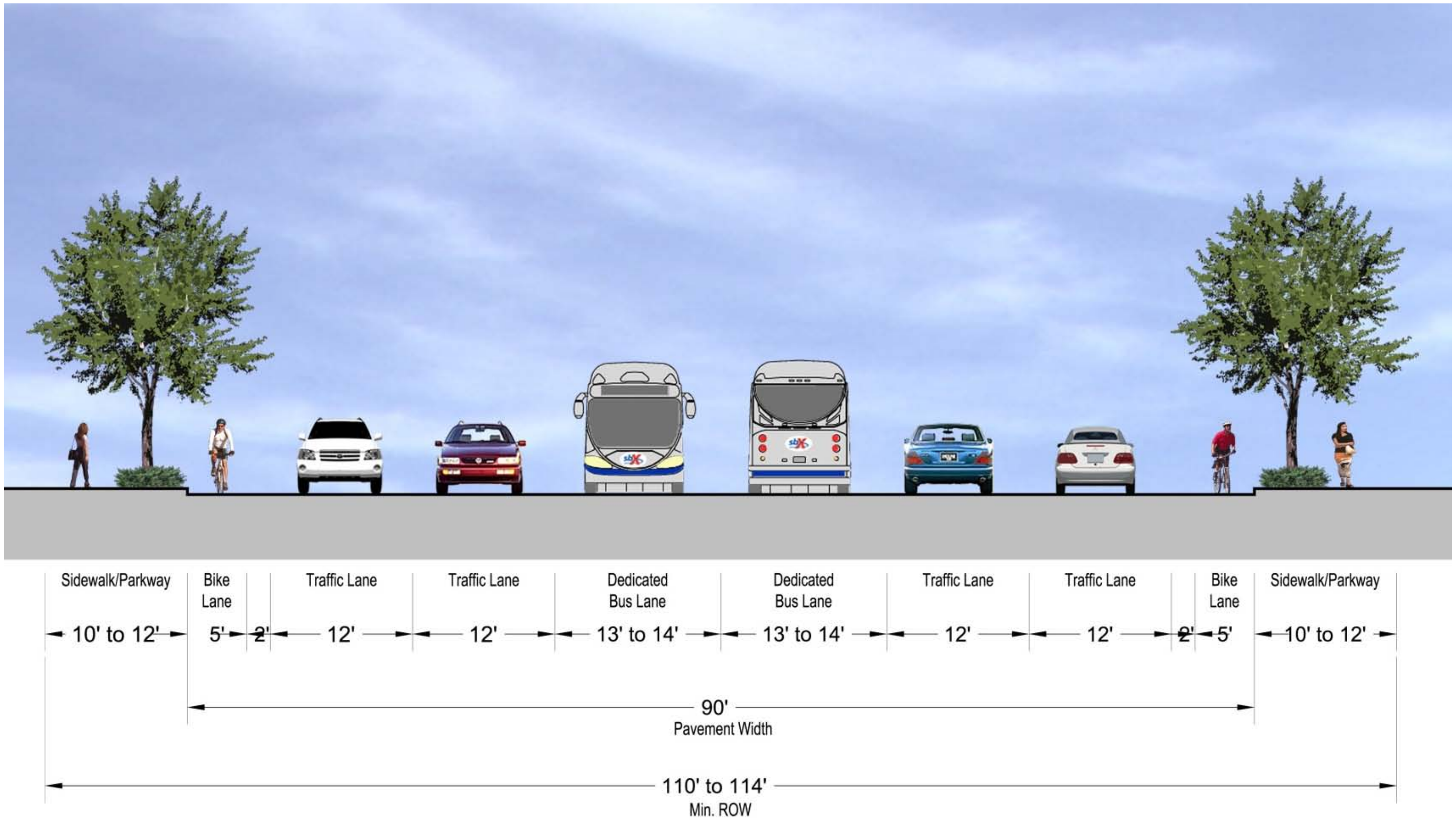


Figure 9-49: Option 1 - Center Running Configuration in between intersections with median, min. 12'dedicated bus lane and one lane of traffic in each direction.



*Note: At local bus stops pavement width and right-of-way may be greater than shown.

Figure 9-50: Option 1 - Center Running Configuration in between intersections with bike lanes, min. 12' dedicated bus lane and one lane of traffic in each direction.



*Note: At local bus stops pavement width and right-of-way may be greater than shown.

Figure 9-51: Option 1 - Center Running Configuration in between intersections with buffered bike lanes on both sides, max. 13' to 14' dedicated bus lanes and two lanes of traffic in each direction

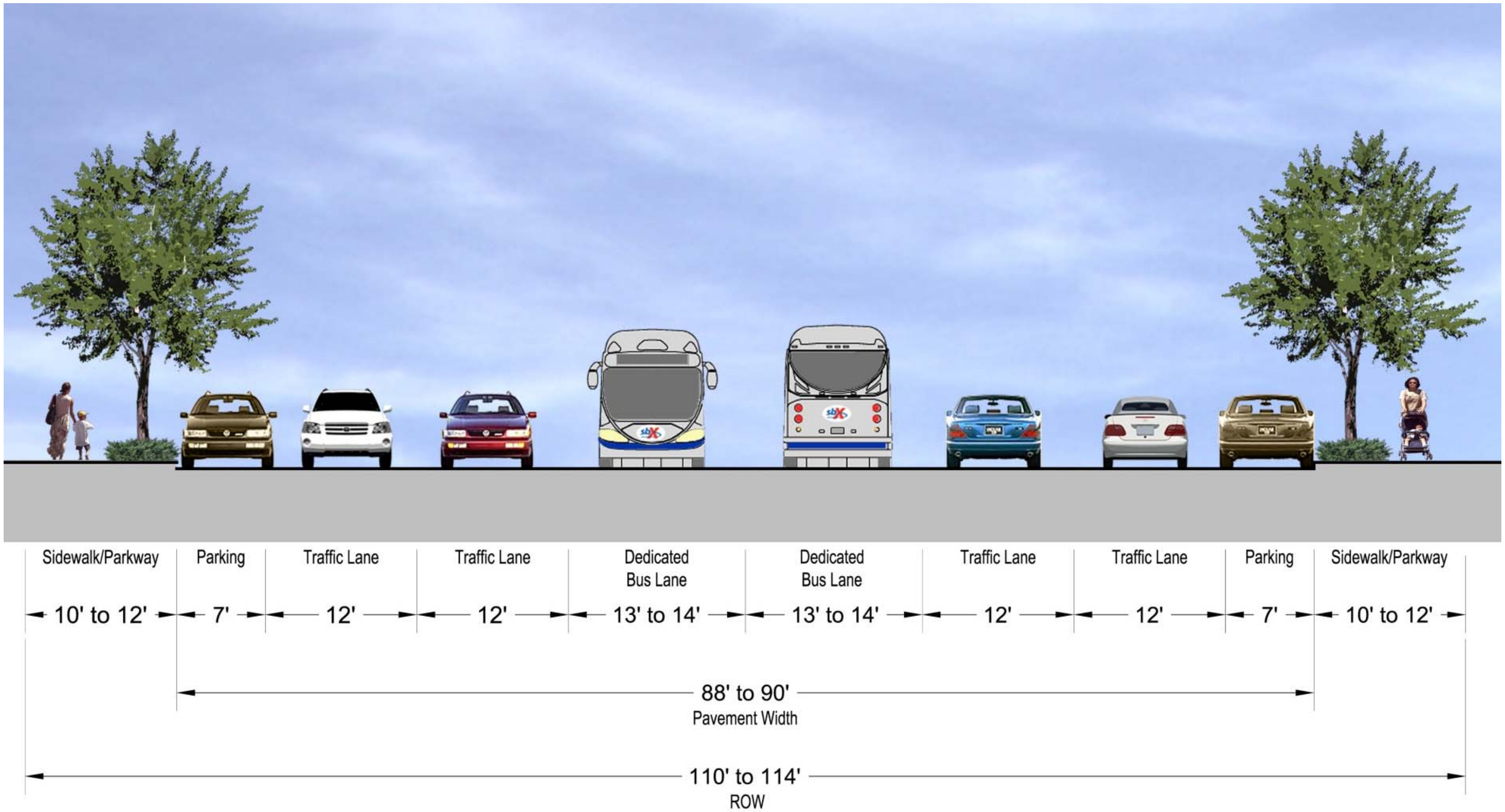


Figure 9-52: Center Running Configuration in between intersections with parking on both sides, max. 13′ to 14′ dedicated bus lane and two lanes of traffic in each direction. The lane widths can be reduced to 11′ and parking can be eliminated on one side, in tight conditions if agreed to be cities.

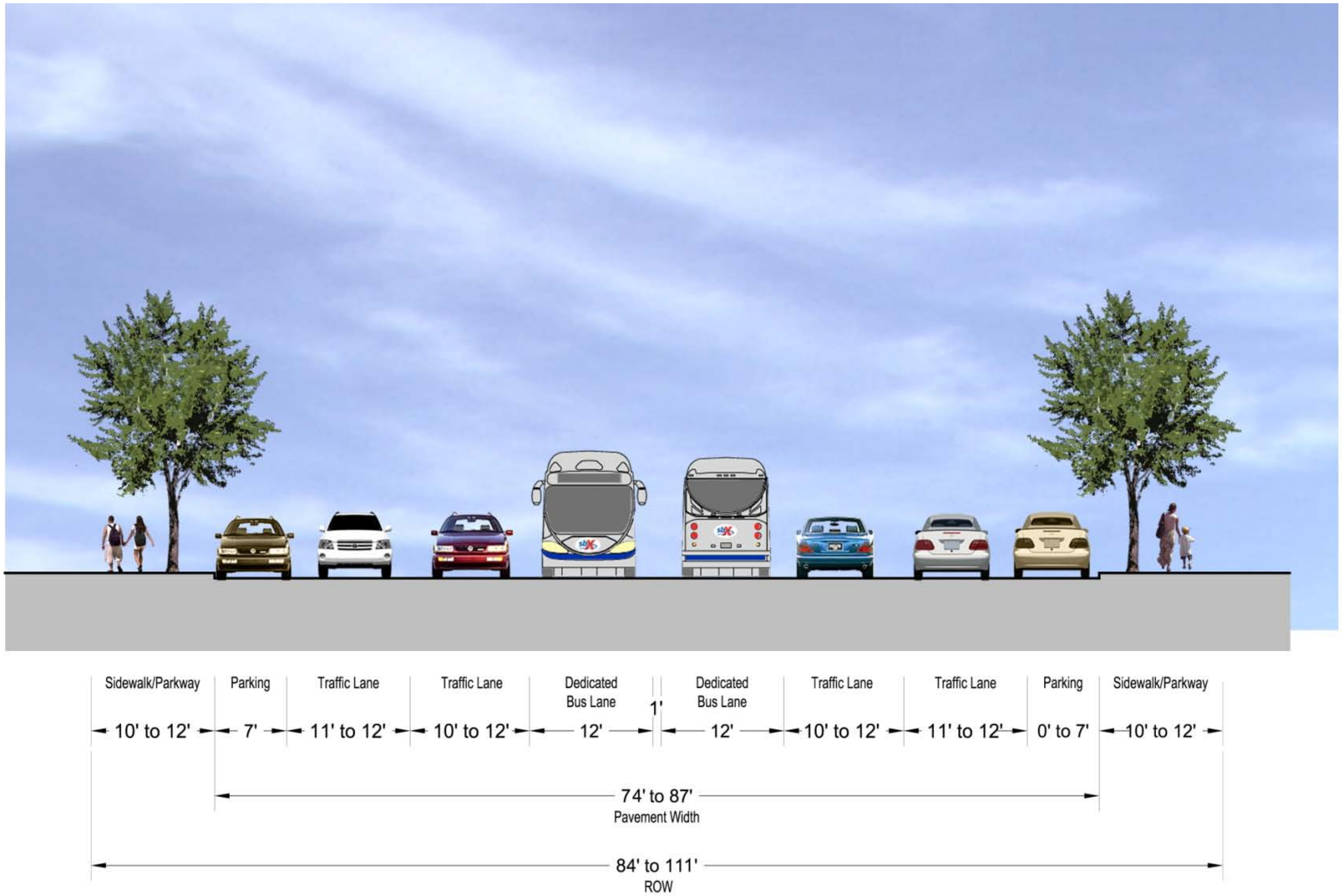
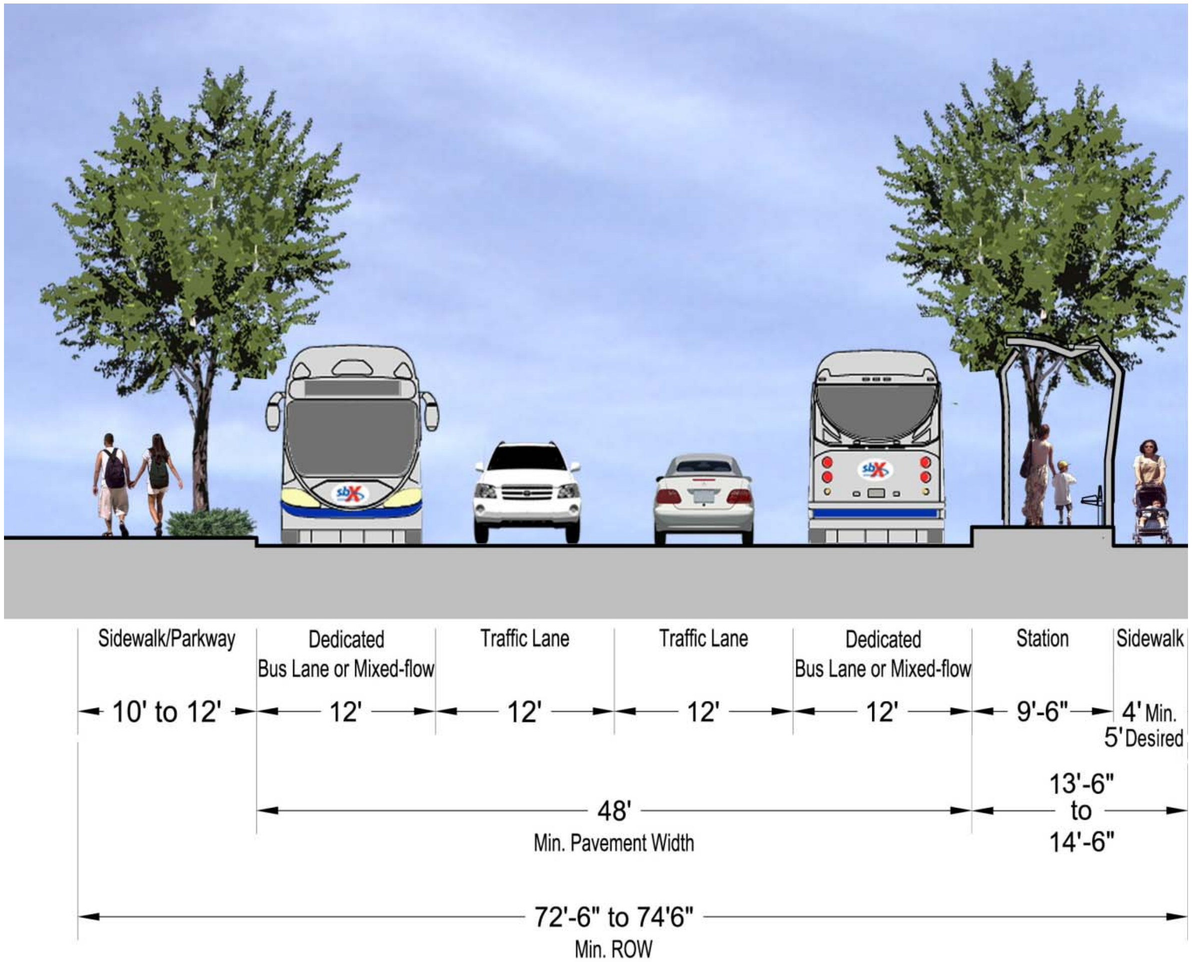


Figure 9-53: Minimum Center Running Configuration in between intersections with parking on both sides, min. 12′ dedicated bus lane and with reduced travel lanes. Parking can be eliminated on one side, if the ROW is less than 100′.

SIDE RUNNING CONFIGURATION AT STATIONS



*Note: At local bus stops pavement width and right-of-way may be greater than shown.

Figure 9-54: Minimum Side Running Station Configuration, min. 12' dedicated or mixed-flow lane and with one lane of traffic in each direction

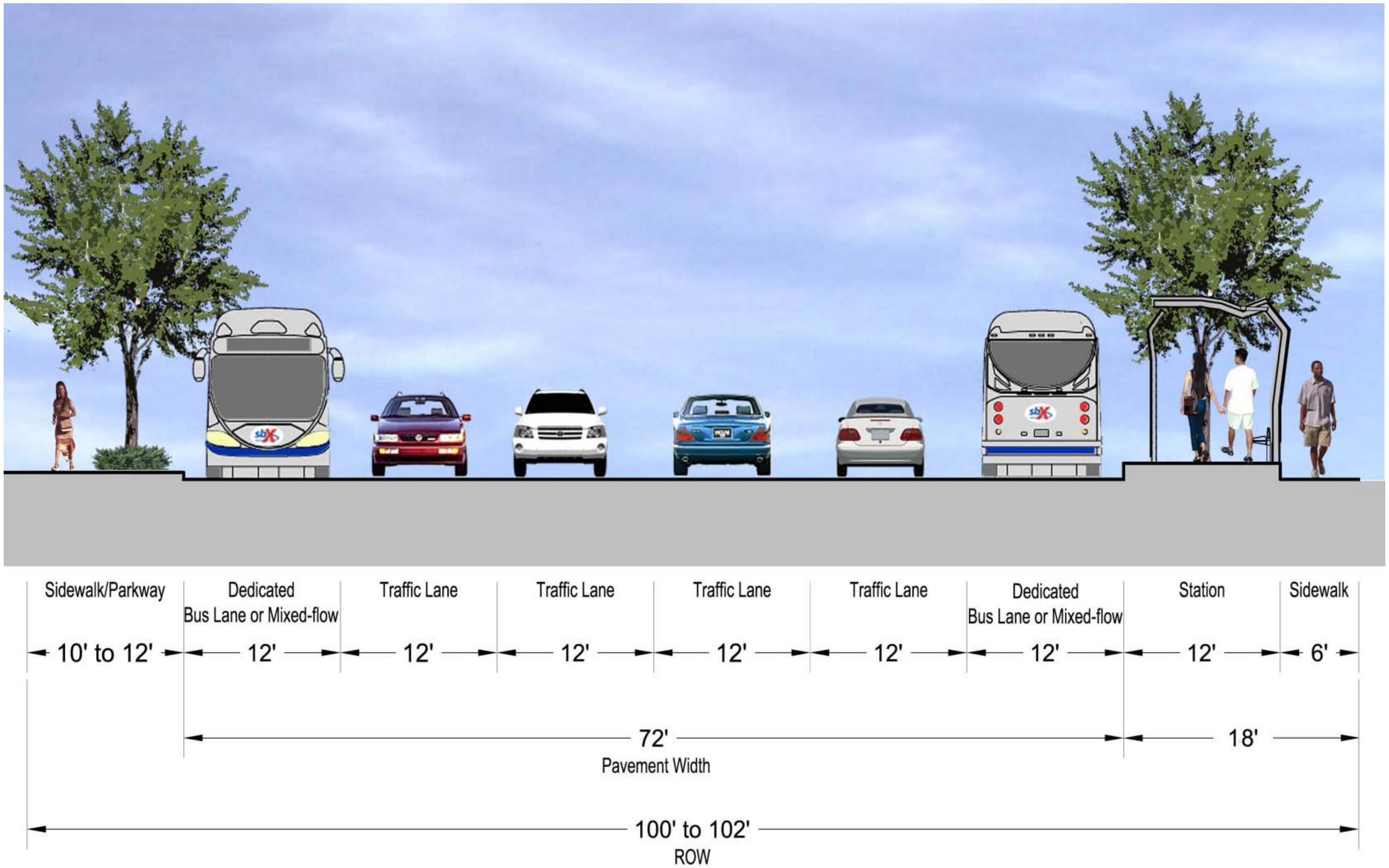


Figure 9-55: Optimum side Running Station Configuration, min.. 12' to dedicated or mixed-flow lane and with two lanes of traffic in each direction

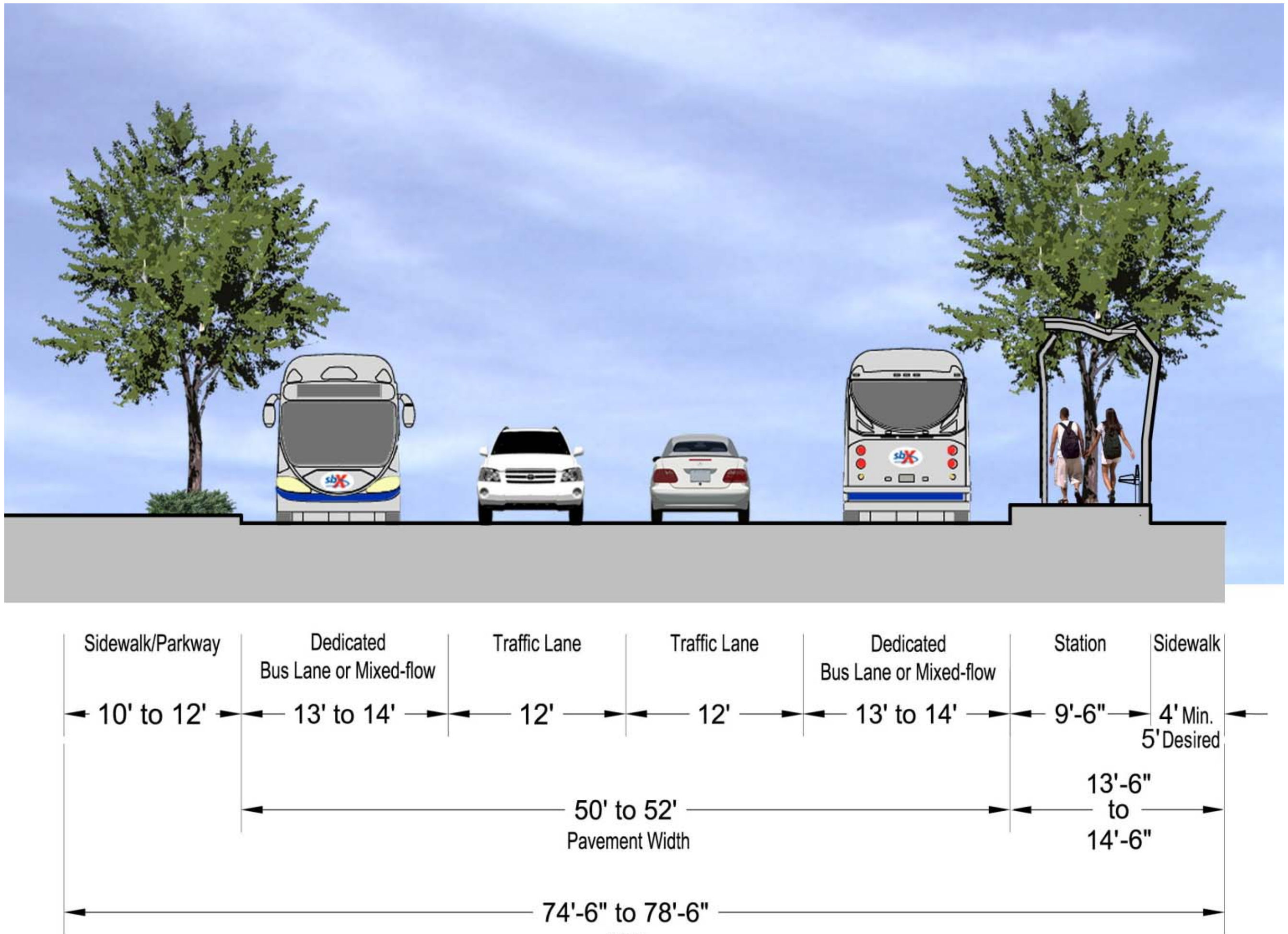


Figure 9-56: Minimum Side Running Station Configuration, max. 13′ to 14′ dedicated or mixed-flow lane and with one lane of traffic in each direction

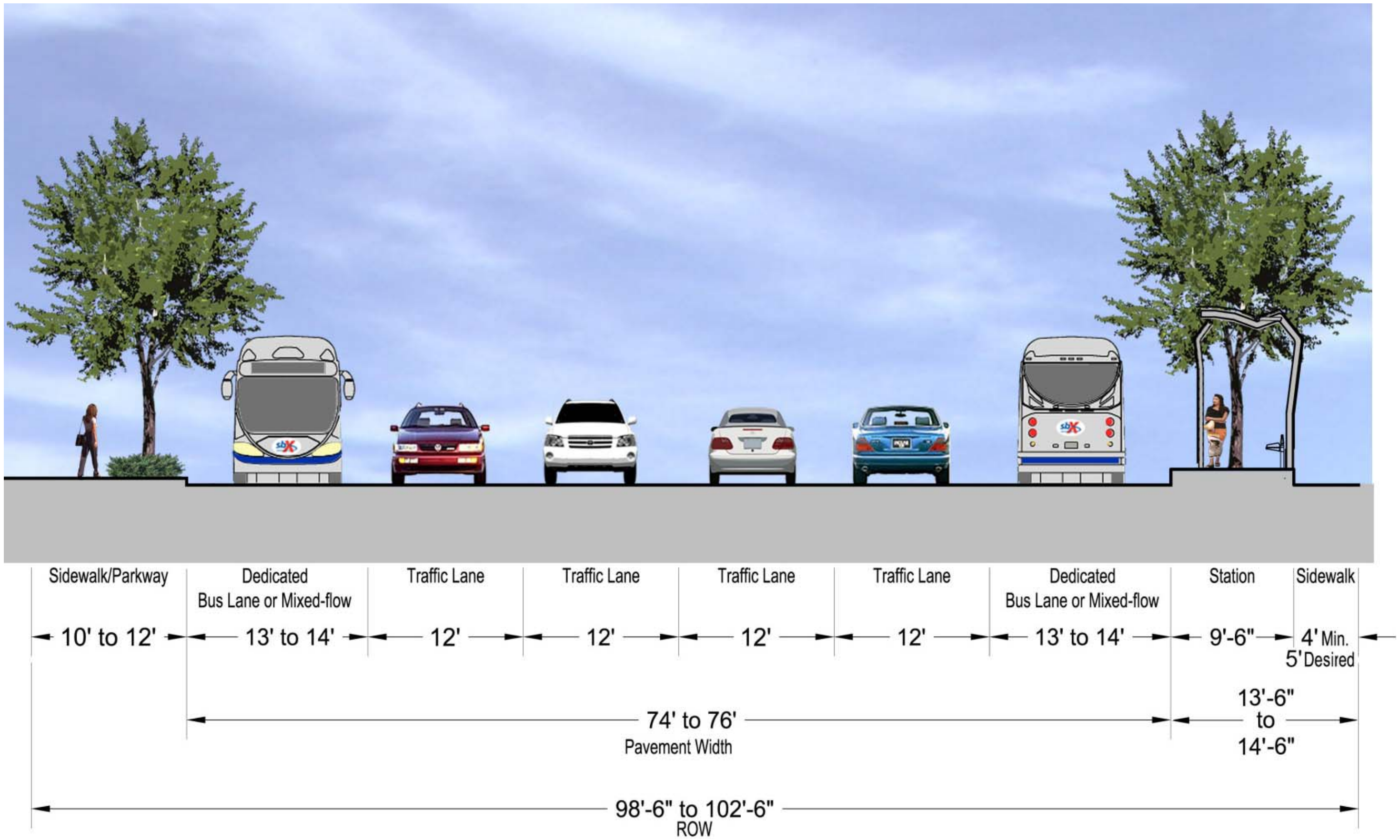


Figure 9-57: Optimum Side Running Station Configuration, max. 13′ to 14′ dedicated or mixed-flow lane and with two lanes of traffic in each direction. The traffic lane widths could be reduced to 11′ to accommodate this configuration within a 100′ ROW.

SIDE RUNNING CONFIGURATION IN BETWEEN STATIONS

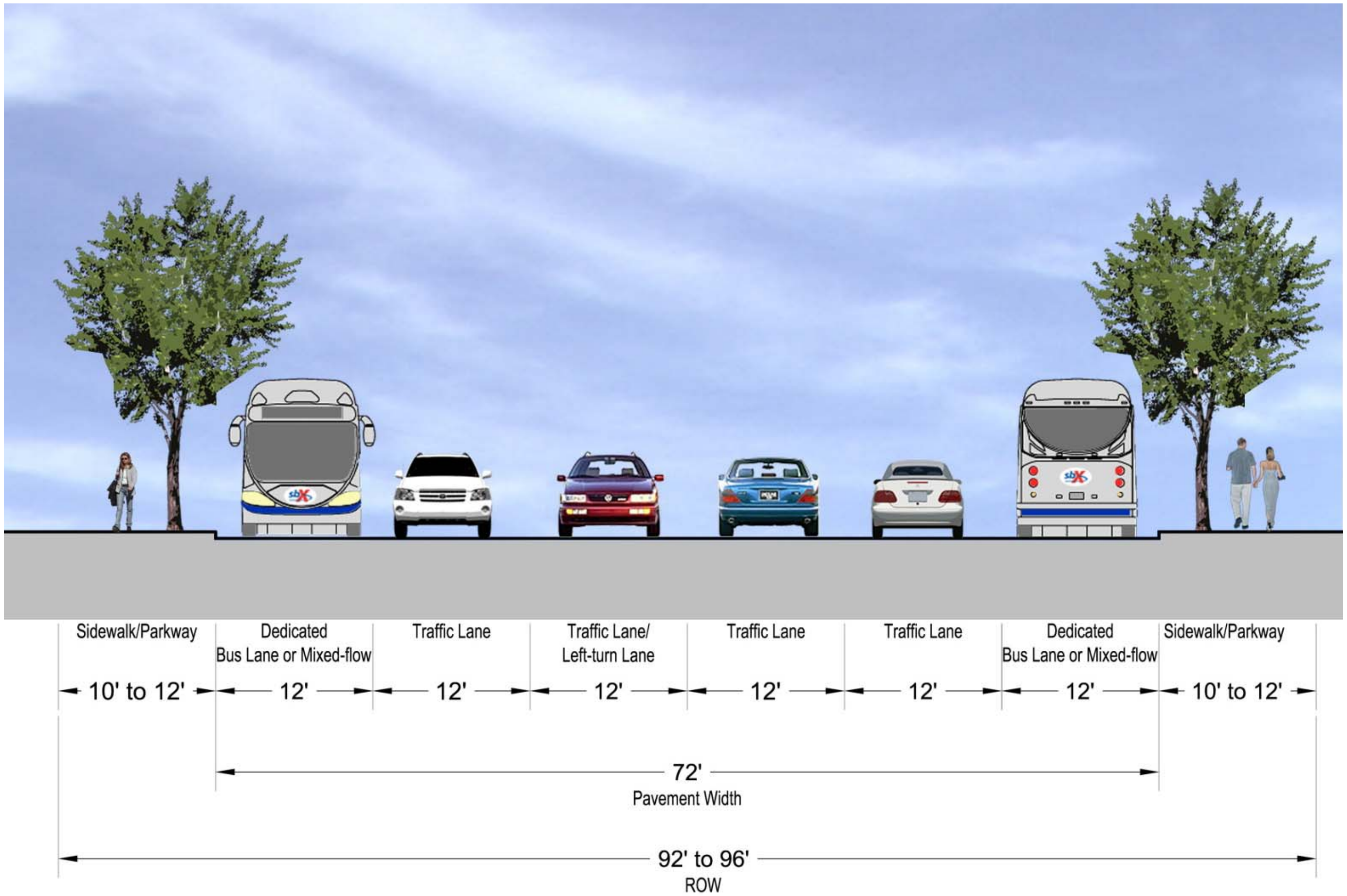


Figure 9-58: Side Running Station Configuration in between stations, min. 12′ dedicated or mixed-flow lane with two lanes of traffic in each direction.

10. sbX ROADWAY DESIGN ELEMENTS

sbX roadway elements, such as running ways and queue jump lanes, are major factors that allow sbX vehicles to maintain high operating speeds and service reliability, and help make the sbX service more competitive with the automobile than typical local bus service. Combined with Transit Signal Priority (TSP) as described in Section 11, these elements can achieve significant increases in the reliability and the level of service provided.

10.1 sbX Design Speeds

Maximum operating speed in the sbX exclusive lanes shall be no more than 10 mph greater than the posted speed limit of parallel traffic. Design speed of parallel traffic and for sbX in mixed flow shall be the posted speed limit.

10.2 sbX Running Ways

sbX vehicles operate in running ways, which serve as the major determining factor in the speed, reliability, and total cost of a BRT system. Greater separation between the running way and mixed traffic produces faster operating speeds, and greater reliability, but increases capital costs.

sbX service can operate on three types of running ways:

- **Mixed-Flow Traffic Lanes** – Travel lanes used by sbX vehicles, local buses and regular traffic.
- **Converted Bus-Only Lanes** – Lanes, either at the curb or the median, that have been converted from mixed-flow or parking lanes to bus only lanes. These lanes may be used exclusively for buses during peak periods or throughout the day. The lanes are not physically separated from adjacent mixed-flow lanes and are usually delineated by pavement striping or signage. sbX vehicles and local buses would be allowed to enter curb running converted bus only lanes, however local buses would not be able to use center running lanes with a single platform, due to door configuration of local bus vehicles.
- **Dedicated Bus-Only Lanes** – Similar to a converted bus-only lane, either at the curb or the median that are purpose-built for transit and are physically separated from mixed traffic by barriers, bollards, or raised medians/ curbs. As such, physical implementation and capital costs are somewhat higher for dedicated bus-only lanes compared to converted ones. The sbX Green Line E Street corridor operates in portions of center running dedicated bus-only lanes. sbX vehicles and local buses would be allowed to enter curb running dedicated bus only lanes, however local buses would not be able to use center running lanes with a single platform, due to door configuration of local bus vehicles.

In all three types of running way, the local bus stops would be located at separate stop locations from the sbX service. The following sections describe various BRT running way operating environments. Each defines the running way, identifies key operating advantages and disadvantages, and describes the applicability of each running way option available to Omnitrans and San Bernardino County.

10.2.1 Mixed-Flow Traffic Lanes

Mixed-flow lanes are general purpose traffic lanes used by buses and regular traffic, including trucks, private automobiles, and motorcycles. Preferred local bus stop locations would be located on the farside of the intersection ahead of the sbX stations, with a preferred distance of 40′ (a minimum of 25′) between the sbX stations and local bus stop to allow for sbX vehicles to reenter the mixed flow lanes (as shown in Figure 9-6.)

- **Advantages --** Mixed-flow traffic lanes have minimal capital costs since major physical modifications or expansions to the roadway are not necessary. Intersection delays can be reduced when Transit Signal Priority (TSP) and queue jump lanes are implemented along a corridor. Buses benefit from a range of street and traffic improvements, which reduce overall traffic delay. Utility work in portions of the roadway generally does not impact bus operations with mixed flow traffic lanes. Local bus stops would be located adjacent to sbX stations, allowing for a short walking distance for transfers.

- **Disadvantages –** Bus operations are impacted by traffic conditions and congestion resulting in reduced speeds and reliability, and increased chances for collisions. Delay to buses may also result from turning, queuing, or double-parked vehicles and merging, turning, and/or loading/unloading buses may delay mixed-flow traffic. The absence of fixed infrastructure or guideway makes the system seem less "permanent," which may reduce development potential along the corridor. Local bus stops may require bus turnouts where adequate space for the sbX service to pass local buses is not available.
- Omnitrans' policy is that BRT shall operate in mixed-flow travel lanes when traffic conflicts do not impact operating speeds, reliability, daily boardings, and route performance; and/or average boardings per day are within standard range. BRT shall also operate in mixed-flow travel lanes when bus-only lanes are impractical.

10.2.2 Converted Bus-Only Lane

Curbside parking or mixed-flow lanes converted for transit vehicle use only during peak periods or throughout the day are considered converted bus-only lanes. These lanes can revert back to mixed-flow traffic after operating hours depending on traffic conditions and route demand throughout the day. Converted bus-only lanes generally do not require physical alterations, such as median conversion or street widening, to the street ROW. The lanes are demarcated by appropriate signage, pavement markings (e.g. diamond symbol), wide striping, and pavement coloring. The lanes may be partially reserved (i.e., taxis, high-occupancy vehicles, emergency vehicles, or turning vehicles may be allowed to use the lane) or fully reserved (for buses only). Intersection crossings are made at-grade. Mixed traffic is typically allowed to enter or cross bus-only lanes to turn or park at designated parking spots along the curb. If a parking lane exists adjacent to converted bus-only lane, then peak period parking bans may need to be adopted. For converted bus-only lanes, the curb lane would be the preferred condition to allow for both local bus and sbX service to access the bus-only lane. Local buses would not be able to use a median lane due to the local bus door configuration. Local buses stops would interact with the sbX stations in the same way as mixed flow traffic lanes.

- **Advantages --** Increased competitive advantages can be gained versus automobiles and buses traveling in mixed-flow lanes. Buses operating in their own lane can operate faster, more reliably, and more safely than buses operating in mixed-flow traffic lanes. Higher peak period loads can be accommodated and shorter headways maintained since mixed-flow traffic does not conflict with bus movements. When combined with TSP and queue jump lanes, travel delays can be further minimized at intersections. Mixed-flow traffic does not conflict with merging, turning, and/or unloading and loading buses. There is a potential for development intensification and diversification along the corridor. Utility work in portions of the roadway generally does not impact bus operations with converted bus-only traffic lanes, as the bus can easily enter and exit the designated lane. Local bus stops would be located on the curb adjacent to sbX stations, allowing for a short walking distance for transfers.
- **Disadvantages –** Buses still cross intersections at-grade. Lanes are not physically separated from mixed-flow lanes, which may result in conflicts with turning or parked vehicles. To prevent conflicts with parked vehicles, peak period parking bans may be required.

Travel time advantages compared to the automobile are only achieved during hours when buses travel in bus-only lane. Conversion of lanes to bus-only lanes may require the displacement of parking, traffic, businesses, and pedestrians. Capital costs are higher than for BRT operating in mixed-flow traffic lanes. Active enforcement is necessary to keep lanes clear of non-designated vehicles. Local bus stops would not require bus turnouts for the sbX service to pass local buses however, the sbX service would be required to merge into mixed flow traffic lanes to pass local buses.

Omnitrans' policy is that Converted Bus-only Lanes are applicable when: (i) delay from mixed traffic impacts route performance; (ii) sufficiently wide (11'–13') parking or mixed-flow traffic lanes are available; (iii) sufficient financing exists for roadway improvements and lane demarcation; and (iv) daily boardings justify improved service.

10.2.3 Designated Curbside Bus-Only Lane

Designated curbside bus-only lanes are physically separated, purpose-built curbside lanes for transit vehicles only.

This requires physical alterations to the street ROW, where sufficient ROW is not available. Physical separation is accomplished with concrete barriers, raised medians or pavement, or bollards. Designated curbside bus-only lanes do not revert to mixed-flow traffic use like converted bus-only lanes.

Bus-only lanes may be partially reserved to allow shared usage by taxis, high occupancy vehicles (HOVs), emergency vehicles, or turning vehicles or can be fully reserved for buses only. The lane is physically separated throughout the entire length of the lane, except at intersections where crossings are made at-grade and at lane entrance and exit. Mixed traffic is typically allowed to enter or cross bus-only lanes to turn or park at designated parking spots along the curb. Local buses would have access to the bus-only lane, and local bus stop interface would be similar to the mixed-flow traffic lane condition, with the exception that local bus stops would require bus turnouts to prevent buses at local buses stops from blocking the use of the bus-only lane.

Lanes are demarcated by pavement markings, vertical signage and pavement coloring (especially at intersections and merge points).

- **Advantages --** Improved sbX travel times can be attained in designated curbside bus-only lanes, making sbX vehicles in these lanes more competitive with the automobile. Buses operating in their own lane can operate faster, more reliably, and more safely than buses in mixed flow lanes. Such systems can accommodate higher peak period loads and operate at lower headways. Mixed-flow traffic does not conflict with merging, turning, and/or unloading or loading buses. There is potential for development intensification and diversification along the corridor and near stations. Curbside bus-only lanes are generally more cost efficient than median bus-only lanes. Utility work in portions of the roadway generally does not impact bus operations with designated curbside bus-only lanes, as the bus can easily enter and exit the designated lanes, depending on lane delineation devices. Local bus stops would be located on the curb adjacent to sbX stations, allowing for a short walking distance for transfers.
- **Disadvantages –** Buses still cross intersections at-grade, including driveway curb cuts for adjacent, private land uses, and conflict with high volumes of right-turns. Implementation of new curbside bus lanes and street widening may displace parking, pedestrian and bicycle paths, and nearby residents and businesses. Higher capital costs compared to converted bus-only lanes. Active enforcement would be necessary to keep

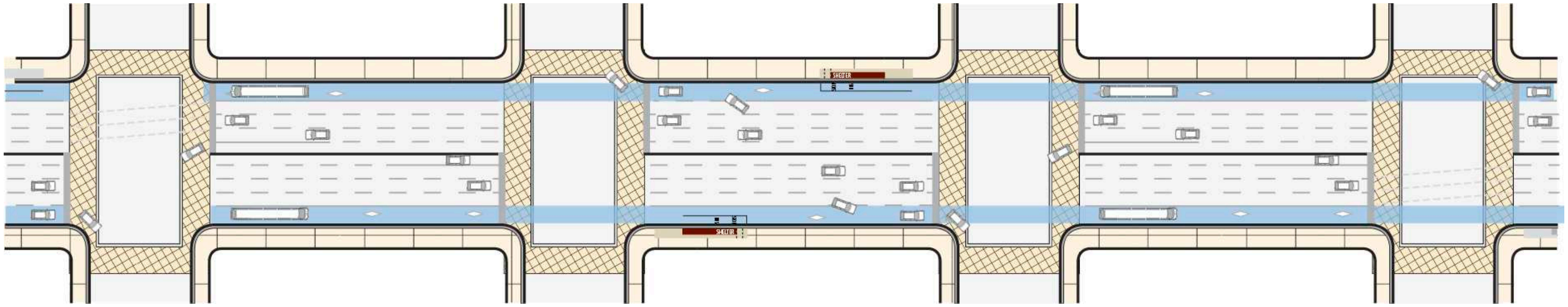


Figure 10-1: Example of Dedicated Curbside Lane

non-transit vehicles out of the bus-only lanes. When compared to median bus-only lanes, station costs are generally higher as two separate platforms are needed. Local bus stops would require bus turnouts to prevent local buses from blocking the exclusive lane.

Omnitrans' policy is that designated curbside bus-only lanes are applicable when: (i) delay from mixed traffic impacts route performance; (ii) existing traffic and street conditions prevent the conversion of a parking or mixed-flow traffic lane to a bus-only lane; (iii) the street section is wide enough to add an 11' to 13' curbside lane; (iv) permits to modify the ROW have been or can be obtained; (v) sufficient financing exists for proposed capital improvements; and (vi) daily boardings justify improved service.

10.2.4 Designated Median Bus-Only Lane

Designated median bus-only lanes are physically separated median lanes for transit vehicles only. Designated median bus-only lanes require physical alterations to the street ROW, in terms of median conversion and/or the takeover of adjacent mixed-flow lanes for bus-only operations. Physical separation is accomplished with concrete barriers, raised medians or pavement, or bollards. Designated bus-only lanes do not revert to mixed-flow traffic use like converted bus-only lanes. Lanes are demarcated by pavement markings, vertical signage and pavement coloring, especially at intersections and merge points.

Designated median bus-only lanes may be partially reserved to allow shared usage by taxis, high-occupancy vehicles (HOVs), emergency vehicles or turning vehicles to use the lane or fully reserved for buses only. Local bus service would not be able to utilize the median bus-only lanes due to the vehicle door configuration. The lane is physically separated throughout, except at intersections where crossings are made at-grade and at lane entrance and exit.

- **Advantages --** Improved sbX travel times can be attained compared to automobiles and buses traveling in mixed-flow traffic lanes, making dedicated bus-only lanes more competitive with the automobile. sbX vehicles operating in their own lane can operate faster, more reliably, and more safely than buses and vehicles traveling in mixed-flow traffic lanes. Such systems can accommodate higher peak period loads and operate at lower headways. Mixed flow traffic does not conflict with merging, turning, and/or unloading or loading buses. There is potential for development intensification and diversification along the corridor and near stations.

- **Disadvantages –** Buses still cross intersections at-grade. Implementation of new median lanes may displace landscaping, median recreation areas, and adjacent traffic lanes. Considerably higher capital costs compared to converted bus-only lanes. Relatively higher capital costs compared to dedicated curbside bus-only lanes. Active enforcement would be necessary to keep non-transit vehicles out of the bus-only lanes. Left turning vehicles are banned from the busway, but are accommodated adjacent to the median dedicated BRT lanes. Center bus-only lanes require wider ROW than curbside bus-only lanes for provision of barriers and stations. Utility work in portions of the roadway may impact bus operations with designated median bus-only lanes, depending on lane delineation devices. Local bus stops would be located on the curb, and transit users would need to cross the street to access the median stations. Local bus stops would require bus turnouts in some locations to prevent local buses from blocking mixed-flow travel lanes.

Omnitrans' policy is that designated median bus-only lanes are applicable when: (i) delay from mixed traffic impacts route performance; (ii) existing traffic and street conditions prevent the conversion of a parking or mixed-flow traffic lane to a bus-only lane; (iii) the existing street profile is not wide enough to accommodate adding 11'–13' curbside lanes; (iv) sufficiently wide enough center medians exist (in addition to adjacent lanes) for a busway; (v) permits to modify ROW have been or can be obtained; (vi) sufficient financing exists for proposed capital improvements; and (vii) daily boardings justify improved service.

10.3 Roadway Cross Sections

Depending on the characteristics of each street along which the sbX system will be developed, accommodation of sbX lanes will require shared or exclusive use of some existing travel lanes, possible reduction in some existing lane widths, widening of roadways, and development of modified cross sections with space for sbX lanes, general travel lanes, parking, parkway, sidewalks, bikeways and shoulders as appropriate, in order to meet all pedestrian and vehicular space requirements.

Cross section requirements begin with each street's functional classification and requirements for moving traffic at acceptable levels of service. Following development of new cross sections, assessments will be made of the adequacy of existing rights-of-way (ROW), the need for widening, availability of additional ROW, the need to purchase new ROW and any resulting impacts.

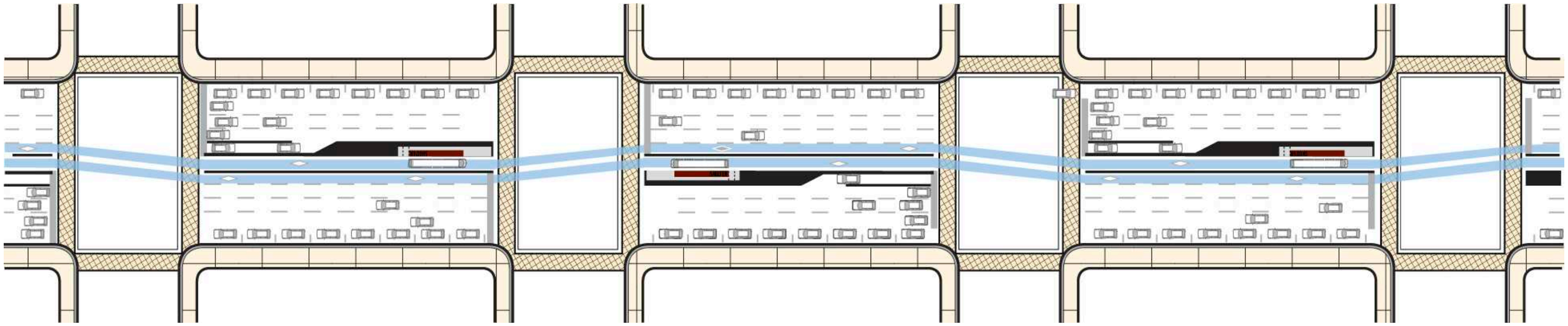


Figure 10-2: Example of Dedicated Median Lane

Throughout the design process, the designers will work closely with Omnitrans and the respective local jurisdictions to develop effective designs, identify and resolve design issues, and secure design approval from each city's Public Works and Engineering departments as applicable.

Table 10-1 presents desirable and minimum standards for BRT lanes and other roadway elements. These standards should be used in developing proposed cross sections. An example of a proposed cross section for sbX Service in the sbX 4th Street/Holt Boulevard Corridor is shown in Figure 10-3.

Table 10-1: Proposed Roadway Cross Section Element Design Standards

Planning Widths for sbX		
	Minimum	Preferred
BRT lane width for center running	12′ with 1′ buffer between lanes	13′ – 14′
BRT lane width dedicated BRT lane for side running	12′ *	13′ – 14′
Width of center running station (as designed)	15′	15′
Width for side running station	13′6″	18′
*Does not exist on the sbX Green Line. LACMTA Wilshire BRT has 12′ lane at curb.		

10.4 Intersection Geometry

The geometry of the design of intersections shall be approved by the local jurisdictions and Caltrans as applicable.

10.5 Queue Jumpers

Delay at intersections from queuing vehicles detrimentally impacts bus performance. The cumulative impact of intersection delay can significantly hinder bus on-time performance and operating speed. Queue Jumpers are an effective solution that provides a special lane allowing transit vehicles to bypass queues at congested points, such as intersections. The lanes are distinctively identified by special pavement delineation.

Queue jumpers consist of a nearside right turn lane and farside bus stop and/or acceleration lane. Buses are allowed to use the right turn lane to bypass traffic congestion and proceed through the intersection. Additional enhancements to queue jumpers could include an exclusive bus only lane upstream from the traffic signal, an extension of the right turn lane to bypass traffic queued at the intersection, or an advanced green signal indication allowing the bus to pass through the intersection before general traffic does.

The ability to provide queue jump lanes could mean the difference between Omnitrans ability to provide local bus service or sbX service. Advantages include travel time saving, increased transit competitiveness, improved image of transit, and increased corridor carrying capacity. Furthermore, time saving can be achieved if the lane is integrated with a bus-only lane and/or TSP. Capital costs are relatively low compared to large-scale physical measures, such as grade separation, to reduce intersection delay.

Installation may result in: (i) a small increase in traffic delay; (ii) a decrease in roadway width for mixed traffic lanes; (iii) displacement of parking, pedestrians, and/or traffic; and (iv) increased danger for motorists and pedestrians, until they become accustomed to early entry of the bus into the intersection. Insufficient roadway width may prevent the installation of queue jump lanes at key congested intersections. Without other improvements (e.g., TSP) queue jumpers may be ineffective in reducing bus delay. Lanes require constant enforcement. If right turns are allowed out of the queue jump lane, this may interfere with bus flow.

Adequate distance would be provided on the far side of the intersection to enable easy reentry of the bus into mixed-flow traffic.

Figure 10-3: Example of a street cross section for dedicated median lane BRT

Produced for the City of Ontario by KTU+A, Holt Boulevard Corridor Streetscape and Strategic Plan, February 2012 (draft).

As shown in Figures 10-4 to 10-6, there are multiple strategies for queue jump lanes including:

Queue Jumper with Acceleration Lane

This option includes a nearside right turn lane (bus exempt), a nearside bus stop, and an acceleration lane for buses with a taper back to the general purpose lanes. The length of the acceleration lane is based on speed and should be designed by an experienced engineer.

Queue Jumper with Farside Bus Stop

This option may be used when there is a heavy directional transfer to an intersecting transit route. Buses can bypass queues either using a right turn lane (bus exempt) or an exclusive bus queue-jump lane. Since the bus stop is located farside, a standard transition can be used for buses to re-enter the traffic lane.

Queue Jumper with Continuous Bus Lane

This option includes a nearside right turn lane or an exclusive bus queue-jump lane, a farside bus stop and a continuous bus lane extending to the next block or further, depending on bus circulation patterns. Right turns are allowable by general traffic from the bus lane. Queue jumpers at arterial street intersections should be considered when:

- High-frequency bus routes have an average headway of 15 minutes or less;
- Forecasted traffic volumes exceed 500 vehicles per hour in the curb lane during the peak hour and right turn volumes exceed 250 vehicles per hour during the peak hour;
- Intersection operates at an unacceptable level of service (defined by local jurisdiction); and
- Cost and land acquisition are feasible.

An exclusive nearside bus-only lane in addition to the nearside right turn lane should be considered when the right turn volumes exceed 400 vehicles per hour during the peak hour. Further analysis should be conducted to determine specific warrants for the implementation of queue jumpers. The analysis should consider travel time benefits for bus passengers given varying levels of traffic congestion. The analysis should also consider the potential effect of causing delays to general traffic at the intersection blocking the transit vehicles travel between intersections.

Queue jumpers shall be implemented on a limited, as needed basis, at primary intersections, where delay significantly impacts bus performance, where adequate right-of-way exists to place a queue jump lane, and where benefits to transit are potentially the highest. A public awareness education process may be needed when queue jumpers are being implemented. Queue jump lanes provide the greatest benefits to buses when combined with TSP and/or bus-only lanes.

10.6 Curbs, Gutters and Medians

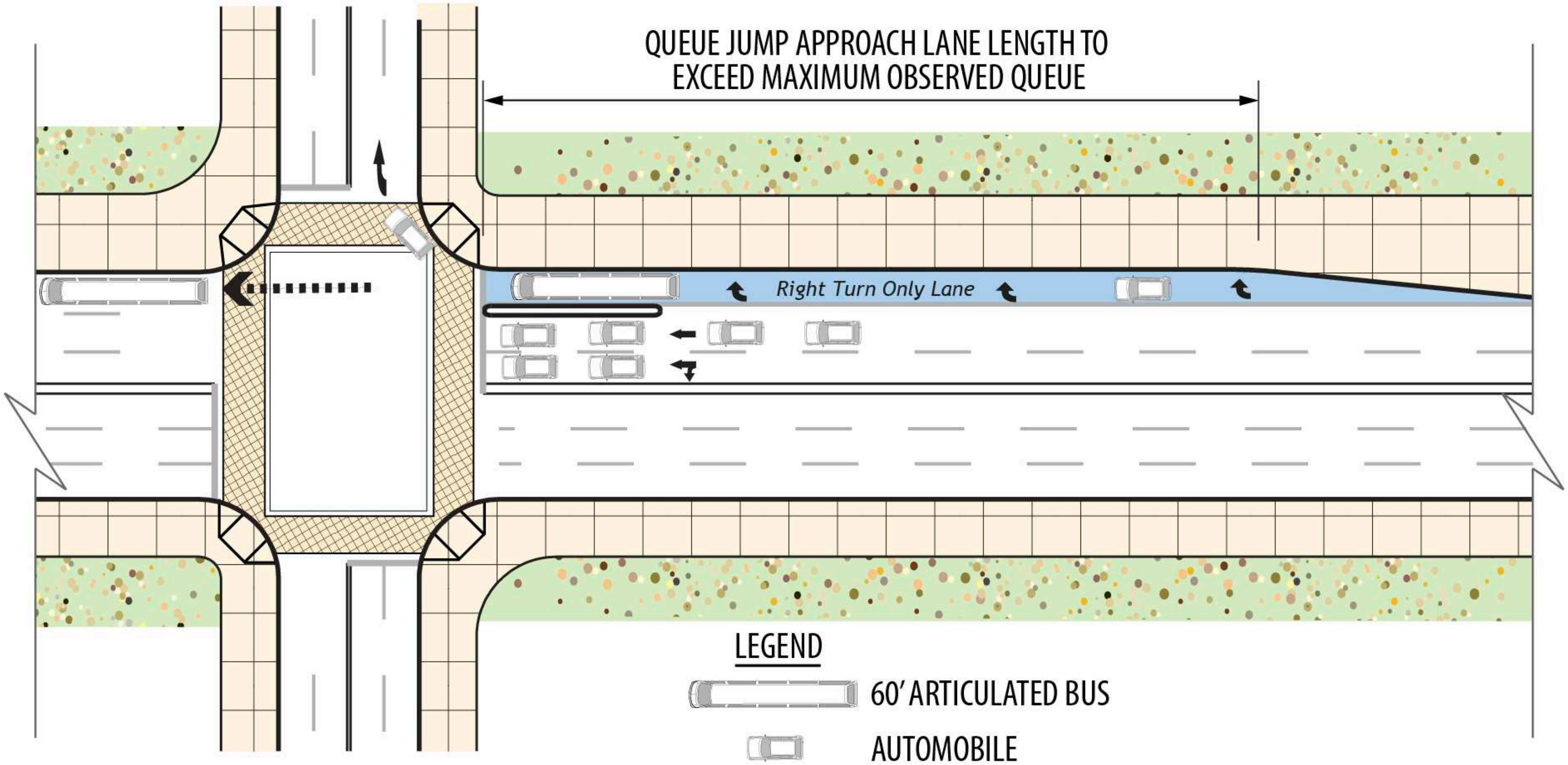
New curb and gutter will adhere to applicable city standards. Where the existing roadway is to be widened, curb and gutter shall be replaced to match existing. Curb and gutter will be 6″ or 8″ high, with a 1.5′ to 2′ gutter width according to individual city standards. At sbX station platforms, the curb height will be approximately 12″ to 15″ for level boarding.

All existing curb ramps will be maintained or relocated to new curb return location. If the existing curb return at a proposed station location does not have a curb ramp, one will be provided.

10.7 Clearances

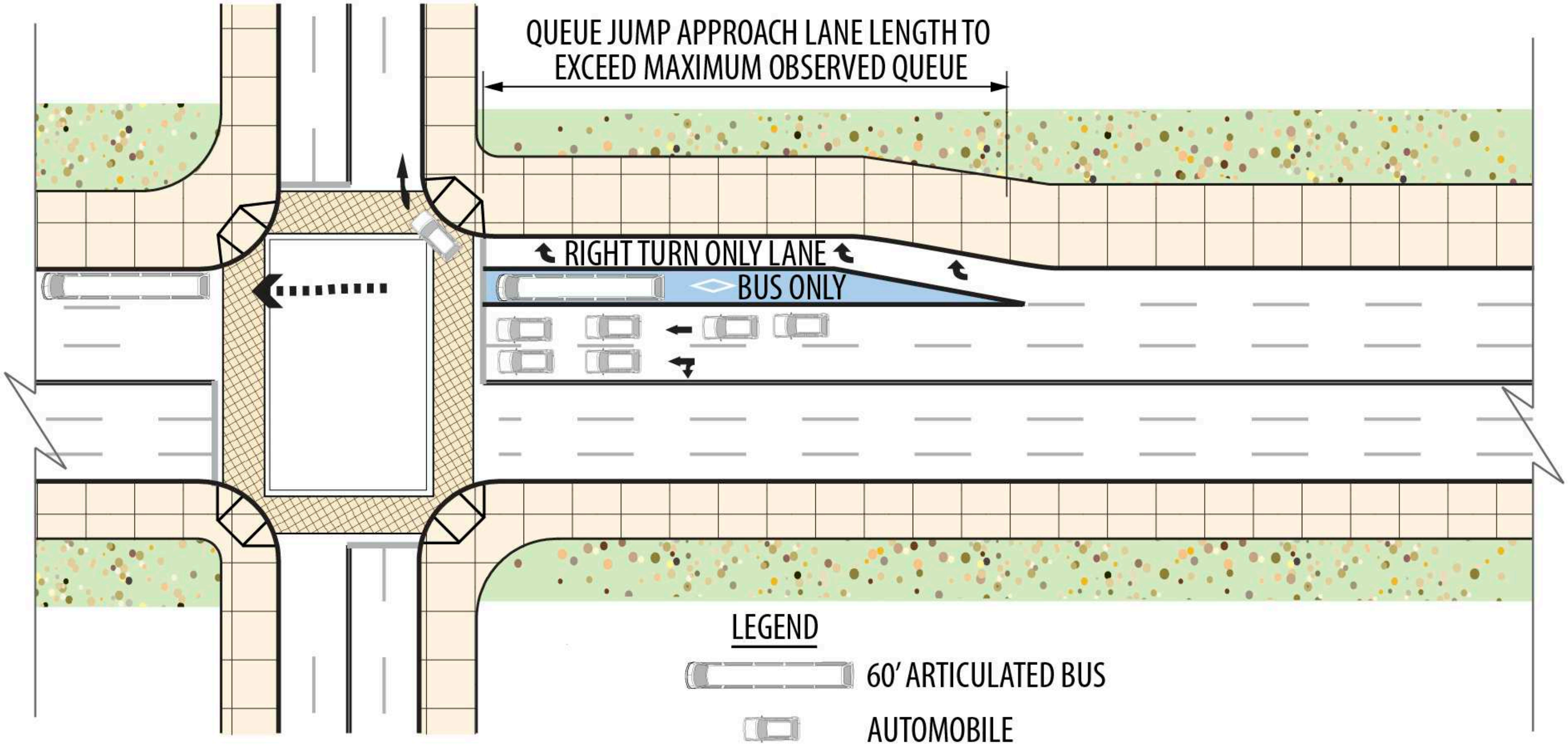
Minimum horizontal clearance from the street to fixed objects on sidewalks that are to be reconstructed or on sbX station platforms shall be 2′ measured from the edge of the traveled way or face of curb. At stations the minimum clearance between overhead canopy and curb face will also be 2′.

Existing minimum vertical clearances will not be reduced along the sbX runningway. This may require the runningway pavement to be no higher than the existing pavement at critical locations.



NOTES:
1. ONLY TRANSIT VEHICLES PERMITTED TO MAKE STRAIGHT-AHEAD MOVEMENT OUT OF THE RIGHT-TURN LANE.
2. EFFECTIVENESS WILL BE IMPROVED IF THE QUEUE JUMP LANE IS INTEGRATED WITH TRANSIT SIGNAL PRIORITY.

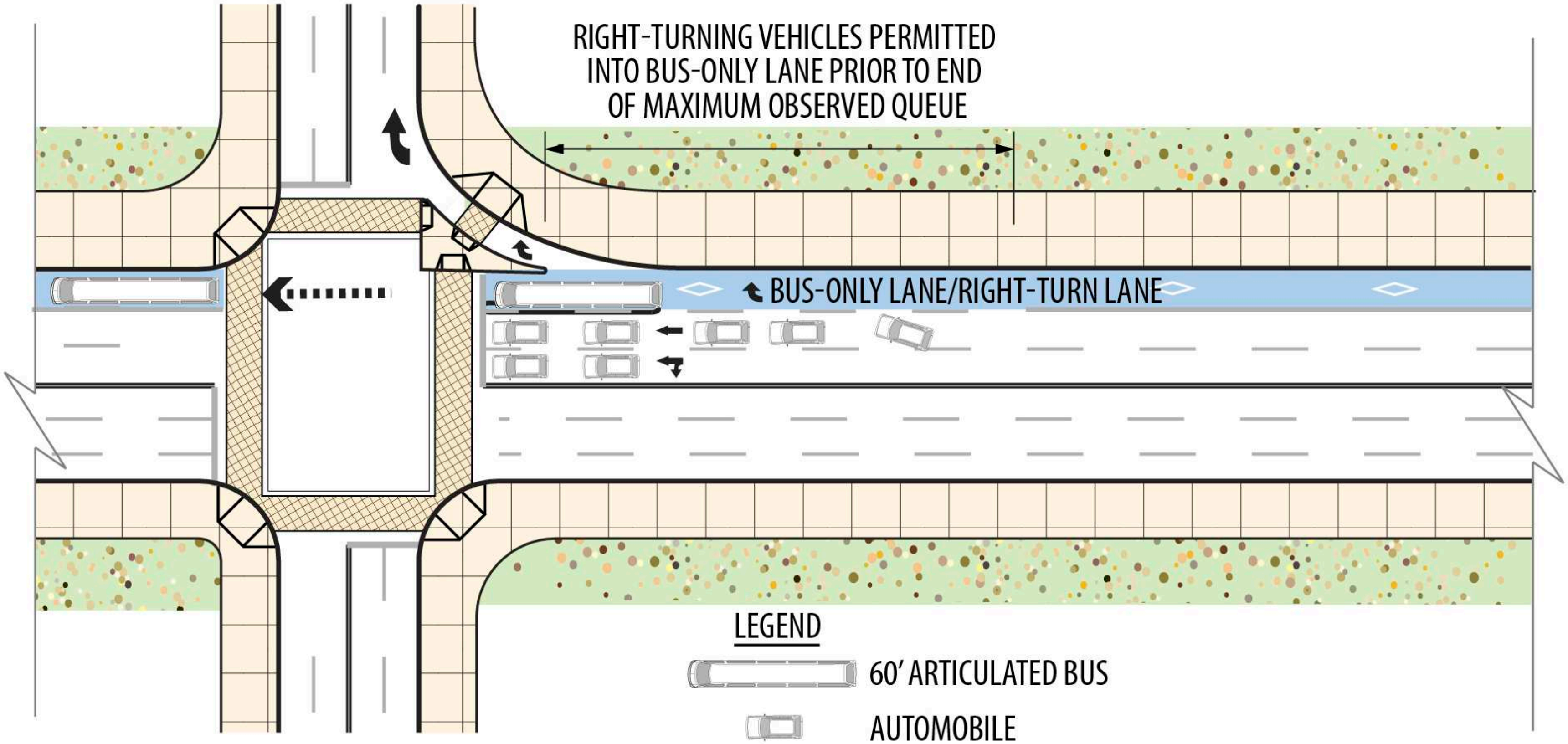
Figure 10-4: Queue Jump Lane as Part of Right Turn Lane



NOTES:

1. THE LENGTH OF THE QUEUE JUMP APPROACH SHALL EXCEED THE MAXIMUM OBSERVED QUEUE LENGTH IN THE ADJACENT MIXED TRAFFIC LANES.
2. ONLY BUSES ARE ALLOWED TO THE QUEUE JUMP LANE.
3. EFFECTIVENESS WILL BE IMPROVED IF THE QUEUE JUMP LANE IS INTEGRATED WITH TRANSIT SIGNAL PRIORITY.

Figure 10-5: Queue Jump Lane Adjacent to Right Turn Lane



NOTES:

1. RIGHT-TURNING VEHICLES ARE ALLOWED INTO THE BUS-ONLY LANE IN THIS SCENARIO, BUT ONLY TRANSIT VEHICLES MAY MAKE STRAIGHT-AHEAD MOVEMENTS.
2. RIGHT-TURNING VEHICLES ALLOWED INTO THE BUS-ONLY LANE PRIOR TO THE END OF THE MAXIMUM OBSERVED QUEUE.
3. BUS ONLY LANE IS CONTINUOUS THROUGH THE INTERSECTION IN THIS SCENARIO.
4. EFFECTIVENESS WILL BE IMPROVED IF THE QUEUE JUMP LANE IS INTEGRATED WITH TRANSIT SIGNAL PRIORITY.

Figure 10-6: Queue Jump Lane with "Pork Chop" Islands

The general geometric design principals contained in the AASHTO publication "A Policy on Geometric Design of Highway and Streets," and the standards for the local jurisdictions will be followed.

10.8 Turn Lane Storage Length

Turn lane storage length will be based on standard traffic engineering assessment of acceptable levels of service and the availability of ROW, costs, impacts and related factors.

10.9 Minimum Curb Radii

The minimum curb radii at intersections shall be determined using the standard local bus turning template, which is the maximum of Omnitrans fleet or city standards, whichever is greater. The standard bus turning radii is shown in Figure 10-7.

Curb returns will be reconstructed only where impacted. Non-standard curb radii will conform to standard unless doing so would impact an existing building or structure.

10.10 Additional Measures Supporting Transit Priority

The physical improvements described above are only as effective as traffic management, regulation and enforcement measures in place to ensure that these facilities and infrastructure function well and give transit a competitive advantage over the automobile. Traffic management, regulation and enforcement measures are described below:

10.10.1 Traffic Control and Management

Traffic controls relate to curb use, turning movements, and street directions at individual locations, on selected segments, or on an entire route where existing roadway traffic, parking, or turning movements reduce operating efficiency.

Three types of traffic control are generally adopted:

- Curb Parking Restrictions and Loading Controls. Imposed during peak periods or working hours to increase the lane width available to buses, reduce conflicts with vehicles entering or leaving a parking space, and increase transit operating speeds. These lanes may also be used as bus-only lanes if parking is banned throughout a corridor.
- Turn Controls (Banning of Left/Right Turns). Reduces the time lost behind queuing automobiles and reduces the chance of conflict with turning vehicles.

Initial opposition to these regulatory measures may appear if public "buy-in" is not obtained, especially for the prohibition of on-street parking, which can affect retail and commercial areas.

10.10.2 Enforcement

Bus-only lanes must be enforced to be effective. Without the active enforcement interference and improper use by automobiles, taxis, and trucks, can significantly reduce bus performance and safety.

Enforcement is necessary along bus-only lanes where potential exists for vehicular turning, or parking conflicts.

Enforcement must include the agencies and entities that will be involved in enforcement activities, such as local jurisdictions, Caltrans, SANBAG, local and state police, state and local judicial systems, and federal entities, as well as the type of strategy employed. The following are the types of enforcement methods available:

- **Routine Enforcement –** Random enforcement along a corridor throughout the day.
- **Special Enforcement –** Team patrols for a specific purpose.

- **Selective Enforcement –** A combination of routine and special enforcement, often focusing on problematic sections or locations.
- **Public Enforcement –** The public can call in violators.
- **Automated Enforcement** – Closed-circuit television (CCTV) may be used to identify violators and direct enforcement personnel accordingly. Also, cameras mounted on buses or at the wayside along the corridor, may be used to record violators and then subsequently issue summons or fines after accessing state or DMV databases. Violators shall be fined, have their cars towed, or be given penalty points against their driving record. These penalties are often publicized through public awareness programs.

Widespread disregard for bus-only lanes can significantly reduce operating performance of buses in these lanes. The higher the level of enforcement desired, the higher the costs. Automated or video enforcement requires regulatory changes to existing legislation, which may delay or sideline deployment.

Enforcement shall be conducted consistently around existing sbX stations and queue jump lanes. If a bus-only lane is implemented, routine enforcement, combined with CCTV and automated cameras, can most effectively regulate the corridor, although, as noted, regulatory changes must be made to existing legislation. It shall also be a priority to reduce operating expenses, so the introduction of automated cameras is very appropriate.

10.10.3 Signing and Pavement Markings

Special signage and traffic signal displays are essential along the sbX routes to keep motorists out of bus-only lanes or to differentiate bus-only signals from conventional signals.

Special signs and signal displays are most applicable in areas where the potential for conflict with mixed traffic is the highest or conflicts have proven problematic in the past.

As shown in Figure 10-7, signs and displays may include the following:

- **Traffic Signs –** Diamond symbol and "Bus Only" pavement markings in bus-only lanes, pavement striping, and vertical signage, such as warning and regulatory signs about staying out of the bus-only lanes and turning prohibitions.
- **Signal Displays –** Transit-specific signal displays, which are most applicable on median bus-only lanes and queue jump lanes. These signals are used to differentiate the transit signal from signals meant for normal traffic.

The use of "BUS ONLY" pavement legends shall indicate the exclusive use of the lanes by buses. In addition, the logo "sbX" shall be installed on each block in the center of the sbX lanes in each direction to indicate that the lanes are for the exclusive use of sbX and to prevent any other vehicles, including non-sbX buses, to enter the exclusive lanes. Where transitways and/or bus lanes are built on arterials, signs shall be provided in each direction at each intersection. Figure 10-8 shows the sbX pavement legend for exclusive lanes.

Implementing alternate pavement color through colored asphalt or concrete can reinforce the notion that a particular lane is reserved for another use, thereby reducing conflicts with other vehicles and should be implemented along sbX lanes where feasible.

The following Figures 10-9 and Figure 10-10 are typical signage and pavement markings implemented by the sbX. All signs should be high intensity with graffiti resistant film.

Figure 10–7: Bus only traffic signs and signal displays.

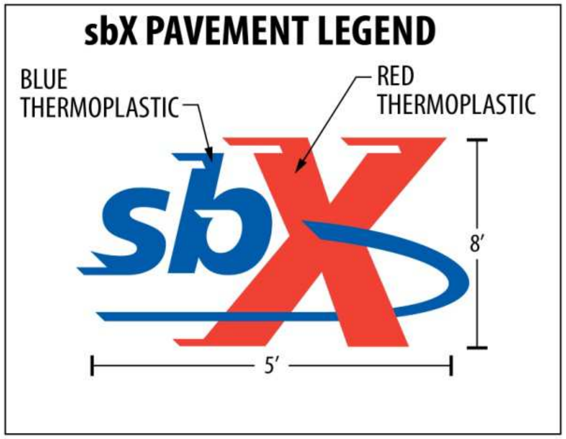


Figure 10-8: sbX Roadway Marking Detail

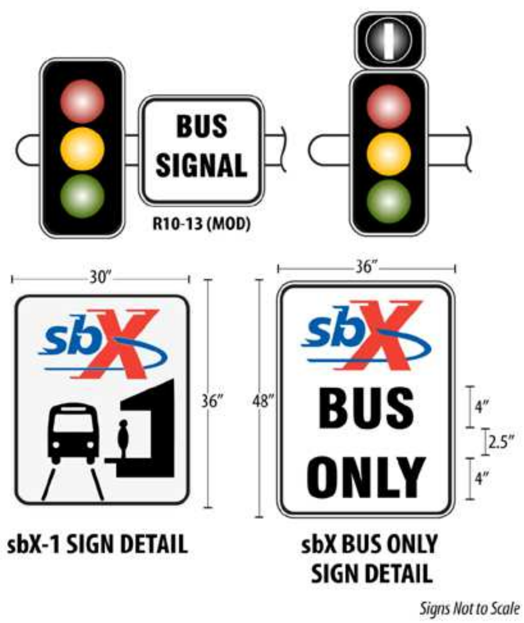


Figure 10-9: Typical sbX Signage Detail

Differentiation in the appearance of the runningway can be accommodated through a number of techniques including pavement markings, lane delineators, alternate pavement texture, and alternate pavement color. Implementing alternate pavement color through colored asphalt or concrete is particularly effective in reinforcing the message that a particular lane is reserved for another use, thereby reducing conflicts with other vehicles. As shown in Figure 10-11, Omnitrans has developed standard lane delineators and pavement symbols for the sbX Green Line; however lane delineators for future corridors will be developed in coordination with the respective jurisdictions.

Signing and pavement markings will be designed per applicable California MUTCD and municipal standards, with variances requested if necessary for any sbX distinguishing signing or markings. Special treatments or markings to differentiate the sbX service can effectively convey where the sbX service operates.

Figure 10-10: Typical sbX Signage Detail (continued)

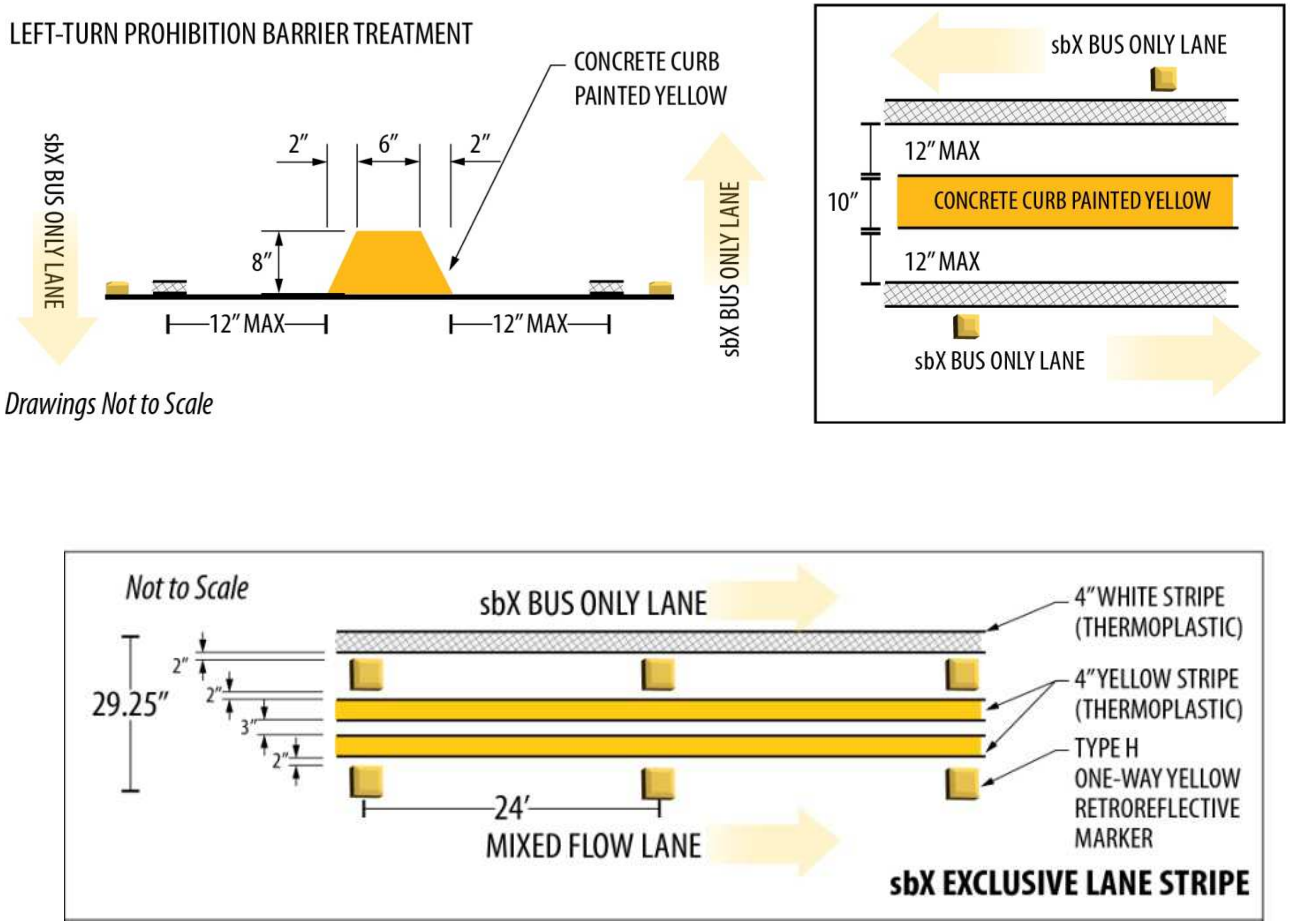


Figure 10-11: sbX Lane Delineation Detail

11. TRANSIT SIGNAL PRIORITY

Transit Signal Priority is employed at signalized intersections to provide priority to transit vehicles (buses) thereby reducing the total travel time. TSP technology can be provided at intersection in two levels: Always-on or Conditional priority. Always-on Priority requests priority to all transit vehicles. Conditional Priority requests priority based on various factors such as schedule variance, scheduled headway variance, passenger load, time of day, direction of route, etc. In order to minimize traffic impacts and maximize the benefits due to TSP, local jurisdictions and transit operators prefer to have the option of seeking / requesting TSP only when certain conditions are met. For example, TSP would only be requested if the sbX vehicle is behind schedule.

The objective of the sbX System is implementing conditional TSP, and the selected technology should be able to communicate or interface with the transit operations management system. Omnitrans has recently acquired a Continental TransitMaster™ System and the proposed TSP approach has been designed to take advantage of TransitMaster™ capabilities.

Figure 11-1 illustrates the four functions in the Transit signal priority process. Figure 11-2 illustrates the technical approach recommended for TSP deployment for the sbX corridors. Under the proposed approach, TSP functions will be executed by on-bus systems, bus-to-intersection communications, and traffic controller equipment.

Figure 11-1: TSP Functions

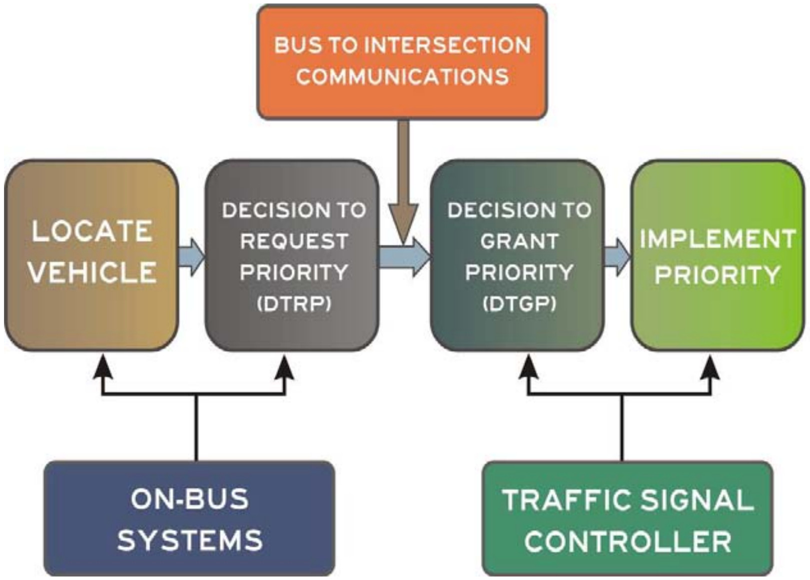


Figure 11-2: TSP Decision Process

11.1 Transit Signal Priority Architecture

Under the proposed TSP system architecture, buses are equipped with TransitMaster™ on-bus systems that communicate with the intersection controllers using an IEEE 802.11b/g Wireless Local Area Network (WLAN). Once in the corridor, TSP-equipped buses request priority by sending specific check-in, position update, and checkout messages to the intersections. The traffic controllers then process the messages and implement priority for the buses according to criteria set for granting such priority. The TSP Parameters will be jointly determined by Omnitrans and the respective cities prior to deploying the system.

Priority may be requested at signalized intersections equipped with the TSP Components and granted based on parameters determined by Omnitrans and the respective cities. When the

TransitMaster on-bus system decides to request priority, communications are initiated with the intersection where priority is requested. Three messages are transmitted for each priority request, two check-in messages and one check-out message, using the on-board IEEE 802.11b/g radio. As currently configured, the three messages are as follows:

- **Message 1:** The on-bus system sends a check-in message to TSP-equipped intersections using the WLAN. The message is typically sent when the bus is an estimated 20 seconds away from the intersection. At 30 miles per hour, this is a distance of about 900' from the intersection.
- **Message 2:** An update message is sent to the intersection five seconds later. This is done primarily for redundancy, to ensure that the request for priority is received by the intersection, but could also be used to update the estimated time of arrival accounting for any traffic conditions that the bus experiences as it approaches the intersection if supported by the intersection controller firmware.
- **Message 3:** Finally, as the bus leaves the intersection, a check-out message is sent allowing the intersection controller to cancel any additional priority strategies that it may be employing. This will reduce the impact of providing priority to the bus on traffic signal operations.

The system architecture provides for health and performance monitoring of the TSP systems by the respective cities and Omnitrans. Data is extracted from the signal priority data network and sent through the sbX station area T-1 communications network to the TSP Network Monitor data server. The TSP Network Monitor provides for network monitoring, maintenance planning, and historical data reporting. For health monitoring purposes, network devices can be accessed once they are on the network by sending requests through the T-1 communications network to the signal priority data network. Each segment of the TSP WLAN will have two network drop points connected back to the Network Monitor data server.

As already stated, the proposed system architecture employs a WLAN to provide for communications between mobile network clients, that is, TSP-equipped sbX vehicle, and intersection traffic signal controllers equipped with wireless antennas, receivers, and terminal servers ("intersection clients"). The WLAN has been developed using the IEEE 802.11b/g specification. The WLAN consists of a network of devices known as access points (AP) that are connected together using both wired, where available, and wireless communications. Each AP manages a number of wireless mobile and intersection clients associated to it by authenticating a client's right to be utilizing the network and to broker network communications between the client and other network devices.

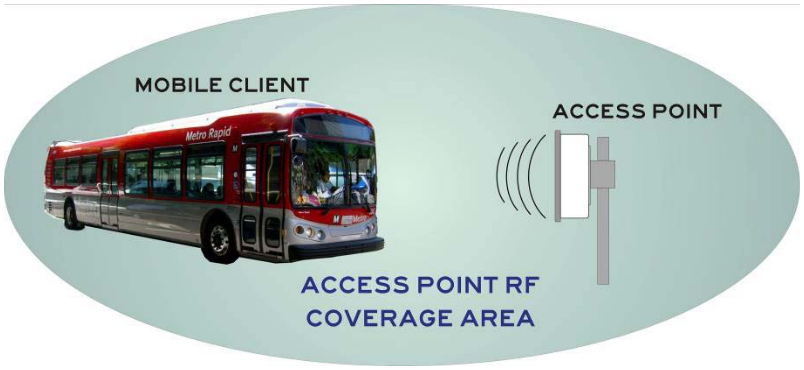


Figure 11-3: Mobile Client Communicating with Access Point

The mobile clients, sbX vehicles, may move around within an AP's coverage area and be provided with network services as depicted in Figure 11-3.

With the correct antennas and configuration, a single AP can provide network service to a radius of up to about one mile and, in some circumstances, perhaps even longer distances along bus transit corridors. Clearly, this distance is inadequate to provide communications for an entire bus line. Extended coverage is obtained by deploying multiple APs so that the individual coverage areas are overlapped. When deployed along a bus transit corridor, the coverage areas of the individual access points overlap to provide reliable and continuous communications between the buses and intersection controllers while buses are traversing the corridor as depicted in Figure 11-4.

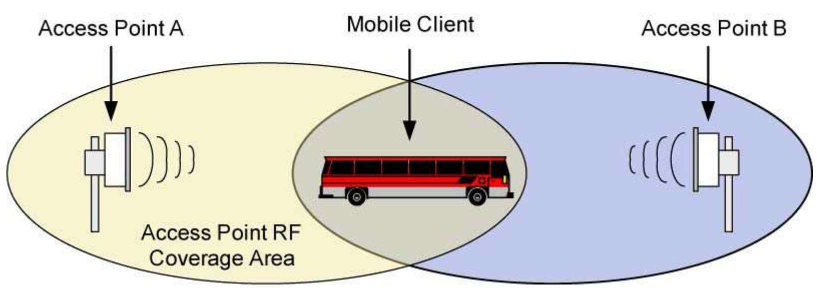


Figure 11-4: Mobile Client Communicating with Multiple Access Points

By installing a series of APs with overlapping coverage areas, continuous network access for buses along the corridor can be created. These extended networks require that the equipment be configured so that a mobile client can now be served by two or more APs at any one time, allowing a mobile client to move between the coverage areas of multiple APs with seamless communications throughout a bus transit corridor. Using a combination of hardware and software on both the clients and the APs, mobile clients are provided with continuous network access allowing the signal priority equipped buses to be unaware of any changes or transitions between the various APs in a wireless network.

To create the corridor-wide wireless network and allow for the seamless roaming of mobile clients, the APs are interconnected using wireless network bridges. A network bridge is a specialized WLAN device that provides point-to-point wireless communications required to connect multiple APs and provide for seamless communications in signal priority equipped corridors when wired signal interconnect is not available for use. For this project, network bridges that provide both wireless bridging and AP functionality are used. Once a wireless network infrastructure link is established, the AP/bridge device functions as an AP to accept mobile and intersection clients as well as to connect the AP with adjacent APs as depicted in Figure 11-5.

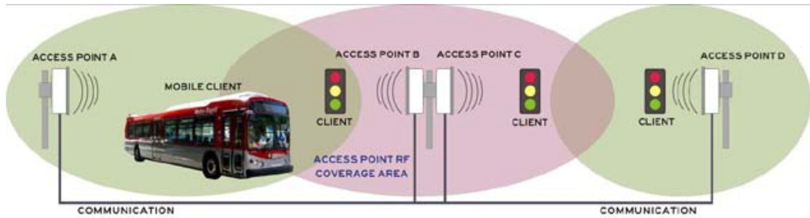


Figure 11-5: Wireless Network Bridges Connecting Multiple Access Points

11.2 TSP System Design

The implementation of bus signal priority systems along an sbX corridor requires the installation of communications equipment and traffic signal control equipment upgrades at intersections along the corridor as well as software upgrades to the TransitMaster on-bus and fixed end systems for TSP functions. The following sections provide a brief overview of the overall network design, types of hardware and software that need to be deployed at intersections in the corridor, and TransitMaster software modifications.

11.2.1 Access Point/Bridge Intersections

This is the most common type of intersection configuration for a network access point. At these intersections, network bridges will be installed and configured for both AP and bridge functionalities. The WLAN hardware establishes the necessary network infrastructure by creating a wireless bridge to the adjacent APs. The AP hardware is installed on existing signal poles at the intersection, providing WLAN coverage for mobile and intersection clients in the vicinity of the AP.

Network AP/bridges are required at roughly every third or fourth signalized intersection, on the average. The AP/bridges have been installed on traffic signal poles or signal pole mast arms at the maximum possible height. Typical installations are shown in Figure 11-6. Installation requires mounting the AP/bridge with its integrated antenna on the signal pole or signal pole mast arm and running coax cable from the bridge enclosure to the intersection controller cabinet where additional network hardware is installed, including a terminal server, network switch, and power supply equipment for the pole-mounted hardware.

Figure 11-6: Typical WLAN AP/Bridge Equipment Installations

The AP/Bridge equipment will be installed as high as possible on the traffic signal pole or on the signal mast arm in order to obtain an unobstructed line of sight to the adjacent APs and intersection clients and to minimize interference from surrounding vegetation and any other physical obstructions. For these intersections, line of sight is important in order to establish wireless links to the adjacent APs as well as coverage for the intersection and mobile clients.

At intersections equipped with Type 332 controller cabinets, the WLAN hardware is installed on a custom-fabricated aluminum panel that is attached to the cabinet frame on the back side of the cabinet and hinged so that signal technicians can easily move the WLAN hardware out of the way when necessary for signal maintenance. The WLAN hardware includes a terminal server, network switch, and power supply equipment. Details of the panel are shown in Figure 11-7.

Figure 11-7: AP/Bridge Equipment Panel In Type 332 Traffic Cabinet

11.2.2 Access Point / Bridge with Network Monitor Drop Intersections

As noted earlier, each network segment is connected to the TSP Network Monitor data server for network monitoring, maintenance, and data collection.

These intersections will be equipped the same as the AP/Bridge or AP/Signal Interconnect intersections. At these locations adjacent to sbX stations, a connection will be installed from the equipment panel inside the traffic signal controller cabinet or in the backpack enclosure attached to the traffic signal controller cabinet to the TSP Network Monitor data server using the BRT station area T-1 communications network. Installation details at the traffic signal controller cabinet are the same as for the AP/Bridge or AP/Signal Interconnect intersections with the network monitoring communications hardware.

11.2.3 Client Intersections

At intersections between APs where buses will request priority, only client hardware is required. At these locations, terminal servers that convert the IP-based communications data packets, received from access point to which each client is associated, to serial data for input to the traffic signal controllers are installed in the traffic controller cabinet. The serial port on the terminal server will be used for communications with a serial port on the traffic signal controller. Using its wireless communications features, the terminal server will also be able to access the corridor WLAN as a network client. Terminal servers can be attached directly to the rack inside a 332 cabinet without interfering with traffic signal maintenance as shown in Figure 11-8.

In addition, an antenna will be mounted on top of the cabinet, as shown in Figure 11-8, with antenna cabling to the terminal server. At certain locations where the traffic signal cabinet is located on the side street or otherwise obstructed by buildings, the antenna for the terminal server will be installed on a traffic signal pole at the intersection. At these locations, the signal strength at the controller cabinet is too low for a reliable connection to the WLAN network.

Figure 11-8: Terminal Server and Cabinet-Mounted Antenna

11.2.4 Intersection Traffic Signal Hardware

Intersection signal controller hardware and software modifications would be necessary for the intersections along sbX corridor. The modifications would include upgrading the signal controller equipment as necessary, upgrading signal controller firmware as necessary to accommodate wireless bus-to-intersection communications, and modifying signal timing with

TSP parameters. Each of the modifications is necessary to provide full system implementation at each intersection.

Signal timing for bus signal priority will be performed by the respective cities for the intersections in each of these cities. Timing will be based on rules set by the cities and typically provide for green extension, early green return, and limitations on granting priority for consecutive cycles in order to maintain progression.

11.2.5 TransitMaster On-Bus Systems Modifications

The existing TransitMaster on-bus systems will be upgraded for TSP functions, including wireless bus-to-intersection communications, to request priority. The existing IEEE 802.11b/g radio already installed as part of the TransitMaster will be employed for bus-to-intersection communications.

11.3 Traffic Signals, Control System and Standards

Buses will operate via a combination of standard traffic signal controls and special sbX signals. Basic signal prioritization for buses is to be implemented along the major arterials of the sbX network.

Existing traffic signals, cabinet, controller, as well as conduit may require modification to provide the hardware and software capabilities for signal prioritization and for additional signal phases. Signal pole relocation and mast-arm modifications may be required due to the proposed implementation of sbX dedicated lanes and bus only signals.

Incorporation of new signals meeting municipal traffic control standards will be developed in coordination with the traffic departments of each local municipality along corridor.

12. ELECTRICAL DESIGN CRITERIA AND STANDARDS

Electrical work on the sbX system may potential include street and pedestrian lighting, traffic signal power and controls, fiber optic lines and twisted pairs for communications, station power and lighting, and existing information kiosks. All electrical work beyond the electrical meter will be in accordance with the following:

- NFPA 70;
- NEMA (National Electrical Manufacturers Association)
- IES (Illuminating Engineering Society);
- IEEE (Institute of Electrical and Electronics Engineers);
- ANSI (American National Standards Institute);
- California MUTCD;
- California Building Code; and
- Building Code for local jurisdictions.

All electrical work for street lighting as well as for traffic signals shall follow standard practices, local electrical utility and local municipalities' traffic engineering requirements.

12.1 Power Source

Power shall be supplied through the local grid by the local electrical utility as required. During the design stage, the local electrical utility should be contacted to determine the location and type of service available. Separate metering may be needed for various usages (shelters, informational kiosks, signals, lighting, etc.) due to rate differentials. Low voltage requirements will be added on an as-need basis for Systems related items including but not limited to CCTV, TVM/SAV, network equipment, etc.

All shelters shall provide solar illumination in two formats, one to provide solar illumination for Omnitrans bus shelter interior security lighting and two to provide stand-alone solar security illumination on bus stop poles for individual bus stop locations.

12.2 Shelter Electrical Requirements

Local bus stops require a 1-inch conduit to junction box at rear corner of shelter pad (circuit breaker). Connect to building power (if possible) or nearest signal control box or electric power junction box. Electricity (120 volts/20 amp circuits) and communications to support ticket vending machines, real-time passenger information, lighting of stops, security cameras, and emergency call boxes are required. For cleaning purposes and landscape maintenance, an electrical outlet should be provided. The shelter shall be grounded by installation of a grounding rod or similar acceptable method, and outlets shall utilize Ground Fault Interrupter.

Shelters shall also require solar illumination, per the following design criteria:

- Solar units must be capable of mounting to Tolar Lexan dome roof shelters of either 13' or 17' in length. Solar panels to be of low profile design for aesthetic and vandal resistant purposes and use security hardware to fasten to the shelter roof. Each solar unit will have a serial number assigned and visible from the interior of the shelter;

- Solar units to be designed to include vandal resistant hardware and designed to withstand abuse from potentially damaging individuals. Security fasteners will be used for any exposed points;

- Solar illumination for shelters is to be for the interior seating area of the shelter only;

- Illumination is to be provided for a period of no less than 6 hours after dusk and 2 hours before dawn;

- Minimum illumination level will be 3 foot candles to be measured at 3' above the concrete shelter pad at or near the shelter bench area and illuminate approximately 40 square feet. Greater illumination levels may be provided as options;
- Solar units must be of modular design to allow for independent replacement of solar collector, light bar, light fixtures/bulbs, batteries and lighting control module. Replacement part numbers to be provided;
- Light source to be high intensity, white light emitting diodes (LED); and
- Solar unit must be capable of providing 5 days of full brightness, from a full charge, with no additional charging.

sbX stations require seven 2" SCHD 40 PVC conduit for electrical and communication. Traffic signals conduit shall be a minimum 2" rigid steel conduit; no PVC conduit shall be allowed unless otherwise noted for traffic signal interconnect.

12.3 Solar Bus Pole Security Lighting Requirements

Stand-alone security solar illumination on bus poles shall be installed by Omnitrans at individual bus stop locations. The design criteria are as follows:

- Solar unit to mount on 1.75" standard square sign pole. Solar unit casing should be low profile and theft resistant. All exposed hardware must use security fasteners. Mounting to pole must use security fastener hardware;
- Solar unit to have serial number attached to the exterior surface and visible from the sidewalk;
- Solar illumination must activate at dusk and remain illuminated for 6 hours and must activate for 2 hours prior to dawn;
- Solar illumination to be activated automatically (no push button activation);
- Solar illumination must provide a minimum of 4.0 foot candles at the sidewalk from an elevation of 10' and provide a minimum of 6 square feet of illumination at sidewalk level. Greater illumination levels may be provided as options;
- Illumination must be provided by white Light Emitting Diode (LED);
- Solar lighting must be able to be adjusted in 90 degree increments to allow for optimal area of illumination;
- Battery capability to hold charge for 5 days minimum from full charge without re-charging;
- Solar unit to be of modular design to allow for component part replacement; and
- Solar unit component parts to be warranted for 5 years, excluding batteries.

12.4 Street and Pedestrian Lighting

Along the sbX dedicated lanes, where widening is required, any existing lighting standards shall be removed and reset/replaced laterally to the alignment at the prescribed setback from the face of curb as required by the local Jurisdictions. Design of lighting at the sbX stations shall work in concert with existing lighting design so as to provide the minimum required lighting levels set forth by local municipalities. Any additional lighting required by the project's design, outside the limits of stations, including parking areas, shall also follow the local jurisdictions' standard specifications.

For passenger comfort and convenience, lighting levels on sbX station platforms shall be 5-20 foot candles and lighting external to stations shall be 2-5 foot candles. For local bus stops, a lighting level of 3 foot candles at 3' above ground is required throughout the shelter.

Parking areas shall have lighting capable of providing adequate illumination for security and safety. The minimum requirement is 1 foot candle, maintained across the surface of the parking area.

12.5 Transit Facility Lighting

Facility lighting should consider the following:

- Inside public areas, provide light levels to support operations and to provide deterrence against criminal activity;
- In all spaces, provide lighting according to its operational use and corresponding visual tasks and to support the closed-circuit television system, where CCTV is required;
- In above-ground maintenance and storage areas, provide complete perimeter and area lighting. At a minimum, access points, entrances, the perimeter and restricted areas must be illuminated from sunset to sunrise. Where appropriate, use auto-sensing day/night cameras to enhance video coverage;
- Controls, switches and distribution panels for security lighting must be located in areas to prevent unauthorized access and tampering. Wiring for security lighting must be in rigid conduits and embedded (if feasible);
- Vehicle and pedestrian entrances must have a minimum illuminance level of 10 Lux (1 foot-candle); and
- All other interior or exterior areas where CCTV coverage is required must have a minimum illuminance level of 2 Lux (0.2 foot-candle) measured 6" above finished floor or grade, unless infrared cameras and infrared lighting are provided.

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13. SYSTEMS & SECURITY

13.1 Design Objectives

This section presents the security systems designed to provide a reasonable level of safety and security for Omnitrans patrons, employees, the general public and local emergency service personnel. The design criteria are intended both as a reference and as a guide to the designers of facilities and systems.

Facility design and operating procedures shall promote a sense of well-being by patrons, and personnel, discouraging acts of crime, violence, and abuse. Security provisions shall also discourage acts of vandalism, theft and fraud.

The purpose of system safety and security design criteria is to provide sufficient definition and description of all facets of a system security concept so that design engineers and architects have guidance for the proper selection of equipment. Through these criteria, security considerations will be integrated into all aspects of the design, equipment selection, architectural concepts, procedures and operations.

Security systems are safety critical, and shall therefore be designed to remain in service during security emergencies under all conditions as well as within the environmental operating limits of the security equipment involved.

Security shall be incorporated into facility design as follows:

- Provide sufficient space for electronic security system monitoring stations and equipment;
- Provide adequate, redundant electrical power for security systems;
- Provide access control as needed; and
- Protect utilities by locating transformers, control valves, switches and similar equipment within security-controlled areas.

The objective is to create an environment where customers, employees and visitors are not only free from crime and other threats to personal safety, but in which they perceive and believe themselves to be so.

In order to achieve this objective, the following concepts must be applied to the design:

- Provide lighting to reduce fear of crime;
- Apply Crime Prevention Through Environmental Design (CPTED) principles as appropriate;
- Use fencing/barriers as needed to deter intrusion;
- Provide closed circuit television coverage as needed;
- Provide intrusion alarms as needed;
- Provide access control as needed; and
- Maximize lines of sight by minimizing obstructions to vision by occupants.

13.1.1 Physical Security Planning

The system shall contain deterrence from, protection against, and surveillance of potential acts of violence. This approach to design shall apply to both fixed facilities and mobile elements (vehicles) of the Omnitrans system. In general, the sbX system shall include features that enhance patron and personnel security. This can be accomplished through:

- Facility design;
  - Architectural Design;
  - Structural Design;
  - Lighting;
  - Landscaping;
  - Barriers / bollards;

  - Perimeter fencing;
  - Tamper resistant equipment;

- Security systems;
  - Access control;
  - Intrusion detection;
  - CCTV;
  - Communications; and
  - Information systems security.

13.1.2 Station Related Systems

Design standards and specifications for each station related system will be developed as the design progresses. As with all phases of the design process, these standards and specs will be reviewed with affected agencies and utilities as applicable for conformance with existing standards, or the need for approval of variances. Station related systems include, but are not limited to the following systems:

- Variable Message Signs (VMSs);
- Advanced Travel Information System;
- Public Telephones (PTELs);
- Emergency Telephones (ETELs);
- Public Announcement (PA) System;
- Communication Transmission System (CTS);
- Fare Collection System, Ticket Vending Machines (TVM) and Equipment;
- Wide Area Network (WAN); and
- Closed-Circuit Television (CCTV) System.

Station related systems are addressed further in Section 11 of this report.

13.1.3 Public Areas

Public areas must maximize their self-policing capabilities by providing broad and easy surveillance ability, minimizing areas of visual obstruction, avoidance of unobservable corners and niches, and providing inherently intuitive functional layouts. The objectives for employing police presence facilities and physical and electronic security systems include both enhancing protection and creating an environment where customers, employees, and visitors perceive a higher level of personal security. These measures also serve as a deterrent against criminal and terrorist activities.

Provide visible signs of security features, including:

- Closed-circuit television system (CCTV);
- Signage;
- Lighting; and
- Security presence (Police, fare inspectors, security guards, etc.).

13.1.4 Facility Design

Risk to Omnitrans facilities from physical attack must be mitigated through a combination of architectural and structural design.

Where glass is used in construction where adjacent spaces are occupied, use materials specifically designed to resist shattering into sharp fragments in an explosion. Window frames and their supports must be capable of resisting the ultimate capacity of the glazing.

Wayside signal and communication enclosures at grade must also be protected by barriers or bollards from direct vehicle impacts. The vehicle impact force to be mitigated must be for a 4,000 pound vehicle at 30 miles per hour.

13.1.5 Barriers/Bollards

Vehicle barriers can be used to provide: safety; theft deterrence; asset protection; pedestrian vs. vehicle traffic separation;

pedestrian control; and traffic control. Barriers protect facilities, critical infrastructure, and people from both errant and terrorist vehicle attacks. Properly designed and installed barriers are effective in controlling both pedestrian and vehicular movement inside a facility, within a facility's perimeter, or gaining access to the exterior of a facility.

Structural barriers can be grouped into two general categories:

- Natural barriers (water, vegetation, terrain); and
- Fabricated barriers (bollards, guardrails, fences, walls).

Table 13-1 below shows typical vehicle barrier usage and potential locations.

13.1.6 Perimeter Fencing

Fences provide a visible demarcation of non-public space and define the limits of a facility and/or yard. Fencing can range from high-security grill type fencing to cost effective chain-link fencing. If the security threat is lower or if aesthetics are a high priority, ornamental fencing can be used providing it is designed to prevent scaling. Low security fencing shall be used to define functional areas, and high security fencing shall be used for control of access to Omnitrans property by unauthorized persons.

Perimeter fences should be located and constructed to prevent the introduction of persons, dangerous substances or devices, and should be of sufficient height and durability to deter unauthorized passage.

Areas adjacent to fences should be cleared of vegetation, objects and debris that could be used to breach them or hide intruders.

Gates should provide an equivalent level of protection as the fence, be self-closing and have access control.

Table 13-1: Potential Barrier Uses and Locations

		Potential barrier location				
		Entrances, Exits, Perimeters of Admin/Control facilities	Entrances to parking lots	Entrances to stations	Entrances to Maintenance / Storage facilities and yards	Construction sites
Barrier Usage	Create stand- off distance	♦	♦	♦	♦	
	Protect assets / pedestrians	♦	♦	♦	♦	
	Slow vehicles		♦		♦	
	Stop vehicles		♦	♦	♦	
	Restrict vehicle entry		♦	♦	♦	♦
	Direct traffic	♦	♦	♦	♦	♦
	Revenue collection		♦			
	Theft deterrent		♦		♦	

13.1.7 Security Systems

Security systems must be designed to remain in service during emergencies. There must be sufficient space inside communication rooms for the electronic security system.

Integrating both physical and electronic security systems provides the highest level of protection for operations, employees, commuters, and visitors. To achieve this, the following design philosophy must be used:

- Auto-sensing day/night and/or infrared cameras must be used where it is not feasible to provide light levels sufficient to meet video surveillance requirements;
- Electronic security system equipment (command, control, and communication racks and panels) must be protected;
- Provide access control and intrusion detection to areas where this equipment is mounted or maintained. Security equipment racks or components must be segregated from non-security system equipment. These racks or components must have tamper indication using additional access control. Normal and stand-by power must be provided from dedicated security breakers;
- Provide tamper alarms on all security equipment racks and panels;
- Cabling must be protected in rigid conduit. If conduit is marked, the label must not include descriptive terms such as "Security," "Alarm," "CCTV," etc.;
- Communication (both data and video transmission) must use fiber optic cable for network connections and to devices wherever feasible;
- An independent rack-mounted security workstation must be provided in each communication room with dedicated electronic security system equipment racks. This workstation must provide all administrative and maintenance access to the respective security system, must be mounted inside a secured security rack, and must be protected against intrusion;
- Access control card reader systems must support both contact-less card and magnetic swipe cards;
- Electronic locks, when used, must be configurable for failing secure or un-secure in the event power is interrupted; and
- Modular camera components must be used to the greatest extent possible to minimize maintenance time. Use vandal-resistant, low-profile, dome housings for cameras wherever feasible.

13.1.8 Environmental Requirements

The security systems equipment must be capable of safe, correct and reliable operations at full load capacity and within the full range of environmental conditions.

For outdoor installations, the security equipment must be installed in enclosures and able to operate safely and correctly within the temperature ranges of minus 13 degrees F (-25 degrees C) to plus 158 degrees F (+70 degrees C) at 95% humidity with rainfall at up to 4" per hour. The design must protect against condensation, heat and water build-up in and around system elements.

13.1.9 Closed Circuit Television Cameras

CCTV cameras are an important part of the overall security of a facility. Not only can the cameras provide real-time surveillance of unmanned or remote locations, they can provide valuable information should a breach or incident occur. In addition, the presence of cameras can serve as a deterrent to potential intruders who may believe they are being observed.

13.1.10 Requirements

The CCTV system must provide reliable video surveillance, video data storage, and video display. The system must:

- Provide immediate display of CCTV cameras triggered by the corresponding intrusion detection system and at access point alarms;
- Provide fixed camera video coverage of all designated public entrances and exits, including platforms entrances and exits, TVM's and key intersections;
- Use digital video technology as the method for transmitting video images, point-to-multi pint video transmission system;
- Use closed-circuit television cameras to provide immediate view of all intrusion detection alarm zones and doors protected by electronic access control;
- Provide electronic digital storage of all video surveillance (all cameras). The minimum required is 30-days of storage for all cameras (minimum of 8-frames per second); and
- Cameras triggered by alarms must have an automatic capability to provide 10 seconds of pre-alarm video recording at not less than 30 frames per second. (Note: storage capability inside the camera does not satisfy this requirement – it must be stored a minimum of 100′ from the camera being recorded). The system must automatically continue to store video at not less than 30 frames per second until the alarm is cancelled.

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14. FARE COLLECTION EQUIPMENT

To lower dwell time and improve operating speeds and corridor travel time, the sbX system has adopted a proof-of-payment or at-station payment approach by means of off-board fare collection.

This barrier free proof of payment fare collection system to be used as part of the sbX system will interface with the existing bus system. No additional barriers will be installed at the stations and proof of payment will be required at all times when riding the sbX system. Patrons shall board and exit the sbX vehicles using all doors during stops at each station.

A proof of payment system requires that fare media inspections take place to enforce the proof of payment criteria. If a patron cannot provide proof of payment or a reasonable explanation of why they had not purchased a ticket, the inspector has several options, one of which is the issuing of fines or citations.

Ticket Vending Machines (TVM) and Stand Alone Validators (SAV) will be located at all stations. TVMs will issue tickets and SAVs will be used to activate prepaid tickets and passes. These devices will be at entrances to the stations. Each station platform will typically have two TVMs and one SAV.

14.1 Fare Structure

One day, 7-day and 31-day rolling period passes are currently available for use on the Omnitrans bus system. Discount fares for Seniors, Disability, Medicare and Student patron categories are available with proof of eligibility. Children that are 46" tall or less, ride free of charge, with a limit of two free of charge children per paying patron.

Exact change is currently required when boarding the bus, but in the future all passengers will use a pass rather than cash on the bus. For this reason, TVMs should be located at all transit centers and major transfer points in the future.

14.2 Proof of Payment Enforcement

A ticket inspection operation should be implemented to check approximately 20 to 30% of the daily BRT ridership. This percentage falls within norms accepted by other transit agencies in North America. Procedures can be developed to check everyone boarding at any one station or between stations or any variety of circumstances.

Ticket inspection techniques can be employed in a variety of ways. Inspectors can be located on the vehicle after doors close. Once onboard, the inspector is expected to inspect each patron. Asking for tickets and walking up and down the aisle can be a method to check everyone on the vehicle at any time. All passengers departing buses can be asked for proof of payment as well. Any area defined as a fare paid area, is open to inspection, including boarding platforms.

Riders must have in their possession, valid fare media for a visual or machine read inspection. The visual inspection will be enabled by ticket stock with date and time stamped on the ticket. The visual inspection process will confirm the valid proof of payment of those passes; these can be color-coded or have special graphics preprinted on them for identification purposes.

The machine readable inspection will be performed using a hand-held device to read all valid fare media. This device will provide an audible signal for a valid pass and display the period of validity information. The handheld fare media reader will be a small portable unit equivalent in size to a PDA class device, and will have a commercially available rechargeable battery, which is easily replaceable in the field. The primary function of the device is to allow fare inspectors to check that passengers have a valid proof-of-payment encoded on their magnetically encoded ticket.

14.3 Ticket Vending Machines

Ticket vending machines will be capable of dispensing passes from up to four types of stock. Any combination of stock will be used to dispense passes.

The ticket vending machines will allow payment using credit/debit cards. The vending machines shall be upgradeable to include ticket purchase using coins using nickels, dimes, quarters, Susan B. Anthony and Sacagawea dollar coins, and bank notes using $1, $5, and $10 or $20 bills.

Payment receipts will be dispensed upon request. Instructions will be provided in English, Spanish and will also meet ADA standards for those passengers with visual impairment.

A bankcard processor (BCP) shall be provided in each TVM. The BCP shall consist of a bankcard reader, a PIN pad and card control electronics. It shall be capable of processing all electronic payment media accepted by the TVM, including, credit, debit and check cards.

Ticket vending machines will be capable of communicating with central processing equipment to provide monitoring of the equipment operation, financial auditing functions and the ability to download information and data.

TVMs will also be capable of expansion of fare media for the use of SMART cards acceptable to the existing fare collection system on local bus vehicles.

As shown in Figure 16.1, typical dimensions of the TVM are 32” wide x 24” deep, with a height of 72” inches.

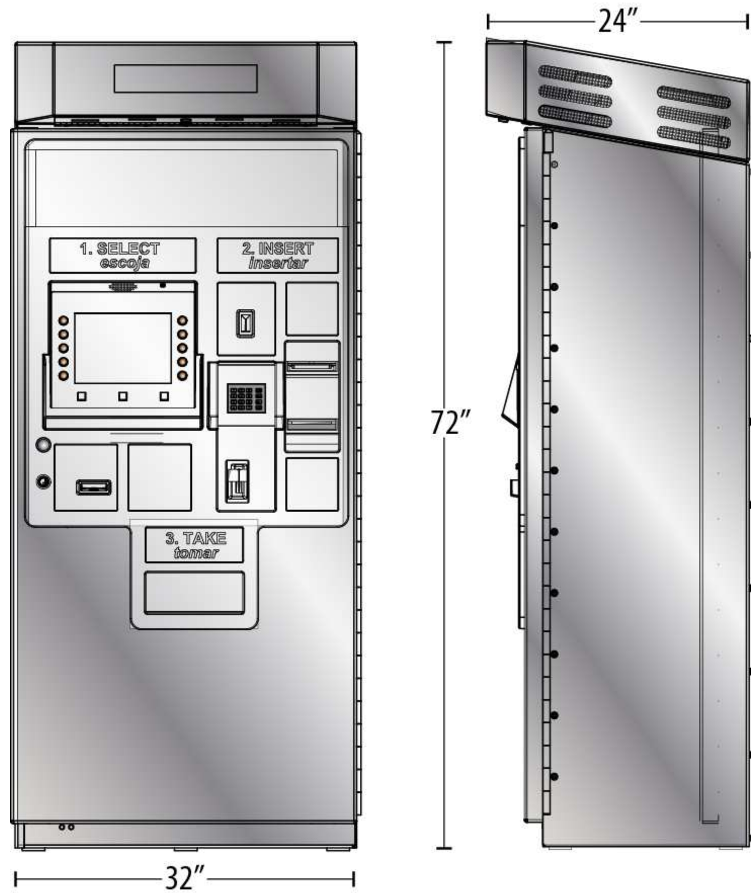

Figure 14-1: Typical Ticket Vending Machine Dimensions

14.4 Stand Alone Validators

Stand Alone Validators (SAV) will also be used for activation of tickets that have been pre-purchased. SAVs do not accept cash in any form and are simply electronic devices to read and/or write to magnetic stripes located on ticket stock. They also print on the ticket stock, information contained on the magnetic stripe such as, passenger category, date of validation, type of pass, and expiration date and time. Station of validation is also indicated. The function of the SAV will be to determine if cards are authentic and have proper value (within time limits) for the trip taken. SAVs will be connected to the central processing equipment to provide monitoring of operation and storage of data.

Dimensions of the SAV are 21" wide x 24" deep, with a height of 60".

14.5 Central Processing Equipment

The TVMs and SAVs will send messages and data to fare collection central processing equipment via a carrier transmission system to report activities and the status of the equipment, and to store data. The station equipment will be capable of being polled at any time for requested information. The central processing equipment will be capable of downloading information and data to the station equipment.

14.6 Passenger Interfaces

Instructions for use of TVMs and SAVs will be available in English and Spanish to guide patrons in making appropriate transactions. Braille characters and audio instructions will also be available to assist visually impaired patrons.

There will be an interface between riders and the TVMs in the form of a screen mounted on the front panel of the TVM. Directions will be given as to passenger category, type of pass, number desired and the required amount of money to insert. As money is inserted the total will decrement indicating the amount remaining to be inserted. Upon payment of the correct fare, instructions will be given to pick up tickets and/or change in the ticket tray. Other important system wide information can also be presented on this screen, as necessary.

Passengers shall make selections of pass categories by either making a touch screen selection, or by pressing a button located on the faceplate of the TVM. The same process is repeated for type of pass and the number of passes required.

14.7 Security

The design of the Fare Collection System shall discourage and minimize the effects of vandalism and theft, prevent unauthorized access to the interior of the TVMs and SAVs, and prevent unauthorized removal of the equipment from its installed location. Access to the equipment by authorized personnel equipped with proper keys and individual access code(s) shall be provided.

All TVMs and SAVs shall have security systems which shall indicate an intrusion attempt by providing an audible alarm at the site and by sending an alarm message to the central processing equipment. All TVM's and SAVs shall have a dedicated CCTV camera.

Access to the fare collection system network, its station and central processing equipment shall be secure, in that unauthorized users shall not be able to alter or view data.

14.8 Alarm Reporting Requirements

The TVMs and SAVs will report security, maintenance and revenue alarms to the fare collection central processing equipment. Security alarms reported will include alarms such as intrusion door opened, door closed, and cashbox removal indications. The maintenance alarms will consist of alarms that report on all abnormal or degraded conditions of station equipment. Revenue activities that are reported to the central processing equipment shall include the removal or addition of either ticket stock or cash.

14.9 Other System Requirements

Debit/Credit Network – The central processing equipment connects to a debit/credit network to allow fare media purchase transactions at the TVMs to be paid by debit or credit cards. The debit/credit network communicates with the central processing equipment via a carrier transmission system. PIN encryption devices are part of the fare collection system equipment to decrypt and encrypt the PIN of the debit/credit cards.

14.10 Maintenance and Servicing

Maintenance of equipment will be required to correct malfunctions such as jammed coins or bills, and out of ticket stock conditions. A variety of other inoperable components will require that maintenance staff have access to the systems needing maintenance actions. The equipment shall be designed to provide different levels of access to the interior of the equipment and money containers by maintenance personnel, revenue servicing personnel, and money processing personnel at the revenue-counting facility.

14.11 Access Control

Separate keys will be required to access the different levels of the equipment interior. Keys to all money containers are limited to the revenue crews, and the maintenance supervisor. There will be no such thing as one master key that opens all locks.

15. PARKING LOT DESIGN

The following is a brief overview of parking facility requirements including characteristics, basic dimensions, design criteria, and accepted standards. Station parking (park-n-ride) requirements include the number parking spaces are determined using the Travel Demand Forecast model and also dictated by developable/useable land in the vicinity of the nearest station.

Facilities will be paved, landscaped and designed to provide safe and convenient parking and bus transfer facilities for sbX riders. The parking lot facilities may include:

- Passenger/pedestrian circulation areas;
- Passenger information;
- Landscape areas;
- Stormwater retention basins;
- Standard parking spaces;
- Kiss-n-ride parking (optional);
- Accessible parking;
- Bicycle storage;
- Motorcycle parking (optional); and
- Security features including lighting, ETELs, cameras, etc.

To comply with accessibility requirements, the California Building Code specifies accessible parking space requirements for all sized lots. For smaller lots anticipated for Omnitrans projects, requirements include: 1 accessible space for each 25 spaces for the first 100 spaces, and 1 accessible space for each 50 spaces for the next 100 spaces up to 200 spaces. Van accessible spaces are also required.

For parking lots with off-street sbX stations such as the Kendall/Palm Station on the sbX Green Line, the facilities should also include:

- Passenger waiting and loading areas;
- All of the amenities planned for the on-street stations;
- Parallel stops or saw-toothed bus bays or islands designed for circulation of articulated buses; and,
- In some cases a bus turnaround.

Table 15-1: Typical Parallel Parking Dimensions

Size	Width (ft)	Length (ft)	Aisle Width
Standard	8.5-9.5	18-20	24-26
Intermediate	8-9	16-18	22-24
Compact	7.5-8.5	15-17	20-22
Accessible	9.0 + 5.0	18.0	
Van Accessible	9.0 + 8.0	18.0	
Source: *Guide for Design of Park-and-Ride facilities, AASHTO*			

Local and sbX service may need to be accommodated via bus bays within the parking lots. Design characteristics for sawtooth and parallel bus berths include:

- Sawtooth berth design:
  - Length of space for articulated bus: 80’-85’
  - Recessed area from curb line: 7’-10’
- Parallel berth design:
  - Length of space for articulated bus: 100’

Ingress and egress must meet local traffic engineering design standards for turning radii, and entrance and exit locations relative to nearby intersections. Parking bay widths, aisle widths, parking stall lengths, drainage, stormwater management, etc.

must meet the municipal code of the affected local agency. Shown in Table 15-1 are typical parking lot dimensions.

Any required bus layover areas should be located on the inbound roadway to the passenger loading area. Storage capacity should be provided according to the service plan developed for the lot.

The minimum layover area should be designed to accommodate two articulated buses. The bus loading area should be separated from roadways used by other vehicles. This area is ideally accessed directly from the street and should be consistent with the capacity requirements of the service plan.

16. LANDSCAPING

Landscape elements should enhance the comfort and attractiveness of the transit route. While maintaining the safety and accessibility of riders to the transit system and other adjacent users, trees, shrubs, groundcovers and vines should provide visual interest and unity as well as provide protection from the hot inland sun. Landscape elements should also create visual connections along the route as well as to adjacent streets and neighborhoods to the transit corridor.

16.1 Code and Standards

Unless otherwise stated, landscaping for new facilities or as part of changes to existing facilities should be designed in conformance with local landscape ordinances or published standards. Where the requirements stipulated in this document or any referenced source conflict, the more restrictive requirements shall apply.

16.2 Basic Goals

Landscape design should meet the following conditions:

- Recognized by the community as an example of design innovation and excellence;
- Ensures the comfort and safety of the Omnitrans system users, as well as those of adjacent pedestrians, or other adjacent modes of transit;
- Provides a uniform urban design along the entire length of the route, while also achieving a "fit" into the existing neighborhood(s) and physical context of the sites;
- Complements station architecture, art, signage, graphics and lighting designs;
- Uses elements compatible with local climate conditions, is sustainable and conserves water resources where feasible;
- Requires reasonable initial costs and maintenance costs;
- Should mitigate the effects of street widening for exclusive lanes; and
- Uses plant materials selected and located appropriately to avoid conflicts with utilities.

16.3 Plant Selection

Selection of plant materials should consider:

- Initial and maintenance costs;
- Local availability;
- Attractiveness;
- Compatibility with urban context and station architecture;
- Growth rate;
- Tolerance to drought, wind, pollutants, vandalism, and abuse;
- Hardiness;
- Compatibility with soil and drainage conditions;
- Sun/shade exposure preferences;
- Maintenance characteristics including leaf, flower, and limb litter; and
- Potential damage to adjacent paved areas by roots and attraction of rodents or insects.

Figure 16-1 shows plant palette used for the sbX Green Line consistent with local plant character

Figure 16-1: Plant palette used for the sbX Green Line

MYOPORUM parvifolium
Myoporum

HEMEROCALLIS 'Pardon Me'
Red Daylily

PHORMIUM 'Pink Panther'
Pink Panther Flax

MYRSINE africana
African Boxwood

CALLISTEMON 'Little John'
Dwarf Callistemon

ROSA "Knock Out Red"
Knock Out Red Rose

EUONYMUS japonicus 'Microphyllus'
Boxleaf Euonymus

GERANIUM 'Red'
Red Geranium

DIETES bicolor
Fortnight Lily

TRACHELOSPERMUM jasminoides
Star Jasmine

HELICHRYSUM petiolare
Licorice Plant

PITTOSPORUM tobira 'Variegata'
Variegated Pittosporum

DISTICTIS buccinatoria
Blood Red Trumpet Vine

LANTANA
Lantana

PHORMIUM 'Sea Jade'
Sea Jade Flax

NERIUM OLEANDER
Oleander

Figure 16-1: Plant palette used for the sbX Green Line (continued)

16.4 Growth Rate

Shade trees should be selected which produce a relatively mature canopy within 4 to 5 years of installation. Groundcovers should be selected to provide complete coverage within two years of installation. Once established, no plant material should need maintenance more than once a season in order to contain it within its designated planting area.

16.5 Environmental Adaptability

All plant material should have generally low water requirements, be hardy, long lived and resistant to disease. Long lived native plants are preferred. Soil testing should be performed to determine acceptable soil amendments and/or replacement of soils.

16.6 Tree Protection and Support

Existing trees that are healthy and attractive should be preserved whenever possible. Appropriate protection should be specified for trees that remain. Tree wells without grates are acceptable with Omnitrans approval. All new trees within pedestrian areas should be staked. For non-pedestrian areas, trees under 36" box size should be staked and roped with trees greater than 36" box size.

16.7 Irrigation

All planting areas should be irrigated during the establishment period. A permanent automatic irrigation system should be installed at all stations and park-and-rides where applicable. Water requirements should be considered in the selection of all plant materials. The design of irrigation components should focus on long-term low water usage, minimizing graffiti, and easy accessibility for maintenance personnel.

16.8 Relocating Trees

Provide tree protection barriers for those existing trees adjacent to any tree transplantation operations. Handle plant material to be transplanted only in ways and means accepted by the landscaping industry. Plants should be dug and prepared for moving in a manner that will not cause damage to branches, shape, root system, and development. Plant material should typically be planted the same day it is dug. Coordinate preparation of planting pits or beds to ensure this schedule.

Following transplantation, it is important to have a comprehensive watering and fertilizing schedule that includes watering the transplanted trees daily for the first two weeks, every other day for the next three weeks, and every third day for the balance of the determined watering/maintenance period. Such watering should thoroughly saturate the root ball to its full depth.

16.9 Maintenance

Landscape designs should minimize maintenance requirements. Maintenance-intensive treatments should be avoided. Lawns and other plant materials requiring intensive maintenance should be limited. Integration with existing acceptable plant materials and vegetation in adjacent areas should be emphasized.

Plant selection should consider mature plant size and correct spacing of plant materials minimizing pruning requirements. Planting design should consider ease of access by maintenance crews to plant materials during Omnitrans maintenance hours. Areas that require erosion protection should be landscaped with low-maintenance groundcovers.

Except where restoration of an existing landscape requires continuity and consistency, turf, formal hedges and espaliers should be avoided.

Plants that attract rodents and insects, excessive leaf litter and stains pavements should be avoided.

It should be the responsibility of the Cities and adjoining property owners to maintain landscaping once installed by Omnitrans Contractor and the Contractor's maintenance period has expired.

16.9.1 Corridor

Existing trees along the route should be protected in place unless they are to be displaced by new construction. Where feasible displaced healthy trees should be boxed and transplanted to other locations along the route. Choose species that define the route and complement existing species, as appropriate.

Street trees should be selected and spaced to conform to local requirements. Where no existing local requirements apply, selection and spacing should be approved by Omnitrans. Trees planted in paved pedestrian areas should be 24” box minimum. Trees should be spaced between 20’ and 50’ apart, depending on the species and local agency requirements.

16.9.2 Stations

Planting design for stations should include a mix of appropriate native and adapted drought tolerant plants, shrubs and groundcovers. The planting plan for the stations should attempt to provide as much landscape as feasible within the station site. Existing plant material should be retained, when appropriate.

16.9.3 Park-and-Ride lots

Shade trees should be provided in the parking lots between parking stalls, in the parking row-end islands or in stalls specifically designed for planting. Canopied trees reduce glare, reflection, heat, and the visual monotony of parking lots and provide a comfortable transition between the car and the station.

Entries to the stations may be emphasized by landscape elements determined by the designer (i.e. flowering specimen trees; masses of understory plants). Trees should be located, as appropriate, to provide useful shade in waiting, circulation and parking areas.

Trees should be located, as appropriate, around the perimeter of the parking lot and along pedestrian walkways leading to the station to achieve a visual impact and to emphasize the pedestrian routes to the stations.

Plantings should not obscure visibility from the street nor provide concealed areas within the parking lot.

Future photo of sbX Green Line landscaping

Figure 16-2: Photo of sbX Green Line Landscaping

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17. TRANSIT CENTERS DESIGN CRITERIA

Omnitrans' routes converge at several major transfer points, hubs where multiple routes converge to allow riders to transfer in a reliable and timely manner from one route to another. As transfers are a critical part of the experience of riding transit, Omnitrans must provide secure, comfortable facilities for passengers to make transfers.

Omnitrans' major transfer points are divided into two different types.

Transit centers are typically off-street facilities that provide timed transfers between many bus routes, multiple providers, and/or bus-to-rail connections. Pomona, Montclair, Fontana, and the planned San Bernardino Transit Center are examples of transit centers that provide connections between multiple bus routes and Metrolink rail service. Chino, Chaffey College, and Yucaipa are examples of transit centers in the Omnitrans system that provide off-street connections between multiple bus routes but not rail.

Transfer centers are generally on-street locations where buses share the road with vehicular traffic, and where transfers are provided between multiple bus routes, usually not timed. Transfer centers are typically located at shopping centers, malls, hospitals, universities, and other major activity centers. Many provide connectivity between Omnitrans routes and other transit services, such as Mountain Transit, Foothill Transit, Riverside Transit Agency, LA Metro, and Metrolink rail service.

Transfer centers include the temporary Fourth Street Transfer Center in downtown San Bernardino, Rialto Metrolink Station, Rancho Cucamonga Metrolink Station, Redlands Mall, South Fontana Transfer Center, and Ontario Civic Center Transfer Center. A transfer center is currently being planned for expansion at Ontario Mills Mall.

Figure 17-1: Examples of Fontana, Montclair and the 4th Street Mall Transit Centers

17.1 Transit Center Location

The ideal location and design for each transit center will depend on its intended purpose. For example, a transit center within a park and ride lot is better situated away from congestion choke points and congested areas but closer to highways and major roads. Transit centers that are intended primarily to provide transfers between different bus lines are better situated close to high activity locations with good accessibility to residential or commercial areas and other bus lines. In general, transit centers are better situated at a central location with a high transfer rate and corresponding high number of boardings, near accessible land uses that support high activity centers and communities.

Placement of transit centers should also consider the following factors:

- Proximity to Central Business District (CBD)
- Urban design issues
- Crossroads of major transportation arteries
- Available infrastructure
- Compatible land uses
- Private development plans

17.2 Sense of Place

Transit centers are intertwined with the adjacent area they serve and are reflective of the local communities. As important assets to the local communities, transit centers should contribute to a sense of place in the communities and can serve as a catalyst for increasing activity and corresponding investment in communities.

Context sensitive design can help create a sense of place, and principles of Crime Prevention through Environmental Design (CPTED), should drive the design of the stations, by providing unique, memorable locations, that provide a sense of comfort and safety to passengers. Omnitrans will work with the local jurisdictions through the design process of transit centers to help achieve these goals.

17.3 Accessibility

A common problem faced in public transportation planning is the "first mile / last mile problem" – when passengers getting off of a bus or a train do not have efficient transportation to get to their final destination, which may be a couple of miles away. Many of Omnitrans' riders solve the last mile problem by transferring from Metrolink service to Omnitrans service (with a free transfer). Omnitrans is continually improving mobility options and reducing travel times with the development of the sbX bus rapid transit system, consisting of ten rapid transit corridors that will connect to local routes at major transit centers and transfer centers.

Multi-modal trips are becoming more common in major metropolitan areas, with the prevalence of "car-train-car," "bike-train-bike," and "bike-bus-bike" trips. Several emerging trends include locating car share stations or bike share stations at transit centers, as well as bike centers where transit riders can rent bikes short-term, store their bikes in a 24-hour secure facility, or use a shower before going to work.

One of Omnitrans' goals for its transit centers is to make them more multi-modal, including facilities for pedestrians and bicyclists. 93 percent of Omnitrans' riders access the bus stop by walking, typically ½ mile each way, and 4 percent of riders access the stop by bicycling (*Omnitrans 2011 Onboard, Access, and Omnilink Riders Study*). Bicycling is a growing mode of transportation to access Omnitrans' system. Omnitrans has had two-bike racks on the front of every fixed route bus since 1996, and is currently installing three-bike racks on all buses (by 2013) due to the need for more bicycle capacity on board. The sbX bus rapid transit vehicles (beginning operations in 2014) will hold eight bicycles on board.

Part of the solution to integrate bicycles with transit is to provide a mix of secure and basic bicycle parking at transit centers, transfer centers, and bus stops. At the Chino Transit Center, the City installed bicycle parking racks upon customer request. Some cities, including Montclair, Rancho Cucamonga, Upland, and San Bernardino have provided secure bicycle lockers at Metrolink rail stations. E Street sbX bus rapid transit stations will include bicycle parking racks. The San Bernardino Transit Center (projected to open by 2015) will include a bicycle center with paid staff offering bicycle repair services, short-term rentals, secure parking, and showers, which is projected to increase the mode share of bicycling to access transit at that location.

Omnitrans and its partner agencies are continuing to search for an optimal combination of bicycle and pedestrian solutions that will improve access to transit. SANBAG, with a grant from SCAG, is currently developing a Transit Access Study with recommendations for solutions at and around Metrolink rail stations and BRT stations that will help to solve the "first mile/last mile" problem of access to transit. The recommendations being developed in that study are incorporated into this document.

In accordance with 2011 guidance from the Federal Transit Administration, FTA capital funds can now be used to fund many different kinds of pedestrian facilities within a ½-mile radius of a transit stop or station, and for bicycle facilities within a 3-mile radius of a transit stop or station. This provides future opportunities for making Omnitrans' existing and planned transit infrastructure more multi-modal.

17.4 Site Development

Development of selected Transit Center sites includes the following considerations:

- Physical constraints
- Relocation of infrastructure
- Environmental issues
- Intermodal connectivity
- Passenger circulation
- Economic development opportunities
- Safety and security issues

Omnitrans and other local bus providers serve a variety of routes and vehicles. Bus bay and site design should take into consideration:

- The number of routes serving the transit centers, and the number planned to serve in the short and long term.
- The frequency of routes and the potential for increased frequency on the routes
- The type and size of vehicles currently in service, and the potential for sbX services at transit centers
- Storm water retention requirements

At a minimum, design of transit centers includes the following:

- Bus bays for 40′ and 60′ vehicles, depending on future demand;
- Utilities including electricity and water;
- Hose bibs for washing down bus bays;
- Restrooms for drivers;
- Layout that is conducive to slow speeds and pedestrian safety;
- Pedestrian and bicycle connections to the surrounding area;
- Landscaping and trees for shade;
- Shelters for protection from sun, wind, and rain; and
- Security infrastructure, such as cameras, emergency phones, and lighting.

17.5 Amenities

The environment at a transit center is critical to the traveler's experience. Transit centers must be safe and accessible, as well as provide shelter from the weather, passenger information, restrooms, and other needed amenities.

The following is a full list of amenities that can be provided at transit centers. Future transit centers or improvements to existing transit centers will include some or all of these components.

- **Transit waiting environments –** In close proximity to the bus stop, passengers are in need of shelters to protect them from the sun, wind, and rain. Benches and trash cans are provided. Shelters have lights, sometimes solar-powered and sometimes connected to the grid. The transit waiting environment must be designed with safety and security in mind (high visibility), and must be ADA-accessible, with a wide sidewalk and sufficient space for waiting passengers.

- **Wayfinding signage –** Clear, logical signage using universal symbols is important for directing passengers or the public to various amenities at the transit center site. Wayfinding signage should indicate where parking and drop-offs should occur, where to walk to transfer from one transit route or service to another, where restrooms are located, etc.

- **Real-time arrival information –** By December 2013, information about what time Omnitrans buses will arrive at any stop will be available online, by mobile application, and by phone. Digital signs at transit centers will allow passengers to see what time their connecting bus or train will depart. This enhances the reliability of the system and allows passengers to reduce dead time spent waiting; they can instead use their time to quickly browse a local shop or grocery store, for example, knowing what time they can catch their bus.

- **Transit station building –** The station building provides core functions such as customer service and pass sales, information, waiting areas, and public restrooms.

- **Bike center –** The core function of a bike center is for secure storage for bicyclists who do not want to take their bicycle to their final destination. Typically, 65% of bike center users are also transit users (Source: survey of users of existing bikestationsTM, Mobis Transportation Alternatives Inc.). Bike centers typically provide parts and equipment for making repairs. Some have staff members who sell bikes, rent bikes, provide valet bike parking, and do repairs. Some bike centers also have restrooms, lockers for personal belongings, and showers.

Figure 17-2: Bike center inside transit center in Downtown Las Vegas.

- **Bicycle and pedestrian facilities –** For passengers who may choose to leave their bicycle near the bus stop, it is important to provide free outdoor bicycle parking at transit facilities and bus stops. Even where a bike center is available, passengers who may not be members of the bike center may still want to lock their bike to an outdoor rack near the bus stop if the bike rack on the bus is full. Safe pedestrian facilities are also a necessity, including well-marked crossings spaced at a reasonable distance, HAWK signals (demand-response traffic signals) for crossing the street or busway, and wide sidewalks.

- **Kiss and Ride area for drop-offs –** This allows easy access for transit riders to be dropped off by a taxi or in a private car, and allows for van, shuttle, and paratransit services to connect their riders to other modes of transportation.

- **Drought-tolerant trees and landscaping –** Shade trees are essential for providing a livable environment at transit facilities, both for protection from the weather and as a buffer from traffic. The placement of shade trees should be coordinated with security and law enforcement officials to ensure they will not block sightlines; they should also not be located so close to the roadway or busway as to obstruct bus travel.

  By using drought-tolerant plantings, transit centers can provide an example for the community of sustainability through low resource use. Informational signage can also inform the public about how some of the sustainability measures used at the transit center can be duplicated at home to reduce one's carbon footprint.

- **Electric vehicle charging stations –** In the future, Omnitrans will use electric-powered buses with 15-minute overhead charging stations at the bus bays. Sufficient space must be provided for electric conversion and storage capacity within 200' of the charging stations.

Figure 17-3: Electric bus charging station at the Pomona Transit Center for Foothill Transit

- **Retail –** Joint development of private retail, dining, or services at transit centers is mutually beneficial for transit agencies and for communities. Transit riders have access to food and services within a few steps of their transit stop; and tax revenues or rent from businesses can help to supplement the cost of building and maintaining transit infrastructure.

- **Solar panels –** Solar panels can serve a multitude of functions at transit centers, from providing overhead shelter for passengers, to powering lights and electronic signage.

- **Public art –** Transit centers are a civic space for the public. Engaging local artists or volunteers to create public art or displays at the transit center can contribute to a sense of place and community ownership of the public space.

Figure 17-4: Omnitrans' vision for solar canopies at San Bernardino Transit Center (Phase II) with mixed-used private development on site (produced by Cooper Carry consulting team)

- **Gateway signage and branding –** For passengers arriving in a city via public transportation, a transit center is a gateway providing an introduction to the city. For this reason, transit centers should provide welcome signage, visitor information, maps, and wayfinding signage to direct passengers to nearby destinations. An electronic or changeable information kiosk is also a useful tool for providing information to visitors, including nearby points of interest within walking distance, information alerts related to the transit center, etc.

- **Security –** Security at transit centers is vital to the experience of the passenger. Transit centers with high levels of ridership typically have one or two security staff people, who also serve as transit ambassadors to provide passengers with directions and assistance. Security cameras are also used throughout the site. Design of the site uses the principles of Crime Prevention Through Environmental Design (CPTED), such as providing clear sight lines for visibility.

Figure 17-5: Gateway signage and public art at Omnitrans bus stop adjacent to Rialto Metrolink station (funded with FTA discretionary funds through Omnitrans in partnership with City of Rialto)

- **Sustainable Transit Centers –** One of Omnitrans' goals for transit centers is to build them Leadership in Energy and Environmental Design (LEED) certified and environmentally sustainable.

17.6 Increasing revenue-generating opportunities at transit centers

Omnitrans' transit centers are major hubs of activity; the busiest hub in downtown San Bernardino currently has over 6,000 daily boardings, and the planned San Bernardino Transit Center will have projected 9,000 daily boardings in 2015 (including Metrolink, sbX, and 13 local bus routes).

With the addition of rail ridership, future bus rapid transit ridership, and foot traffic attracted by other potential uses at the transit centers, these locations provide an untapped market for retail, dining, entertainment, and other uses that could serve transit riders and other community residents. In turn, uses that attract people to the transit centers and surrounding areas will increase ridership, and provide increased demand for mixed uses in the surrounding areas.

According to Federal Transit Administration guidance, two ways to generate revenues at transit centers include incidental uses and joint development. An **incidental use** is a commercial activity that can take place at a transit facility without interrupting the provision of public transportation services. Common examples are coffee or snack shops and newsstands.

A **joint development** is a major commercial use on or near a transit facility, typically transit-oriented development such as residences, offices, or major commercial buildings, which are partly subsidized by transit funds. The Federal Transit Administration (FTA) must approve a joint development agreement between the transit agency and its private partner that certifies: 1) that the public transit use for the facility is not disrupted; and 2) that the transit agency is getting a fair return on their investment. The FTA has to ensure that facilities subsidized with federal transit funds are indeed being used for public transportation purposes, and that transit funds are not being used to outfit commercial revenue-generating operations.

Another example of a public-private partnership could be the sale of naming rights for a transit center. Omnitrans' current policy is not to name transit centers after local officials so as not to engage in political positioning; the sale of naming rights (such as to a corporate sponsor), however, could help pay for capital or operating costs for the transit center.

17.7 Maintenance of Transit Centers

Transit centers need regular upkeep to reflect a positive image to passengers and provide them with a safe and comfortable environment. Most transit centers are owned and maintained by the cities they are in.

The following maintenance tasks should be performed at the following frequency, or more often if needed:

- Janitorial – daily
- Power washing of the property - weekly
- Preventive maintenance – weekly, monthly, quarterly, and annually
- Exterior light maintenance – monthly or as needed
- Fire life safety – quarterly and annually
- Clarifier clean-out – semi-annually
- Changing light bulbs – as needed
- Resurfacing – every 3 to 5 years, depending on wear
- Repainting – every 5 to 7 years, or as needed from wear
- Replacing signage – as needed

17.8 Traffic Calming

Definitions of traffic calming vary, but they all share the goal of reducing vehicle speeds, improving safety, and enhancing quality of life. At transit centers, traffic calming measures can be employed to slow down bus vehicle speeds to ensure a safe pedestrian environment. Education and signage controls are one way of achieving this goal, as well as the following design considerations:

- **Speed humps** - rounded, raised areas placed across the roadway. They are generally 10 to 14 feet long (in the direction of travel), making them distinct from the shorter "speed bumps" found in many parking lots, and are 3 to 4 inches high. The profile of a speed hump can be circular, parabolic, or sinusoidal. They are often tapered as they reach the curb on each end to allow unimpeded drainage.

- **Speed tables** - long flat-topped speed humps that slow cars more gradually than humps
- **Raised pedestrian crossings** - Raised crosswalks are Speed Tables outfitted with crosswalk markings and signage to channelize pedestrian crossings, providing pedestrians with a level street crossing. Also, by raising the level of the crossing, pedestrians are more visible to approaching motorists.
- **Chicanes** - Chicanes are curb extensions that alternate from one side of the street to the other, forming S-shaped curves. Chicanes can also be created by alternating on-street parking, either diagonal or parallel, between one side of the street and the other. Each parking bay can be created either by restriping the roadway or by installing raised, landscaping islands at the ends of each parking bay.
- **Raised intersections** - Raised intersections are flat raised areas covering an entire intersection, with ramps on all approaches and often with brick or other textured materials on the flat section. They usually raise to the level of the sidewalk, or slightly below to provide a "lip" that is detectable by the visually impaired. By modifying the level of the intersection, the crosswalks are more readily perceived by motorists to be "pedestrian territory".
- **Neckdowns** – As shown in Figure 17-6, Neckdowns are curb extensions at intersections that reduce the roadway width from curb to curb. They "pedestrianize" intersections by shortening crossing distances for pedestrians and drawing attention to pedestrians via raised peninsulas. They also tighten the curb radii at the corners, reducing the speeds of turning vehicles
- **Safe Crosses** - Safe Crosses are similar to neckdowns, except they are located at midblock locations with a crosswalk. They leave the street cross section with two lanes that are narrower than the normal cross section. They are good for areas with substantial speed problems and no on-street parking shortage.
- **Textured Pavement** - Textured and colored pavement includes the use of stamped pavement or alternate paving materials to create an uneven surface for vehicles to traverse. They me be used to emphasize either an entire intersection or a pedestrian crossing, and are sometimes used along entire street blocks.

Figure 17-6: Traffic Calming Neckdown in Yucaipa

Figure 17-7: Potential Safety and Security improvements at existing transit centers includes the use of rumble strips and increased signage

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18. TRANSIT-ORIENTED DEVELOPMENT (TOD) GUIDELINES

Experience in other parts of Southern California and the country has shown that concentrating development near transit, often called Transit-Oriented Development (TOD) or Transit Villages, is an effective way to shift more trips from automobiles to transit. TODs can serve as a catalyst for economic development and community improvements which focus on the new access provided by the transit service.

This synergy between land use and transportation is a goal of the "livable communities," "sustainable communities," or "smart growth" philosophies. Smart growth can take the form of TODs in which a compact mix of uses may be provided within pleasant walkable environments focused on transit stations. The Federal Transit Administration (FTA) recognizes the potential positive impacts of the establishment of transit-supportive land uses around transit facilities and evaluates projects based on their ability to generate ridership and economic development through land use changes.

The main purpose of this section is to provide general guidelines for Omnitrans and its member cities to use in planning for and evaluating development adjacent to transit. The guidelines will also assist the FTA in assessing transit supportive uses and policies as part of its overall rating process.

In planning transit, the urban design approach is to identify how the existing urban fabric along the transit corridors and at stations can be transformed to a more transit supportive environment that also supports local goals for development and revitalization. Transit Supportive/TOD guidelines are the subject of this section. Topics discussed in this section include:

- TOD Definition and Characteristics;
- Support for Transit Villages at the Federal, State, and Regional Levels;
- Principles and Benefits of TODs;
- Examples of TODs in Western United States;
- General TOD Guidelines;
- Strategies for General TOD Implementation (TBD); and
- TOD Implementation Measures (TBD).

18.1 TOD Definition and Characteristics

TOD refers to a compact, mixed-use, pedestrian-oriented neighborhood or district surrounding a transit station. TODs often feature a variety of residential types combined with retail, employment centers, public areas and other services. TODs typically have a radius of one-quarter to one-half mile (which represents pedestrian scale distances) with a rail or bus station as the center (Figure 18-1). The center of the TOD is surrounded by relatively high-intensity development, with intensity of development gradually reducing outwards to be compatible with non-transit-oriented uses (Figure 18-2). A TOD area is convenient for employees and residents to travel to the transit station by foot, bicycle, transit, and accommodates vehicles.

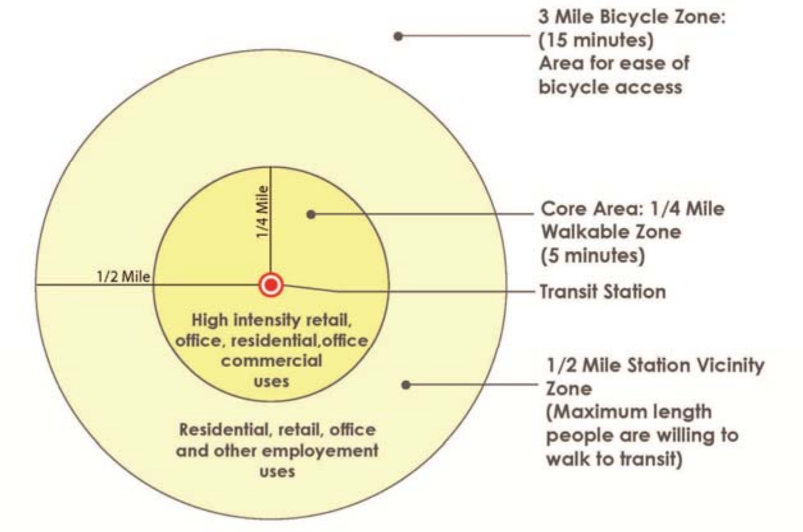


Figure 18-1: Basic TOD Diagram

Figure 18-2: Higher intensity/density development adjacent to the Fontana Transit Center

Transit-oriented developments are often called Transit Villages. Figure 18-3 illustrates the building blocks of the TOD Concept.

Typical characteristics of a TOD within ¼ to ½ mile of a station include the following:

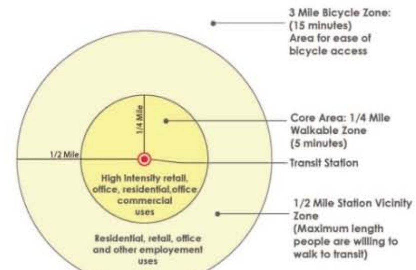
- An attractive, functional and accessible transit station with pedestrian and transit amenities as the focus for the TOD area, as shown in Figure 18-4;
- An appropriate mix of uses such as office and other employment, retail, entertainment, residential, office, and recreational facilities that foster transit usage, walking to the station, and opportunities for people to work, shop, live and play in the area, illustrated in Figures 18-5 through 18-7;
- Inviting public and civic spaces near stations;
- Building entrances oriented toward the street with parking behind buildings or underground (Figure 18-8);
- Well-designed and managed parking such as public parking structures, shared parking between uses, appropriate parking requirements, and bike parking facilities to reduce the land devoted to parking;
- Pedestrian connections such as sidewalks, pedestrian paths, and private paseos leading to the station and between uses (Figure 18-9);
- A bicycle network consisting of bike paths or designated bike lanes, connecting the transit station with other transit stops, the surrounding area, and citywide network (Figures 18-10);

Development in walking distance of BRT station to encourage alternatives to automobile trips, thereby reducing traffic congestion and improving air quality in the area

Building blocks of a TOD

1. The Passenger BRT Station with intermodal transfers (Metrolink, local bus, shuttle, and bicycle)

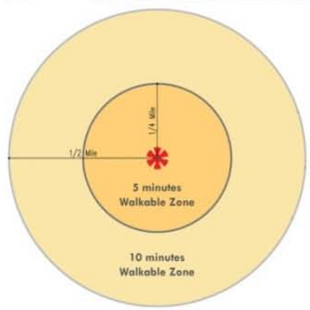
4. Compact mix of uses fostering walking and transit use with highest intensity at the center



2. Pathways for walking to station linking new and surrounding neighborhoods and jobs

5. Mix of amenities such as neighborhood services, public gathering spaces, bike paths and lockers and network of interconnected streets

3. Walkable area is within 1/4 to 1/2 mile from station



6. Improving the BRT alignment by adding landscaping and trails, uplifting the area

Figure 18-3: TOD Concept

Source: Conceptual vision prepared for Omnitrans by Cooper Carry for San Bernardino Transit Center and Transit Oriented Downtown, 2010

Figure 18-4: Transit village around a multi-modal transit center

Source: Conceptual vision prepared for Omnitrans by Cooper Carry for San Bernardino Transit Center and Transit Oriented Downtown, 2010

Figure 18-5: Mixed-use development around an active civic space

Figure 18-6: Mixed-use development with inviting public spaces which connect to a transit station in Fruitvale, CA

Figure 18-7: Retail and restaurants located on ground floors with residential above in this mixed-use development in San Diego, CA

Figure 18-8: Examples of building entrances oriented toward the street with parking behind buildings or underground. Example shown in photo - Downtown Redlands, CA (left) and San Francisco, CA (right)

Figure 18-9: A mixed-use project with varying building heights and entrances along landscaped pedestrian pathways and textured paving of parking areas, Rancho Cucamonga, CA

- An interconnected network of streets where walkways, landscaping, and pedestrian/bicycle amenities receive priority (Figure 18-11);
- Pedestrian-friendly streets with features such as the following:
  - Adequate sidewalk widths for at least two or more people to walk side by side (Figures 18-11 & 18-12);
  - Street trees at the curb in parkways or tree wells, in combination with drought-tolerant landscape and water retention and filtration areas;
  - A row of parked cars on the street to provide a buffer between the pedestrians and moving traffic (Figure 18-13);
  - Traffic calming by providing curb nubs to reduce pedestrian crossing distances (Figures 18-14);

Figure 18-10: Pacific Electric Trail in Fontana, CA with ample pedestrian & bicycle amenities

  - Pedestrian-oriented signage; and
  - Pedestrian scale lighting.

Figure 18-11: A pedestrian-friendly environment with adequate sidewalk widths and street trees in tree wells

Figure 18-12: Enhanced pedestrian streetscapes along high-density housing at Victoria Gardens, Rancho Cucamonga, CA

Figure 18-13: An example of back-in angled parking in the mixed-use, pedestrian-friendly Old Town District in Yucaipa, CA,

Figure 18-14: A typical green street facility in Portland, OR

18.2 Support for Transit Villages at the Federal, State and Regional Levels

The TOD Vision is consistent with the strategies, policies and plans of many local, state, regional and national governmental agencies and national development organizations. Among these are the Federal Transit Administration (FTA), Southern California Association of Governments (SCAG), the State of California, and the Urban Land Institute (ULI).Some of these initiatives include the following:

- Livable Communities Initiative established by Federal Transit Administration (FTA);
- State of California Transit Village Development Planning Act;
- AB32 and AB375 (recent California state laws) addressing sustainability and Greenhouse Gas (GAG) issues;

- Southern California Association of Governments Compass Blueprint Program; and
- Southern California Association of Governments 2012-2035 Regional Transportation Plan and Sustainable Communities Strategy.

18.2.1 FTA

In 1994, the FTA established the Livable Communities Initiative, which works to strengthen the integration of transit and community planning and encourages land use policies that support the use of transit. This might mean improving pedestrian flow into and out of transit stations or building transit-supportive uses such as childcare centers to make it easier for parents to drop off and pick up their children while going to and from work. The FTA gives priority for funding in its New Starts and Small Starts programs for transit projects with transit-supportive land use policies and implementation measures. Local city governments play a major role in its General Plan and other city plans, zoning, standards and programs by providing transit-supportive land uses plans, and implementation mechanisms. Recently passed MAP 21 legislation continues to encourage land use transportation integration.

18.2.2 State of California Transit Village Planning Act

The Transit Village Development Planning Act of 1994 of California's Planning, Zoning and Development Laws and amended in 2011 provides financial and other incentives for communities that develop Transit Village Plans around transit stations so that local land use plans and regional transit can be mutually supporting. One of the key incentives is that at least a 25% density bonus may be granted with performance standards.

Definition of transit village:

(a) A neighborhood centered around a transit station that is planned and designed so that residents, workers, shoppers, and others find it convenient and attractive to patronize transit.

(b) A mix of housing types, including apartments, within not more than a quarter mile of the exterior boundary of the parcel on which the transit station is located.

(c) Other land uses, including a retail district oriented to the transit station and civic uses, including day care centers and libraries.

(d) Pedestrian and bicycle access to the transit station, with attractively designed and landscaped pathways.

(e) A transit system that should encourage and facilitate intermodal service, and access by modes other than single occupant vehicles.

(f) Demonstrable public benefits beyond the increase in transit usage, including any five of the following:

   (1) Relief of traffic congestion.

   (2) Improved air quality.

   (3) Increased transit revenue yields.

   (4) Increased stock of affordable housing

   (5) Redevelopment of depressed and marginal inner-city neighborhoods.

(6) Live-travel options for transit-needy groups.

(7) Promotion of infill development and preservation of natural resources.

(8) Promotion of a safe, attractive, pedestrian-friendly environment around transit stations.

(9) Reduction of the need for additional travel by providing for the sale of goods and services at transit stations.

(10) Promotion of job opportunities.

(11) Improved cost-effectiveness through the use of the existing infrastructure.

(12) Increased sales and property tax revenue.

(13) Reduction in energy consumption.

(g) Sites where a density bonus of at least 25 percent may be granted pursuant to specified performance standards.

Source: California Government Code § 65460.2

18.2.3 AB 32 and SB 375

The AB 32 and SB 375 are recent California state laws that prompt California regions to work together to reduce greenhouse gas (GHG) emissions. These laws would achieve this objective by requiring integration of planning processes for transportation, land-use, and housing. The integrated plans emerging from these laws will lead to more efficient communities that provide residents with mobility alternatives and more convenient job and housing options. These laws offer local governments regulatory and other incentives to encourage more compact and sustainable development and transportation alternatives.

SB 375 includes specific incentives for more sustainable development. In order to motivate more sustainable development, SB 375 reduces costs and barriers associated with building compact TODs by streamlining and exempting from California Environmental Quality Act (CEQA) categories of development that meet specific criteria, especially streamlining for transit priority projects (TPPs), which include the following:

- Contain at least 50 percent residential use (any commercial use must have a floor area ratio of not less than 0.75);
- Provide a minimum net density of at least 20 dwelling units per acre; and
- Be within one-half mile of a major transit stop or high-quality transit corridor.

For more detail on implementation of the Sustainable Communities Strategy see Public Resources Code Section 21155.

18.2.4 Southern California Association of Governments (SCAG)

On the more regional level, SCAG's growth strategy is driven by four key principles: mobility, livability, prosperity, and sustainability. The Compass Blueprint 2% Strategy are guidelines for how and where the growth vision can be implemented with modest changes to current land use and transportation on 2% of the land area of the region. It proposes strategies to encourage transportation investment and land use decisions that are mutually supportive such as, transit-oriented development, infill development, mixed land uses, walkable communities, and locating new housing near existing jobs. At the core of the Compass Blueprint are Demonstration Projects that are partnerships of SCAG and local governments to apply SCAG's principles to local plans such as transit-oriented development. SCAG recently updated its Regional Transportation Plan (RTP). The focus of this plan is to improve the balance between land use and transportation systems, and to provide a policy framework on how to do so. The 2012 RTP includes both the Regional Transportation Plan and a Sustainable Communities Strategy.

18.2.5 Urban Land Institute (ULI)

First published in 2003, The ULI's Ten Principles for Successful Development around Transit was written to direct successful development around transit. These include:

- Creating a flexible, realistic vision and focusing on implementation;
- Forming public/ private partnerships to develop strategies and implement change;
- Planning for development when planning transit stations;
- Determining the optimum number of parking spaces to support transit and surrounding development;
- Turning transit stations into a great place that attracts the community and businesses;
- Getting the right mix of retail development;
- Including a variety of mixed-use projects along a transit line;
- Encouraging assortment of price points; and
- Engaging the corporate community in locational decisions.

18.3 Principles and Benefits of TODs

The San Bernardino Valley is estimated to experience considerable growth by the year 2035. Concentrating growth in walkable districts near transit stations rather than scattered throughout the valley will assist in improving air quality by reducing automobile trips and their carbon emissions, promoting economic development clusters, increasing housing choices, assisting in the affordability of housing by reducing the need for multiple cars in a family, reducing city costs for extending and maintaining expansive infrastructure, providing health benefits for workers and residents through walking & biking, and addressing a growing demand for convenient infill urban housing and neighborhoods. Table 18-1 lists some of the principles and benefits of TODs. These walkable transit district principles and benefits are appealing to changing demographics and growing preferences for a more convenient community life. The benefits are categorized as environmental, economic, and social.

Table 18-1: TOD Principles and Benefits

TOD Principles
TODs occupy land within ¼ mile to ½ mile radius around a rail or bus station, or within 125 to 500 acres. Typically, TOD areas are composed of three elements: • TOD area with platforms, and transit and passenger amenities, • core area within a five-minute walk of the station or about a 1/4 mile of the station, and the most intense employment, residential, and retail uses as well as convenience commercial for passengers, and • a neighboring ring within a ten-minute walk of station or from about ¼ to ½ mile of the station including a 10-minute walk of the station and containing residential, commercial and other uses. A TOD must be a walkable, pedestrian-oriented area with amenities such as street trees, benches, crosswalks, decorative paving, and public art. Direct pedestrian connections between different land uses should be provided. TODs have walking connectivity to the regional transit system and bicycle/trail and shuttle links to the area outside the ½-mile area provide extended connectivity. Plans, policies and zoning provisions relating to the intensity and mix of uses; pedestrian based building setbacks; and providing incentives such as density bonuses, floor area ratio increases, reduction of parking requirements, etc. play a significant role in facilitating a TOD, by making the area transit and pedestrian orientated.
Benefits
Economic • Catalyst for economic development: TODs can act as a catalyst for nearby properties to invest in development and take advantage of the higher land use density, customer base and walkable TOD community. • Redevelopment: TODs can be used to redevelop vacant or underutilized properties and declining auto oriented neighborhoods. • Increased property value: TODs can be used to revitalize the area within ¼ mile of the station. • Decrease infrastructure costs: TODs help reduce infrastructure costs due to compact and infill development that can use existing capacity and does not use as much capacity as auto based development. • Revenue for transit systems: Increased ridership leads to additional revenues for transit service. • Reduced household spending: By reducing auto, parking and travel costs, TODs contribute to an expansion of household net income and community spending. Households that use transit and reduce the need for one car can save up to $9,000 per year. **Environmental** • Increased transit ridership and decreased congestion: By decreasing driving, TODs result in reduced congestion. • Improved air quality and energy consumption: Decreased auto trips lead to lower emissions which results in improved air quality. • Conservation of land and open space: TODs are compact developments, and therefore, consume less land than lower-intensity, auto-oriented development.

TOD Principles
Social • Increased housing and employment choices: TODs provide a diversity of housing and employment types in conveniently close proximity to the transit station. • Greater mobility choices: By creating activity nodes linked by transit, TODs increase mobility options in congested areas. Young people, the elderly, those without cars or not wanting to drive also have mobility options. • Health benefits: By providing more opportunities for walking and bicycling, TODs offer health benefits. • Enhanced sense of community: Bringing more people and businesses closer in a pedestrian environment create an activity hub, TODs enhance community engagement and activity. • Enhanced public safety. By creating more active pedestrian places used throughout the day and night provides "eyes on the street", that helps TODs increase safety. • Quality of life – by reducing the driving time for long automobile commutes, people can recapture this wasted time or other activities.
Sources: Statewide Transit-Oriented Development Study; Gruen Associates/HDR.

18.4 Examples of TODs in Western United States

Below are more details on a few examples of recent Transit-Oriented Developments.

- **Mission Meridian Village, South Pasadena -** The South Pasadena Metro Gold Line was designed to include a town square with pedestrian amenities and artwork. The Mission Meridian Village, adjacent to the Metro Gold Line in South Pasadena transformed an older retail and residential area to include 67 condominiums, 5,000 square feet of retail space, two levels of subterranean parking containing 280 parking spaces, and a bicycle store and storage facility. It is located within two minutes of the Metro Gold Line Mission station and is designed in styles in keeping with the surrounding neighborhood, see Figure 18-15. As a TOD, Mission Meridian Village has been a success. In 2006, it won both the AIA Honor Award for Multifamily Residential developments and Congress for New Urbanism Charter Award. This development and the station have stimulated other pedestrian-friendly compatible developments in the area. (Source: Gruen Associates and www.challc.com).

Figure 18-15: Mission Meridian Village, South Pasadena, CA

- **Village Walk, Claremont, CA -** Village Walk is a transit-oriented development located within an eight-minute walk of Claremont Metrolink Station. It is also near Claremont Village, as well as the five Claremont Colleges. Completed in 2006, Phase I and II consist of 186 condominiums, lofts, town homes and duplexes. Village Walk is the main residential component of the City of Claremont's Village Expansion plan. The plan for the area includes the live/work lofts, restaurants, and shops. On the main street of Indian Hill Boulevard and the adjacent blocks, new shops, offices, restaurants, a boutique hotel, a five-screen movie theater, and a public parking structure with retail tenants, as well as a public plaza were constructed, see Figure 18-16. (Source: City of Claremont website).

Figure 18-16: Village Walk, Claremont, CA

- **Holly Street Village, Pasadena -** The Holly Street Village in Pasadena was built in anticipation of the Memorial Park Gold Line Station. The project includes 374 apartments in 7 buildings, 200,000 square feet of parking, and 11,000 square feet of offices and retail on the ground floor, see Figure 18-17. The light rail station is located at ground level of the main building of the project. (Source: San Bernardino County Long Range Transit Plan).

Figure 18-17: Holly Street Village, Pasadena, CA

- **Grossmont Trolley Center, La Mesa** - Completed in 2010 in the City of La Mesa, the Grossmont Trolley Station Transit-Oriented Development consists of two levels of structured parking on both sides of Grossmont Center Drive, 527 one- and two-bedroom apartments on three and four-levels above the parking, and 3,000 square feet of commercial. The TOD is constructed on a seven and one-half acre site adjacent to the existing Grossmont Trolley Station and replaces 600 surface parking spaces. The Grossmont Trolley Station had only a steep staircase connecting the trolley station to the Grossmont Center with its active uses at the top of the bluff (Figure 18-18). Two elevators were constructed to improve access to the bluff as well as additional transit and pedestrian amenities. A bus court drop-off and pick-up encircles the development and provides access to the replacement parking. The award-winning Fairfield Residential Development follows design standards and guidelines prepared by the City of La Mesa with assistance from Gruen Associates. A portion of the apartments are available to very low- and moderate-income households. (Source: Gruen Associates, City of La Mesa)

Figure 18-18: Grossmont Trolley Center, La Mesa, CA

Fruitvale Transit Village, Oakland - Fruitvale Transit Village is a mixed-use development adjacent to the Fruitvale Bay Area Rapid Transit (BART) District station in Oakland. Fruitvale Village was conceptualized as a need to revitalize the existing neighborhood businesses and a plan to better integrate businesses into transit station development. It includes approximately 40,000 square ft. of retail and restaurant space, approximately 114,000 square ft. of office space including a senior center, a health clinic and a library, and 47 units of mixed income housing. These uses are connected through a pedestrian plaza to the Fruitvale BART station. Phase I was completed in 2004. Phase II, divided into three parts, calls for 450 additional units (Figure 18-19). *(Source: The Unity Council).*

Figure 18-19: Fruitvale Transit Village, Oakland, CA

- **Del Mar Station, Pasadena CA -** Completed in 2007 in Pasadena on the Metro Gold Line, Del Mar Station is an intense, mixed-use development based on the concept of historic transit plazas of Europe. The four- to seven-story buildings, organized around a 1-acre plaza and the train station, have 347 apartment units and 11,000 square feet of retail use, Figure 18-20. (Source: The New Transit Town, Best Practices in Transit-Oriented Development).

Figure 18-20: Del Mar Station, Pasadena, CA

- **Orenco Station, Hillsboro, OR –** Located in Portland's growing high-tech corridor, Orenco Station is situated immediately south of the Intel Ronler Acres plant, a manufacturing and Research and Development facility that employs 16,000 people. In 1999, the National Association of Home Builders named Orenco Station "America's Community of the Year". Started in 1997 on an old nursery site, it is a 1,100 acre new town with a 52-acre village center with mixed-use shops, services and residential. It has a range of housing types and prices (rental units, live-work units, loft units above retail, single family) that includes over 4,300 residential units as well as 200,000 square feet retail uses and 800,000 square feet of office uses, Figure 18-21. There is a pedestrian access to the MAX light rail station that extends from the town center. The town center has four-story residential with ground floor retail along the main street. Currently, the walk from the Orenco Station to the town center takes approximately seven minutes and there is little development and no retail space along the way. *(Source: Planetizen)*

Figure 18-21: Orenco Station, Hillsboro, OR

- **The Pearl District, Portland, OR –** Much has been made of the success of Portland's Pearl District and it is not unwarranted. Since the first residential units were built in 1994 more than 3,500 lofts, condos and apartments have sprung up in the 85-block area, with many more on the drawing board. The area was transformed from an older commercial/industrial area. The Pearl District's zoning emphasizes multi-use structures with street-level food, service and retail shops, as well as residential and office uses, see Figure 18-22. The Portland Streetcar, which runs north and south through the Pearl District every 13 minutes, makes connections with light rail (MAX) as well as the bus transit mall. There is also a strong emphasis on public spaces and parks. Agreements with the City of Portland and property developers have allowed the creation of several parks such as Jamison Square and Tanner Springs Park and also provided tax abatement. Part of the reason that the Pearl District has been so successful is the great diversity of the area. In 2008, rents and property prices increased drastically, pricing-out average Portland residents as well as independent retailers. However, this may change with recent housing market adjustments. (*Source: www.tndwest.com*)

- **Museum Place, Portland, OR –** This project is located in Portland's vibrant downtown area two miles south of the Pearl District. Museum Place is a three-block project that includes five major structures, the last of which was completed in 2006. The building that is most noteworthy sits on the southernmost block and contains the 140 Museum Place Lofts and Townhomes (128 apartments, 12 rental two-story townhomes, and 225 parking spaces for residents and shoppers, 28 of which are income-restricted), as well as a 47,000 square feet Safeway. The Safeway is quite noteworthy itself, for the manner in which it addresses the street, see Figure 18-23. The market, located on the ground floor, has three frontages that all have windows, allowing views from the street into the interior *(Source: www.tndwest.com)*.

Figure 18-22: The Pearl District, Portland, OR

Figure 18-23: Museum Place, Portland, OR

Figure 18-24: Downtown Brea

- **The Stuart at Sierra Madre Villa Station, East Pasadena, CA –** The 1999 East Pasadena Specific Plan encouraged TOD uses around the then proposed Gold Line light rail station at Sierra Madre Villa and provided development guidelines. The Stuart, located adjacent to the final stop of the Metro Gold Line on 7.5 acres of property, and completed in 2006, is the first phase of the TOD. Part of this 188-unit complex is the former Stuart Pharmaceutical plant and office building that was designed by architect Edward Durell Stone in 1958 and is listed in the U.S. National Register of Historic Places. The Stuart features a direct pathway to the Sierra Madre Gold Line station and park-and-ride, and preserves portion of the Stuart Pharmaceutical (Figure 18-24). The second phase of the project (still under review) will include an additional 322 units. *(Source: Gruen Associates and Pasadena Star News)*

- **Downtown Brea, CA –** With the decline of old Downtown Brea, the City of Brea hosted a design charrette in 1989 to bring new life into downtown, Figure 18-25. What resulted from the charrette was a new downtown mixed-use district. Built from scratch, the pedestrian-friendly 60 acre entertainment/retail district consists of movie theaters, restaurants, and retail as well as a mixture of housing options with live-work apartments and townhomes *(Source: www.epa.gov).*

Figure 18-25: The Stuart at Sierra Madre Villa Station, East Pasadena, CA

Figure 18-26: Mandela Gateway, Oakland, CA

- **Mandela Gateway, Oakland, CA –** Mandela Gateway is a HOPE VI project located at the West Oakland Station on BART. Hope VI is a program run by the U.S. Department of Housing and Urban Development, which was created to help transform public housing and help give residents positive incentives for self-sufficiency as well as comprehensive community services. This project consists of 116 attached rental units and 14 townhomes, as well as 20,000 square feet of retail space, an outdoor playground for children, community facilities for local residents, and town squares at both corners of the gateway. The homes are accessed from a gated interior courtyard, except for 18 of the units which have entrances on 8th Street, providing connectivity with the neighborhood, see Figure 18-26). *(Source: www.bridgehousing.com and www.tndwest.com)*

- **BRT – Transit-Oriented Development –** Although Bus Rapid Transit is relatively new in the United States there are several notable development examples. The Cleveland **Healthline, a** dedicated lane BRT project, has resulted in renovation of the entire Euclid Avenue and more than $5 billion worth projects are underway or constructed along five miles of Euclid Avenue [1]. The Metro Orange Line in the San Fernando Valley, Los Angeles, an exclusive lane BRT is being to stimulate major residential projects development around the Canoga Station in Warner Center. Pittsburgh's East BRT, built within a railroad ROW has been a catalyst for new development, see Figures 18-27 through 18-29.

Figure 18-27: Cleveland's Euclid Corridor BRT has paved the way to economic development: *Source: Google Earth*

[1] http://www:columbusunderground.com/forums/topic/cleveland-euclid

Figure 18-28: Metro Orange Line in the San Fernando Valley, LA with new major residential development around stations

Figure 18-29: Pittsburgh's East BRT built in a railroad ROW with a new pedestrian bridge across the busway to connect the development to the station. Source: Google Earth

18.5 General TOD Guidelines

General TOD guidelines would apply to all TODs and should be considered flexible depending on the uses and unique conditions in a specific area. Many of the guidelines may already be a part of a city's general plan and zoning. The general TOD guidelines aim to ensure development which is supportive of transit, walkable, aesthetically pleasing, attentive to detail, human-scale and sensitive to existing and surrounding development. The general TOD guidelines are organized as follows:

- A Mixture of Land Uses and Compact Development;
- Prototypical Building Types;
- A Pedestrian/Bicycle-Friendly Environment and Facilities;
- Well-designed Parking and Access;
- Architectural Design Character and Massing;
- Outdoor Open Space Network
- Building Entries and Service Access
- Building and Site Access
- Signage; and
- Sustainable Development.

18.5.1 A Mixture of Land Uses and Compact Development

- **Transit supportive uses:** Transit supportive land uses that generate high-pedestrian activity support multiple trips, foster 24/7 environment and increase transit ridership should be provided in each station area. These include uses such as movie theaters, restaurants and outdoor cafes, bookstores, floral shops, newsstands, childcare, offices, high-density residential and other retail, employment and institutional uses that cater to the needs of residents, employees and transit stop users, as shown in Figures 18-30 and 18-31.

Figure 18-30: A mix of transit supportive uses, Portland Downtown

Figure 18-31: Nicolette Mall an example of a walkable urban center in the Twin Cities. *Source: Google.com.*

- **Economic development and job creation:** Employment intensive businesses that benefit from being within walking distance of transit should be identified and promoted.

  Over time support the conversion of heavy-industrial uses within a TOD to more employment intensive uses, mixed use and other transit supportive uses. Relocation of these heavy-industrial uses, storage uses, and automobile oriented uses to other parts of the city should be addressed.

- **Mix of uses:** A mixture of land uses, appropriate for a TOD and supporting facilities, is encouraged to foster walking within the development to the transit stations and to the surrounding land uses. These may include uses such as residential, retail, restaurant, offices, entertainment uses, hotel, public facilities, open spaces and other employment uses (Figure 18-32). There is no one size fits all for TODs.

Figure 18-32: A former industrial building in San Diego has been converted and expanded into a mixed-use destination.

  The mixture of land uses may vary depending on existing conditions in the station area and the major development concept/theme envisioned for an area. For example, some TODs may emphasize employment and regional retail with higher-density housing, such as in a downtown area and some TODs may be more neighborhood-oriented with moderate density housing and neighborhood retail and restaurants focused on a pedestrian gathering space.

- **Compact Development:** Compact development with a mix of uses places more people in walking distance of the station and fosters walking between uses minimizing some auto trips. To generate transit ridership and reduce automobile dependency, highest residential densities and floor area ratios permitted in the City should be allowed within ½ mile of a transit station. In a downtown area this may mean multi-story buildings. In a more suburban location, this may mean townhomes near the stations and small lot single-family homes further from the station. To encourage property owners, developers and city decision makers to support compact development and provide a customer base for commercial uses, minimum densities should be required, as well as incentives for achieving maximum preferred densities.

  - Cities should include minimum and desired densities and floor area ratios. In areas without strong economic conditions, projects may comply with minimum densities and floor area ratios by providing to the City a phased development plan that shows how increased density could be achieved such as later converting surface parking into more intensive uses.

  - Incentives per state law may be provided such as the 25% increase beyond the City's highest density, if public benefits are provided and other incentives are provided such as reduced parking, streamlined processing and streamlined CEQA.

18.5.2 Prototypical Building Types

The ½ mile TOD area occupies over 500 acres, providing infill and new development opportunities for many types of uses and building types interspersed with viable existing uses. Development within the TOD are may take the form of separate uses such as duplexes, bungalow cottages, 4- to 6-plexes, townhomes, multifamily housing, offices and retail shopping areas and also new prototypical development such as mixed-use development which combines residential with one or more of the following uses: offices, retail, entertainment, restaurants, community facilities or similar non-residential uses. Mixed-use projects may be arranged vertically (typically ground-floor retail or restaurant with residential above) or horizontally (typically commercial uses on a portion of the property lined by pedestrian connections to residential uses such as part of a unified development).

Although other uses may also be found, as mentioned previously., the following Figure 18-33 illustrates a range of building types typically found in TODs.

- Middle-density housing including duplexes, bungalow cottages, 4- to 6-plexes, townhomes and garden courtyard apartments typically varying from 14 to 24 units/dwelling units/acre;
- Higher-density housing including courtyard apartments or condominiums, and other multi-family residential varying from 20 to 60 units/acre and above;
- Live-work units typically including one- to two-story residential over ground level office and parking;
- Mixed use which means the combination of commercial development combined with residential development either in a vertical configuration (residential over ground level retail/restaurants) or horizontal configuration (residential and commercial development adjoin each other in the same development);
- Retail/restaurant uses clustered in a main street configuration or in a town center with a highly walkable environment;
- Entertainment and hospitality uses such as auditoriums, theater, cinemas, bowling alley, skating rinks, comedy clubs, music clubs, and hotels;
- Employment intensive offices such as professional, government, knowledge based, research and development, and call centers;
- Employment intensive manufacturing and production such as small high-value products assembly, clothing, etc.;
- Cultural or institutional facilities such as artist and crafts studios, galleries, libraries, museums, churches;
- Healthcare facilities; and
- Recreational facilities including parks, community gathering facilities, and sports fields.

Middle density (Bungalow Cottages, Duplexes, Granny Flats, Townhomes)
12 to 24 du/ac


Bungalow cottages, Whidbey Island, WA


Claremont Village Expansion, Claremont, walk-up style townhomes


Meridian Court, Pasadena, CA


San Diego, CA

Multi-Family and Mixed-Use
36 to 54 du/ac


Uptown, San Diego, CA


Fruitvale Village, CA


Portland, OR


Burbank, CA

Employment Intensive Uses (Office, Educational, Industrial-Flex, Live/Work, Artist Studios, Tech Based Offices & Services)


Office


Office Park, Playa Vista, CA


American College, Ontario, CA


Live/work or artist lofts, Gaithersburg, MD and Santa Ana, CA

Entertainment Uses & Retail


Tree-lined sidewalk with restaurants in Culver City, CA


Theater, Culver City, CA


Hotel, San Diego, CA


Small format grocery with residential on top, Portland, OR

Figure 18-33: Residential/Mixed-Use Building Types

18.5.3 A Pedestrian/Bicycle-Friendly Environment and Facilities

- **Continuous pedestrian and bicycle network leading to the transit station**: A major component of any TOD is the creation of connections and linkages from the TOD neighborhood to the transit station. Within the ½-mile TOD area, a plan for and implementation of a continuous, attractive landscaped pedestrian network should be provided linking the mix of land uses to the transit station. A bicycle network consisting of multi-purpose paths for pedestrian and bicycles, bike paths or designated bike lanes should also be included within three miles of transit station.

- **Adequate sidewalk width**: Adequate sidewalk width should be provided to accommodate pedestrians in street rights-of-way. Devices such as curb nubs or "bump outs" and sidewalk easements on private property are methods to provide adequate sidewalk width in constrained right-of-way condition. Sidewalks and parkways 12' to 15' are desirable as they are wide enough for street trees at the curbs, pedestrian amenities, and width for at least two people pass each other and street trees and amenities. Sidewalks or curb parkway width on arterials should not be less than 10'.

- **Public and private streetscape improvements**: Along each of the streets in a TOD streetscape enhancements should be included to make the area more walkable. These enhancements include landscaping of sidewalk areas along the curb, street furniture, special paving, gateway improvements, pedestrian lighting, pedestrian signage, seating, local bus stops, landscaped medians, water features, decorative crosswalks, and other amenities.

- **Safety for pedestrians and bicyclists**: Transit stations design should be integrated with the surrounding urban fabric by providing adequate pedestrian amenities, public open space, and well lit interconnected walkways and bike paths. More pedestrian and bicycle activity should be provided to encorage more eyes on the station area to enhance a sense of safety for all users. Safe and secure facilities, such as restrooms and bike racks, should not be isolated and located far from the station entry.

- **Buffer**: Pedestrian pathways and sidewalks should be buffered from moving traffic by providing street trees along the curbside or a row of parked cars on the street.

- **Outdoor dining:** Outdoor dining may occur on a portion of the paved sidewalk or in adjacent private area, as shown in Figure 18-34.

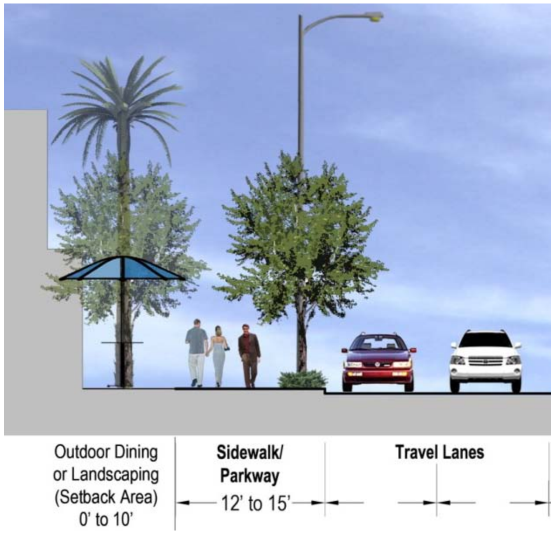


Figure 18-34: Outdoor dining adjacent to a comfortable pedestrian environment

- **Amenities**: At transit stations and along arterials leading to the stations, provide pedestrian amenities appropriate to ridership at the station such as sufficient lighting, street furniture, decorative crosswalks with signalization (Figures 18-35 & 18-36), pedestrian signage, and seating along sidewalks. At intersections of major streets include pedestrian amenities such as colored concrete, decorative or high visibility crosswalks, embedded lights, and signalized intensities.

Figure 18-35: Diagonal crosswalks increase accessibility, and connectivity.

- **Pedestrian-scaled blocks**: To foster a walkable environment, a regularized grid and short pedestrian scaled blocks of 400′ to 600′ or less are the preferred patterns. Large automobile oriented blocks should be scaled down to make them more walkable by providing public access through them, organizing development around open spaces, and pedestrian-scaled access ways, such as paseos.

- **Ground level uses**: Pedestrian-oriented uses should be located at the ground level of buildings fronting the sidewalks, where feasible, see Figures 18-37 - 18-39.

- **Wayfinding**: TODs should provide wayfinding signage, visual cues, and public art to communicate the activities in the TOD and the linkages to transit and these activities.

- **Pedestrian pathways under and over freeways and railroad lines:** In San Bernardino County, many of the 1/2-mile area around the proposed BRT or light rail lines stations encompass freeways and railroads which are barriers to pedestrian movement. Attractive, well-lit pedestrian and bicycle paths should be designed along major arterials over and under the barriers providing access from one part of a TOD to another part.

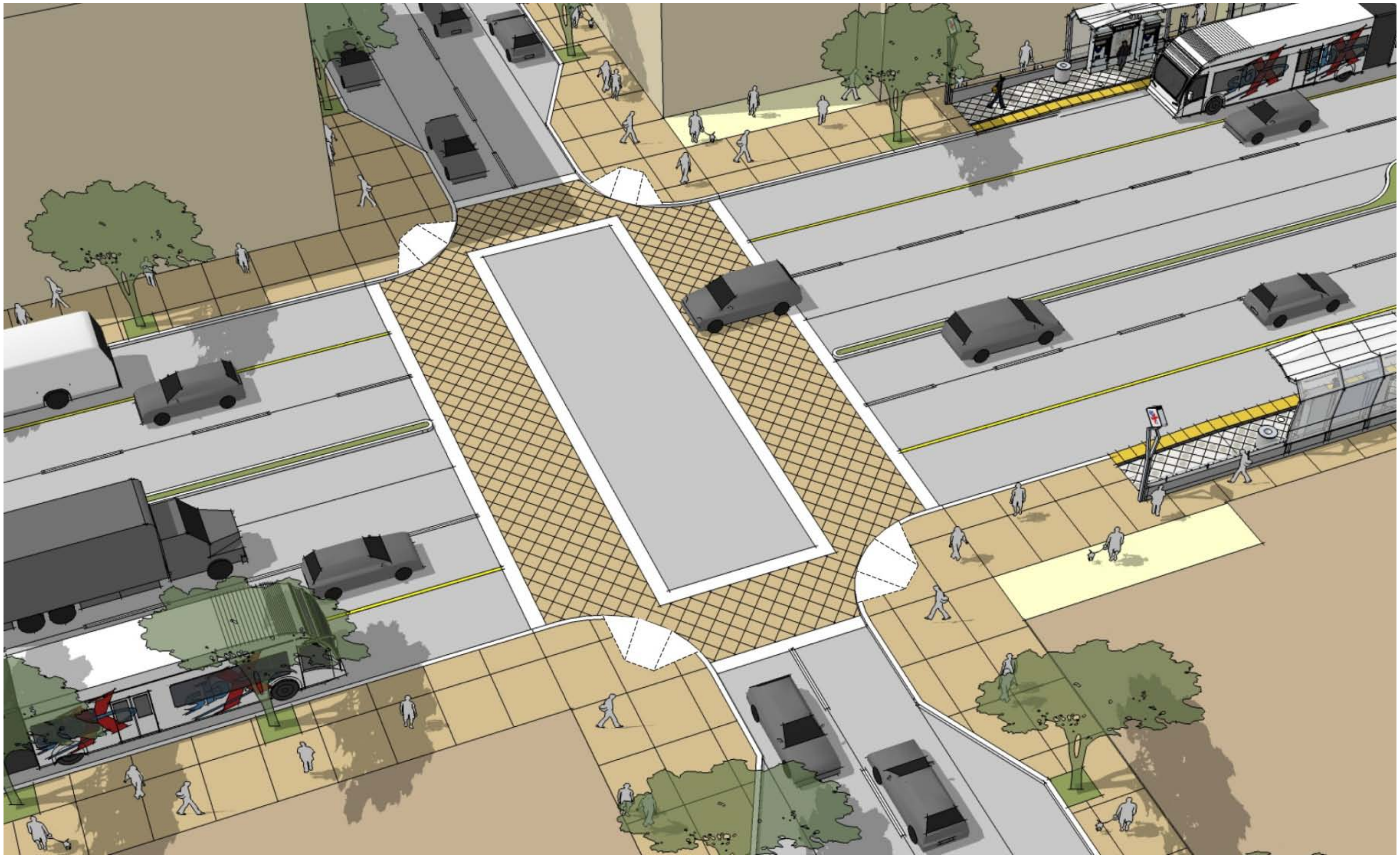


Figure 18-36: Decorative crosswalks create pedestrian awareness and caution drivers entering a pedestrian area.

Figure 18-37: Wide sidewalks with ample space for pedestrians in Downtown Culver City

Figure 18-38: Streetscape enhancements such as landscaping of sidewalk areas, landscaped medians and other amenities.

Figure 18-39: Bus shelter in Santa Monica with amenities such as sufficient lighting and seating.

18.5.4 Well-designed Parking and Access

- **Amount of parking:** As transit is available in walking distance of uses within a TOD, the amount of on-site parking required for development should be less than for other areas of the city. Each City should consider reduced parking standards in TOD areas. In addition to a reduction in required parking, City standards may include provisions for shared parking, unbundled parking, in-lieu parking fees, provisions for transit passes or other mechanisms.

- **Location of parking:** To emphasize the pedestrian realm, on-site parking is discouraged adjacent to the sidewalk along major streets but instead should be located underground or at the rear of the parcels with convenient pedestrian access to non-residential and residential uses. On-street parking, where appropriate, is encouraged to buffer pedestrians along the sidewalk, as well as shared parking access/structures, see Figure 18-40.

Figure 18-40: Public parking located at the rear of the parcels with convenient pedestrian access and parking.

- **Screening of parking:** Existing or new parking spaces in lots which face a street should be screened from view from the street by a hedge or a low masonry wall and vines. Parking garages should be designed with generous landscaping and canopy trees surrounding them.

- **Parking access:** When available, access to parking should be from side streets and from alleys. To minimize traffic congestion and breaks in the pedestrian realm multiple parking access points along major streets are discouraged. Joint use or combined driveways are encouraged. The width of driveway area cuts should be minimized, see Figure 18-41.

Figure 18-41: Guidelines for Parking Design in a TOD

- **Parking garage design:** The design of parking structures should be compatible with the design of the main building. Wrapping an above ground parking structure with residential units, retail, or office is encouraged to screen parking from public view. An above-grade parking structure should not have sloping floors visible from adjacent streets.
- **Safety and security:** Safety and security of the people using the facility are of paramount importance. Therefore, parking structures design should consider open, glass stairwells and glass-backed elevators and should eliminate potential hiding places. Energy efficient lighting should be provided to improve safety. A balance between daylighting, interior lighting and exterior control should be addressed to provide adequate lighting. Lights should be vandal resistant and easy to maintain. Security devices such as video, audio and emergency buttons that call into the booth or local police station should also be provided.
- **Parking structures located away from street frontage:** Above ground parking structures should not front on major streets unless there is no feasible alternative. If parking structures are located on a major street, the ground floor should be devoted to pedestrian-friendly retail, service and restaurant uses with visual interest.
- **Interconnected parking:** Where possible, link the new parking with that of adjacent development to facilitate vehicular and pedestrian movements, especially when streets are congested.
- **Shared use of parking:** Shared parking with a management plan should be included in a new TOD to minimize traffic congestion and parking demand.
- **Drop-off and valet:** Spaces for drop-off, kiss-and-ride, and valet parking should be provided in major projects.
- **Street Layouts:** To provide dispersed access to transit from TOD uses and a more walkable pedestrian environment a grid network of local through streets with sidewalks is preferred over a system of superblocks and cul-de-sacs.
- **Street width:** In order to slow traffic and make wider pedestrian linkages consider a modification in the lane widths of streets and an increase in pedestrian sidewalk widths, where appropriate.
- **Safety devices:** To make an area safer for pedestrians include devices such as "Z" crossings of major streets, median refuge areas for pedestrians, beeping crosswalk signals (Figure 18-42), countdown timers, and embedded flashing devices in crosswalks at non-signalized intersections.

Figure 18-42: High visibility crosswalks provide pedestrians safety

- **Bike lane streets, bike boulevards, and amenities:** Plan for an integrated bike network within the TOD and connections to the County bike network. This may include bike lane streets with bike lanes on either side of travel lanes, two-way buffered bike lanes, or bike boulevards, sharrows, bike boxes at intersections, and bike storage, and repair at major activity centers.

- **Traffic Calming:** To channel traffic to the arterial streets and minimize impacts on the community, traffic calming techniques such as curb extensions, chokers, speed bumps, and raised crosswalks should be used, Figure 18-43.

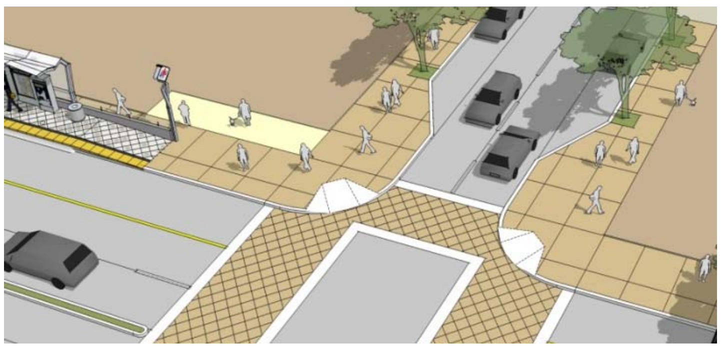


Figure 18-43: A curb extension (nub) is a traffic calming technique used to slow the speed of traffic

18.5.5 Architectural Design Character and Massing

- **Tailor designs to reflect uniqueness of an area:** TODs should vary in design character based on the land use and urban design theme envisioned unique characteristics of a specific geographic location and sensitive existing features and context.

- **Visual interest at street level:** The form of buildings and architectural details should be designed to create visual interest for pedestrians at the street level using techniques such as staggering the frontage of the building, recessing doors and windows, providing varied display windows, providing awnings and canopies for weather protection and shade, and visually extending interior spaces outside through paving and glazing. In addition, clear glass rather than dark tinted glass or reflective glass should be incorporated along ground level frontages to increase a buildings visual and physical interaction with those on the sidewalk and create a safer and more vibrant pedestrian environment, see Figure 18-44.

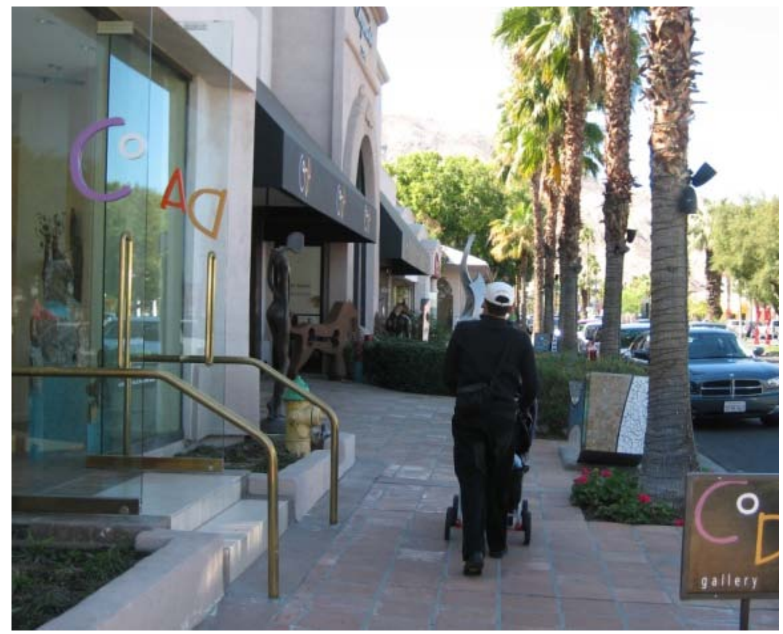


Figure 18-44: Clear glass display windows, awnings, and architectural articulation at the street level

- **Articulated building facades and massing**: To create visual interest and to avoid large bulky façades and blank walls, buildings massing should be articulated in form using techniques such as some stepping back of upper floors, stepped terraces, changes in plane, recessed windows, bay windows, balconies, trellises, which create shadow lines, varied roof lines and changes in color (Figure 18-45).

Figure 18-45: Buildings and architectural details with visual interest for pedestrians at street level

- **Equal design treatment on facades:** Buildings should be designed to be attractive in all directions. Where the rear or sides of the building are visible from streets and alleys these facades should receive equal design treatment to the main façade.

- **Building location to emphasize each street as an urban space:** Building placement and design should consider its relationship to the street:
  - One of the most important elements in creating vital economic development and walkable TODs is to implement "build to-line standards" or a "building frontage line" along streets to establish a continuous "street wall" adjacent to the pedestrian realm. Buildings would be located close to the building frontage line with its building entries facing the sidewalks. Setbacks from the street wall should be limited to courtyards, outdoor dining spaces, and public plazas. Parking should not be located between the pedestrian realm and building façade but should be in the rear of buildings or underground, see Figure 18-46.

Figure 18-46: Building design which fits into the pedestrian environment

  - Uses on the ground level and outdoor activities should be selected to activate the street.

- **Building heights:** Building heights should vary within the TOD with taller structures near the station, along wider streets and as focal points.
- **Ground floor uses and design:** The ground floor is typically the lowest level within a building that is accessible from and within 3′ above or 2′ below grade. In areas designated for mixed-use, ground floor retail, restaurants, and other pedestrian-friendly uses are preferable at the ground floor along the pedestrian realm. The pedestrian realm is generally a 12′-30′ area located between the face of the curb of a street and the face of the building. It includes parkways, sidewalks, and any landscaped areas, and can include public or private areas. However, recognizing that there may not be a market for the entire ground floor of multiple blocks for the uses, residential use on the ground floor may be permitted with the following guidelines:
  - Residential located on the ground floor of facing the pedestrian realm should be designed with articulated facades, including features such as awnings, elevated steps, stoops and entrances, recessed windows, patios, windows treated for privacy and pedestrian interest and landscaping.
  - The more public areas of the residential units, such as lobbies, exercise rooms, living rooms, or dining areas, should face the street while more private areas, such as bedrooms, should be located in the rear or upper floors.
  - Pedestrian-oriented commercial uses should be concentrated near major streets (Figure 18-47).

Figure 18-47: A mixed use project in a San Diego neighborhood with a coffee shop, corner plaza and a human-scale pedestrian-friendly environment.

- **Variety in building facades and urban forum:** Building forum and facades should vary from building to building and from project to project to create interest along the street and a vibrant area.
- **Materials and colors:** Materials and colors should be selected to unify the building appearance and fit into the pedestrian realm context. For example, avoid chain link fences, imitation rock/stone veneer and extensive use of wood siding, heavily textured stucco walls, adobe, or slump stone masonry.
- **Contemporary, pedestrian-friendly design:** Buildings shall be designed to be visually attractive and fit with the vision of a pedestrian-friendly, vibrant streetscape. For example, contemporary glass storefronts inserted into an older building if sensitive to the building key

architectural features are encouraged subject to the unique character envisioned by each community for each TOD.

- **Building shaped at corners:** A building should reflect the corner of an important pedestrian intersection or a focal point by using a variety of techniques such as strong vertical mass or a tower at the corner, a diagonal setback at the intersection, a corner plaza at the intersection, and/or a recessed building entrance at the corner.
- **Lighting:** Lighting is encouraged to accent facades at night and provide security and wayfinding for public and private open spaces. Avoid lighting that interferes with residential uses.
- **Awnings:** Awnings are encouraged for sun protection for a distinctive identify and for visual interest along the pedestrian center. Awnings should be mounted so as to respect the architecture and character of a building and its function. Awnings should project over doors and windows and not blank walls. Open ended awnings are preferred over closed in awnings. Creative steel, canvas, and glass awnings with signage incorporated are encouraged.
- **Energy efficient designs:** Buildings design and site planning shall consider passive solar and ventilation techniques, as well as specification of "green" materials.

18.5.6 Outdoor Open Space Network

- **A network of open spaces:** In addition to the pedestrian network along sidewalks, well-proportioned outdoor open spaces such as landscaped sidewalks, paseos, plazas, terraces, courtyards, gardens, and decks should be incorporated into TODs and connected together, where possible, forming an open space network, Figure 18-48.

Figure 18-48: Well defined courtyards and quiet areas for day and night time use

- **Location and character of common open spaces:** Common recreational areas of private development should be centrally located and preferably be designed as courtyards, plazas and outdoor rooms. The location and character of an outdoor space should consider its function, the size of the project, and the surrounding environment Figure 18-49.

Figure 18-49: Public gathering space created by building setback

  - Plazas are for public gathering and social interaction and should be designed with visibility from the sidewalk, to address the solar orientation, and to include pedestrian amenities such as ample seating, eating places, plants, trees, fountains, sculptures and other public art. Small plazas are appropriate at corners and adjacent to transit stops to provide additional space for waiting near the intersection. Plazas should be designed at or near the grade of the sidewalks and designed not to interrupt the street wall. Outdoor dining and other uses that activate the space should be located adjacent to or be a part of a plaza.

    Courtyards should be well defined by buildings and/or landscape elements and provide quiet areas for residents of a project as well as active recreational uses such as places for children's playgrounds, pools, spas, and fountains. Courtyards are typical of traditional Southern California architecture and provide opportunities for residential windows to face internal and attractive spaces away from the busy traffic on the streets and provide opportunities for pedestrian amenities and public art.

  - Gardens, patios, terraces, and decks are opportunities for smaller open space areas. These should be landscaped and appropriately planted to provide outdoor spaces for individual use.

- **Pedestrian/bicycle connections through private development to the pedestrian realm:** To connect the sidewalk to building entries and parking in the rear, pedestrian/bicycle connections adjacent to a building are encouraged, especially at or near mid-block. These connections could include public/private paseos, alley enhancements, private trees or trails and may require dedications in easements to facilitate a connected network, see Figure 18-50.

- **Human-scale walkway design:** Decorative materials and generous landscaping should be provided on pedestrian walkways through and adjacent to new projects which are complimentary or of the same design as the treatment of the pedestrian realm.

Figure 18-50: Encourage pedestrian connections through buildings to the pedestrian realm

- **Special features:** To encourage social interaction, activate a public space and provide a unique identity for an area, special features such as public art and water elements are encouraged, see Figure 18-51. Water could introduce a sense of relaxation and mask traffic noise.

- **Lighting:** Lighting should be used to guide pedestrians through an open space, to eliminate hidden areas, and to accent special features without interfering with the adjacent residential uses.

Figure 18-51: Special features such as water elements activate a public space

18.5.7 Building Entries and Service Access

- **Building entries oriented to street frontage:** To promote active pedestrian-friendly streets each individual tenant or business establishment and residential lobbies should be oriented to and be accessible from the major street frontage and directly from the public sidewalk. This will also ensure safety of pedestrians by encouraging "eyes on the street."

- **Entries emphasized:** Sidewalk pedestrian entries to shops and residential lobbies should be prominently highlighted with features such as two-story height entries, unique awnings, overhangs, trellises or other distinctive features. Shop and major building entries may be recessed to create a gracious entry provided that the recess enhances the street wall or a plaza along the street frontage.

- **Service areas concealed:** Where possible, service areas should be located at the rear of the building unless these areas can be concealed within the interior of the building design. Loading docks, service/storage areas and mechanical equipment should be screened from public streets and neighborhoods.

18.5.8 Compatibility with Surrounding Development and Between Uses on the Site

- **Privacy between land uses:** The building and site designs should address privacy between residential units and other non-residential uses on the site and on adjacent properties. Some of the considerations to include in City guidelines to address TODs adjacent to a single-family zone include:
    - o Transitioning building height from the maximum permitted building height to a lower height, when directly adjacent to the single-family zone. However, the height would not need to match the single-family height or transition at all when a single-family adjacent zone is at higher elevation than the TOD development.
    - o To provide privacy for adjacent single-family, windows in mixed-use projects directly facing single-family zones within 15′ of the property line, should be designed either translucent, louvered, offset from existing single-family windows, located at least 5′ above the floor of each level or another solution achieving this intent.
    - o Mixed-use projects should be designed to minimize motor vehicle circulation through local single-family neighborhood streets.
    - o Guest parking areas should be located and designed to be convenient in order to minimize parking in residential neighborhoods
    - o Facades and garages that face existing single-family should be designed to be comparable with the setbacks and scale of the existing development.
- **Private development to complement the public realm:** The design of the structures and landscaping should complement the street pedestrian realm with plazas, pocket parks, public gathering spaces and street furniture.
- **Public spaces distinguished from private spaces:** The design should provide visual and physical cues that demark the public space from the private space.
- **Passageways for light and air:** To integrate new buildings with the surrounding area they are encouraged to provide passageways that allow for light and air to adjacent buildings and that connect to the pedestrian realm (Figure 18-52).
- **Noise mitigation adjacent to arterials:** Noise insulation techniques such as double pane or laminated glass should be used in residential units adjacent to heavily traveled corridors.

18.5.9 Building and Site Access

- **Access from side streets and alleys:** Vehicular access should be provided from the side streets, adjacent alleys, and parallel streets. Traffic calming techniques should be provided to minimize intrusion of traffic into adjacent neighborhoods.

Figure 18-52: Passageways provide opportunities for light and air.

- **Pedestrian amenities at street crossings:** Pedestrian crossings at arterials should include items such as curb extensions at intersections, decorative crosswalk paving, shortened turning radii for cars, complementary plant materials and pedestrian lighting, public art and bus shelters (Figure 18-53).

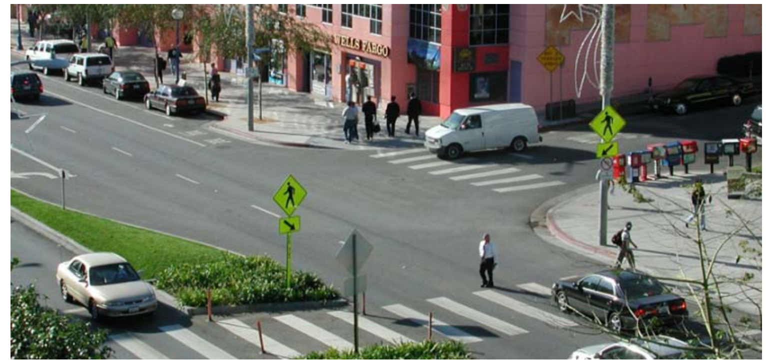


Figure 18-53: Curb extension and crosswalk paving at street crossings add to a pedestrian-friendly environment.

18.5.10 Signage

Clear distinctive signage: Signage should be pedestrian-oriented, distinctive, clear, and uniformly and consistently applied (Figure 18-54). For mixed-use projects, signage may operate at several scales: identification of individual stores, restaurants, entertainment centers and offices; identification of a group of such businesses and identification of residential units.

Figure 18-54: Project signage should be distinctive and clear

18.5.11 Sustainable Development

Constructing transit and creating transit-oriented developments supports economic and environmental sustainability as discussed previously under benefits of TOD. In designing TOD projects, sustainable features should be incorporated. The following are some sustainable guidelines to consider:

- Buildings should be designed utilizing passive daylight strategies including building shaping, building overhangs and louvers and other shading devices, spectrally-sensitive glazing, photo voltaic panels, appropriate placed landscaping for shading effects, light color and reflective roofing, and solar massing strategies to reduce solar gain.
- Use healthy, long lasting, local and recycled materials.
- Plan for water conservation, storage, and reuse by including features such as low flow appliances and fixtures, reuse of grey water for landscaping and permeable surfaces, drought-tolerant plants, bioswales, rain gardens, storm water retention ponds, outdoor recreational spaces, tree canopies, and green roofs.
- Emphasize connectivity to the transit stations, complete streets, and reduced parking to minimize amount of paved surfaces and walkability
- Consider alternative energy sources such as wind power and efficient HVAC systems, natural ventilation, and other energy producing equipment

APPENDIX A – GLOSSARY OF TERMS

Americans With Disabilities Act (1990) – The act provides reasonable access to and use of building, facilities, and transportation by people with disabilities.

ADAAG – ADA Accessibility Guidelines from the US Access Board. see: http://www.access-board.gov/adaag/html/adaag.htm

Bus Bulb/Nub – is an angled narrowing of the roadway and a commensurate widening of the sidewalk resulting in a curb extension for a bus stop.

Bus Pad – a reinforced concrete pad embedded in the roadway that protects the roadway from structural damage from the weight of the buses.

Bus Rapid Transit (BRT) – According to Section 5309 of the MAP-21 legislation (2012), bus rapid transit projects fit into two categories:

- **Corridor-based bus rapid transit project.—** a small start project utilizing buses in which the project represents a substantial investment in a defined corridor as demonstrated by features that emulate the services provided by rail fixed guideway public transportation systems, including defined stations; traffic signal priority for public transportation vehicles; short headway bidirectional services for a substantial part of weekdays and weekend days; but the majority of which does not operate in a separated right-of-way dedicated for public transportation use during peak periods.
- **Fixed guideway bus rapid transit project –** a bus capital project that: (A) in which the majority of the project operates in a separated right-of-way dedicated for public transportation use at a minimum during peak periods; (B) that represents a substantial investment in a single route in a defined corridor or subarea; and (C) that includes features that emulate the services provided by rail fixed guideway public transportation systems, including:
    - defined stations;
    - traffic signal priority for public transportation vehicles; and
    - short headway bidirectional services for a substantial part of weekdays and weekend days.

Bus Turnout – is a short length of roadway that has been widened to allow for buses to reach a bus stop without blocking the curb side travel lane.

Busway/Transitway - Dedicated lane for buses: a special track, road, or section of a road designed and built exclusively for use by buses

Center/Median Running Lanes – Center running or median running lanes, are dedicated lanes located in the center of the roadway.

Crime Prevention through Environmental Design (CPTED) - a multi-disciplinary approach to deterring criminal behavior through environmental design.

Curbside stop – A bus stop in the travel lane immediately adjacent to the curb.

Downstream - in the direction of traffic.

Dwell time - the time a bus spends at a stop, measured as the interval between its stopping and starting.

Farside stop - a bus stop located immediately after an intersection.

Federal Transit Administration (FTA) – The Federal Transit Administration is an agency within the United States Department of Transportation (DOT) that provides financial and technical assistance to local public transit systems.

Headway - the interval between the passing of the front ends of successive buses moving along the same lane in the same direction, usually expressed in minutes.

Intelligent Transportation Systems (ITS) – Intelligent Transportation Systems (ITS) is the integration of advanced communications technologies into the transportation infrastructure and in vehicles. Intelligent transportation systems (ITS) encompass a broad range of wireless and wire line communications-based information and electronics technologies.

Kit of parts – A kit-of-parts is an organization of individual parts and raw material into assemblies of standardized components.

Landing area (landing pad) – an ADA-required 5′ x 8′ paved area adjacent to the curbline, for passengers to board and alight from the bus. The landing area is where the bus deploys its wheelchair ramp. Separate from passenger waiting area and shelter pad.

Layover - time built into a schedule between arrivals and departures, used for the recovery of delays and preparation for the return trip.

MAP 21 – Moving Ahead for Progress in the 21st Century (**MAP-21**) is the federal transportation authorization bill reauthorizing surface transportation programs through fiscal year 2014.

Midblock stop - a bus stop within the block.

Mixed Flow – is a standard travel lane.

National Environmental Protection Act (NEPA) – is a United States environmental law that established a U.S. national policy promoting the enhancement of the environment.

Nearside stop - a bus stop located immediately before an intersection.

Nub - a stop where the sidewalk is extended into the parking lane, which allows the bus to pick up passengers without leaving the travel lane, also known as bus bulbs, bulbouts or curb extensions.

Open bus bay - a bus bay designed with bay "open" to the upstream intersection.

Pedestrian Access Route (PAR) – is the area used for pedestrians to travel to their destination.

Queue jumper bus bay - a bus bay designed to provide priority treatment for buses, allowing them to use right-turn lanes to bypass queued traffic at congested intersections and access a far-side open bus bay.

Queue jumper lane - right-turn lane upstream of an intersection that a bus can use to bypass queue traffic at a signal.

Roadway geometry - the proportioning of the physical elements of a roadway, such as vertical and horizontal curves, lane widths, cross sections, and bus bays.

sbX – San Bernardino (County) Express; the proposed system of BRT corridors and the branding of those services.

Shelter - a curb-side amenity designed to provide protection and relief from the elements and a place to sit while patrons wait for the bus.

Sight distance - the portion of the highway environment visible to the driver.

Stand Alone Validator (SAV) – is a fare collection reader used to check for proof of payment .

Street-side factors - factors associated with the roadway that influences bus operations.

TCRP - Transit Cooperative Research Program of the Transportation Research Board.

Ticket Vending Machine (TVM) – is a fare collection vending machine that dispenses tickets for use on transit systems.

Transit Oriented Development (TOD) – compact, mixed-use, pedestrian-oriented neighborhood or district surrounding a transit station, typically within a ¼ mile or ½ walking distance radius.

Transit Signal Priority (TSP) – electronic sensors and equipment that detect buses moving toward signalized intersections and allow either a delayed red indication or an early green signal to advance the bus through the intersection with minimal delay; typically used in conjunction with dedicated BRT lanes or queue jumper lanes.

Turnout – a dedicated bus lane cut into the curbline, where buses can pull out of traffic, load passengers, and then merge back into traffic

Upstream - toward the source of traffic.

Variable Message Sign – is a changeable, electronic message sign.

Wireless Local Area Network (WLAN) – is a wireless communication system that transmits and receives data.

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APPENDIX B – STATION KIT OF PARTS CHECKLIST

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Station Type/Name	Shelter	Shelter Columns	Shelter Roof Frame	Shelter Solar Panels	Side Wind Screens	Front Wind/Shade Screens	l Canopy Panel	ll Canopy Panel	s Wall Panel	r Low Wall	idation Wall	ting/Bench	ction Equipment	g Strip/Pavers	Pylon Sign	V Directional Signage	Name Signage	Map n Information Phone	d Panel	Receptacles	ir Seating Area	Pub ion Telephone (PTEL)	Closed-Circuit Television (CCTV)	Variable Message Sign (VMS)	Emergency Telephones (ETELs)	Communication Transmission System (CTS)	Wide Area Network (WAN)	Advanced Travel Information System	Stand Alone Validator	Bike Racks	Planters Along Walkways and at Station Area	Entry/Rear Gates	Railing/Lighting Along Station Area
Center Running Station																																	
Center Station #1	x																																
Center Station #2	x																																
Center Station #3	x																																
Side Running Station																																	
Side Station #1	x																																
Side Station #2	x																																
Side Station #3	x																																
Speciality/Unique Stations																																	
Unique Station #1	x																																
Unique Station #2	x																																
Unique Station #3	x																																
Park and Ride Stations																																	
Park and Ride Station #1	x																																
Park and Ride Station #2	x																																
Park and Ride Station #3	x																																

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APPENDIX C – REPORTS AND RESOURCES

Guidance Documents

- APTA Bus Stop Design and Placement Security Considerations - http://www.aptastandards.com/LinkClick.aspx?fileticket=hGJMqluVaIw%3D&tabid=329&mid=1682&language=en-US

APTA Standards Development Program: Recommended Practice. APTA SS-IS-RP-008-10. American Public Transportation Association (2010)

- APTA Bus Rapid Transit Stations and Stops - http://www.aptastandards.com/Portals/0/Bus_Published/002_RP_BRT_Stations.pdf

APTA Standards Development Program: Recommended Practice. APTA BTS-BRT-RP-002-10. American Public Transportation Association (2010)

- APTA Bus Rapid Transit Running Ways - http://www.aptastandards.com/Portals/0/Bus_Published/003_RP_BRT_Guideways.pdf

APTA Standards Development Program: Recommended Practice. APTA-BTS-BRT-RP-003-10. American Public Transportation Association (2010)

- USDOT FHWA Pedestrian Safety Guide for Transit Agencies - http://safety.fhwa.dot.gov/ped_bike/ped_transit/ped_transguide/transit_guide.pdf

US Department of Transportation Federal Highway Administration. FHWA-SA-07-017. February 2008.

- TCRP Legal Research Digest 24 - http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_lrd_24.pdf

Transit Cooperative Research Program Legal Research Digest 24: Transit Bus Stops: Ownership, Liability, and Access. Transportation Research

- TCRP Report 19 – "http://trb.org/news/blurb_detail.asp?id=2597" Transit Cooperative Research Program 19:Guidelines for the Location and Design of Bus Stops , Texas Transportation Institute at Texas A&M University (1996)

Other Transit Agencies' Guidelines

- VTA BRT Design Guidelines - http://www.vta.org/projects/tsp/pdf/6_brt_service_design_guidelines.pdf

VTA Transit Sustainability Policy, Bus Rapid Transit Service Design Guidelines. 2007.

- OCTA Policy -

"http://www.octa.net/temp/OCTA Bus Stop Safety and Design Guidelines.pdf"
Orange County Transportation Authority (CA) - Bus Stop Safety and Design Guidelines (2004)

- Palm Tran - Transit Design Manual –

"http://www.co.palm-beach.fl.us/palmtran/library/TRANSIT DESIGN MANUAL.pdf"
Palm Beach County, Florida Transit Design Manual (2004)

- Arlington County - Bus Stop Standards – "http://www.commuterpage.com/TDM/pdf/Arlington

CoBusStopStandards.pdf"
Arlington County (VA) - Bus Stop Design Standards (2002)

- AC Transit Bus Stop Policy – "http://www.actransit.org/aboutac/bod/policies/pdfs/Policy 508 - Bus Stop Policy.pdf"
  Alameda - Contra Costa Transit District (CA) Board Policy 508 - Bus Stop Policy (2005)

- Grand Junction Transit Design Standards – "http://www.gjcity.org/CityDeptWebPages/PublicWorksAndUtilities/TransportationEngineering/TEFilesThatLINKintoDWStoreHere/TEDS/TRANSITREGS.pdf"
  Grand Junction / Mesa County Metropolitan Planning Organization (CO) - Transit Design Guidelines (2003)

ADA Information – Current Information on Web Sites

- US Dept. of Justice - Transportation Requirements – "http://www.usdoj.gov/crt/ada/reg3a.html#Anchor-11861"

- CA Disability Access Information for Transportation – "http://www.disabilityaccessinfo.ca.gov/transport.htm"

- Disability Access Information for Government - "http://www.disabilityaccessinfo.ca.gov/goverment.htm"

- Federal Transit Administration - ADA Information – "http://www.fta.dot.gov/transit_data_info/ada/14524_ENG_HTML.htm"

- United States Access Board – "http://www.access-board.gov/index.htm"

- ADA Accessibility Guidelines – "http://www.access-board.gov/adaag/html/adaag.htm"

APPENDIX D – POINTS OF CONTACT

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APPENDIX E – SUMMARY OF STAKEHOLDER OUTREACH

On June 13th and 14th 2012, Omnitrans held the first of three rounds of stakeholder outreach and hosted four workshops with local jurisdictions to initiate an update of its 2006 Bus Stop Design Guidelines. The meetings were held in the cities of Ontario, Rialto and Fontana and at Omnitrans in San Bernardino; city staff from all of Omnitrans Service area were invited. The consultant team presented the 2006 Bus Stop Design Guidelines and introduced the sbX service and design. A draft outline of the Transit Design Guidelines was distributed to facilitate discussion with the intent of soliciting information from the city staff. Omnitrans requested that any information useful to city staff be included in the document including any information from Omnitrans regarding design of its facilities, concerns or lessons learned from transit improvements and the transportation planning process. An overview of the FTA process, development of the sbX Corridors and strategies for success in the sbX corridors and coordination with Omnitrans were discussed with the city staff.

The second round of stakeholder outreach occurred on September 25th and 26th 2012 at Omnitrans in San Bernardino. A draft copy of the Transit Design Guidelines containing an update of the 2006 Bus Stop Design Guidelines and sbX design criteria and information was distributed prior to the meeting for review by city staff. A discussion of the Design Guidelines and the sbX service followed, with questions from the city staff regarding the development process for transit improvements and the roles and responsibilities of Omnitrans and City Staff. Design oriented questions concerning the preference of dedicated lanes, signal improvements and station designs were discussed, and Omnitrans discussed the decision making process that occurs as part of the Alternatives Analysis process with coordination and approval by the city. Questions were received and answered regarding the station design and incorporating local history and context to stations, as well as the Omnitrans art program. Funding and maintenance was discussed, including advertising at stations and developers' responsibilities for stations.

The Final Stakeholder outreach occurred on October 29th and 30th, 2012 at Omnitrans in San Bernardino. A presentation of the final draft of the Design Guidelines and a field trip to the Green Line (sbX E Street Corridor) to view the current construction and design of station and roadway improvements was held.

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