OCTA Transit-Supportive Design Guidelines

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LIST OF ACRONYMS

AASHTO	American Association of State Highway Transportation Officials
ADA	Americans with Disabilities Act
ADAAG	Americans with Disabilities Act Accessibility Guidelines
APTA	American Public Transportation Association
ARTIC	Anaheim Regional Transit Intermodal Center
AVL	Automatic Vehicle Location
BAT	Business Access and Transit Lanes
BRT	Bus Rapid Transit
CA MUTCD	California Manual on Uniform Traffic Control Devices
CAV	Connected and Autonomous Vehicles
CPTED	Crime Prevention Through Environmental Design
CTC	California Transportation Commission
DOT	Department of Transportation
ETOD	Equitable Transit-Oriented Development
FARS	Fatality Analysis Reporting System
FAST	Fixing America's Surface Transportation ACT
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GHG	Greenhouse Gas
HAWK	High Intensity Activated Crosswalk
HODO	Hop-On Drop-Off
HOV	High Occupancy Vehicle
HQTA	High Quality Transit Areas
HQTC	High Quality Transit Corridor
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation System
JPA	Joint Powers Authority
LAVTA	Livermore Amador Valley Transit Authority
LED	Light Emitting Diode
LOSSAN	Los Angeles – San Diego – San Luis Obispo Rail Corridor
MAAS	Mobility as a Service
MDOT	Maryland Department of Transportation
MPAH	Master Plan of Arterial Highways
MPO	Metropolitan Planning Organization
MTA	Maryland Transit Administration
NACTO	National Association of City Transportation Officials
NADTC	National Aging and Disability Transportation Center
OCCOG	Orange County Council of Governments
OCCSI	Orange County Complete Streets Initiative
OCTA	Orange County Transportation Authority
OTS	Office of Traffic Safety
POI	Points of Interest
PROWAG	Public Rights-of-Way Accessibility Guidelines
RIPTA	Rhode Island Public Transit Authority
RRFB	Rectangular Rapid Flashing Beacon
RTP	Regional Transportation Plan
SANDAG	San Diego Association of Governments
SARTC	Santa Ana Regional Transportation Intermodal Center
SCAG	Southern California Association of Governments
SCRRA	Southern California Regional Rail Authority
SCS	Sustainable Communities Strategy
SHSP	Strategic Highway Safety Plan
SRTS	Safe Routes to School
SWITRS	Statewide Integrated Traffic Records System
TCRP	Transit Cooperative Research Program
TDM	Travel Demand Management
TIMS	Transportation Injury Mapping System
TNC	Transportation Networking Companies
TOC	Transit Opportunity Corridor
TOD	Transit-Oriented-Development
TSDG	Transit Supportive Design Guidelines
TSP	Transit Signal Priority
VMT	Vehicle Miles Traveled

Part I
Introduction

1 Introduction

1

INTRODUCTION

1.1 What is Transit-Supportive Design and what are the benefits?

Transit-supportive design is an approach to city-building and planning which helps integrate places with transit; it is a thoughtful approach t considers the available transit network, land use and community context in an effort to make these elements work together more efficiently. The OC Transit Vision identifies that a complete and integrated transit system contributes towards achieving broader regional goals, and transit-supportive design is a necessary tool for realizing that complete and integrated system.

The benefits of transit-supportive design go beyond the transit provider, positively impacting places, and riders— who stand to gain economic, environmental, and quality of life benefits.

MOBILITY

- Lower cost of transportation compared to driving.
- Reduced congestion on non-transit streets and highways.
- Greater mobility for people with disabilities.
- Convenient and safer access to local and regional transit services.
- Fewer barriers to transit use, better user experience and satisfaction.

COMMUNITY

- Creation of active and vibrant places.
- Safer and more accessible streets for all users.
- Improved air quality through reduced vehicle miles of travel, particularly travel by single occupant vehicles.
- Greater opportunities for housing choices that allow residents to age within their community.

LOCAL JURISDICTIONS

- More efficient infrastructure systems and maintenance.
- Enhanced local services in more concentrated areas such employment centers.
- Reduced congestion on local streets.
- Improved ability to meet state and regional environmental goals.
- Increase in sales tax revenue and contributes towards economic vitality.
- Connecting workers to employment, connect customers to local businesses.
- Enhances choice to live or visit a particular city.

DEVELOPMENT

- Increased utilization of available land.
- More attractive to potential developers.
- Broader market diversity and feasibility.
- More compact, walkable, and utilized space.

HEALTH

- More active ways of traveling helping lower the rate of obesity and related illness.
- Stress-free access to local goods and services, jobs, and regional destinations.
- Transit service provider
- Improved ridership, increasing ability to provide more or better service.
- More predictable ridership volume and behavior.
- Improved integration of transit facilities into urban context.
- Enhanced local access to/from transit service.
- Safer operations with fewer accidents.
- Promotion of transit as a viable and more competitive transportation choice.

1.2 What is the purpose of the Transit-supportive Design Guidelines?

OCTA's Transit-supportive Design Guidelines (TSDG) provide principles, best practices and guidelines for the planning of transit-supportive communities, the design of streets and intersections to safely accommodate all users transit vehicle types, and the design of bus stops and other types of transit facilities. The guidelines in the TSDG are a distillation of best practices in transit-supportive land use planning, urban design, and service operations observed throughout the United States and internationally, integrated with experiences and needs relevant to Orange County. The goal of the TSDG is to help practitioners create communities that support active transportation and implement high-quality transit facilities to increase transit ridership.

1.3 Who are the guidelines for?

The TSDG is intended for the range of practitioners and organizations involved in creating communities served by efficient, convenient, and accessible transit throughout Orange County. OCTA envisions this document being used municipalities, land use and transportation planners, designers, engineers, real estate developers, and civic leaders / elected officials.

1.4 How to use the guidelines

The TSDG are organized into three parts:

Part I Introduction: The introduction describes the benefits of transit-supportive design, the purpose of the guidelines, and presents an overview of OCTA's existing and future transit system.

Part II Planning Principles: This part of the TSDG describes the relationship between transit planning and community design and presents guidelines for planning transit-supportive land uses and transportation networks.

Part III Engineering Design Guidance: The final part of the TSDG provides design guidance for the placement and design of bus stops and related transit facilities.

The TSDG recognizes the vast amount of information and best practices available to the practitioner and, therefore, focuses on the conceptual application of design elements and refers the user to technical specification in the TSDG appendices and provides links to the best practices resources used in developing the TSDG at the end of each section.

2 Transit in Orange County

This section describes OCTA's current and future public transportation system and highlights some of the projects, strategies and policies being used to achieve the Authority's vision.

TRANSIT IN ORANGE COUNTY

2.1 OC Transit Services Overview

2.1.1 Current OC Bus Service

OCTA is Orange County's primary provider of public transportation. In 2019, OCTA bus service consisted of 61 bus routes and annual boarding's exceeding 36 million. The Authority's bus operations include a range of service types and on-demand and paratransit mobility services. **Figure 1** presents a map of the current bus system by service type. The service type categories as defined in OCTA's Service Allocation Guidelines are described below:

- **Major Routes:** Routes in high-frequency corridors that operate every 15 minutes or better during peak times, seven days a week. Major routes form a grid on arterial streets throughout the areas of Orange County where the population has the highest propensity to use transit, primarily in northern parts of the county. These routes carry more than 75 percent of the system's riders.
- **Bravo!** limited-stop services are included in this category. Bravo! is a branded limited-stop service that runs every 12 minutes during peak hours and every 18 minutes during non-peak hours and only stops at major transfer points and destinations.
- **Local Routes:** Routes that operate on arterials within the grid created by the major routes, but at lower frequencies. Local routes generally operate in parts of Orange County with lower transit demand. Most Local routes operate seven days per week; however, some operate on weekdays only. Local routes carry about 20 percent of the system ridership and are less productive than major routes, averaging about 20 boardings per revenue hour.
- **Community Routes:** Routes that connect areas of concentrated transit demand with major destinations in addition to providing local circulation. Community routes tend to be less direct than local routes because the service focuses on neighborhoods and destinations within the arterial grid served by major routes. Community routes carry less than three percent of the system's ridership, averaging 15 boardings per revenue hour. City-operated shuttles in La Habra, Westminster, and Mission Viejo fall into this category.
- **Metrolink StationLink Routes:** Routes connecting Metrolink stations and nearby major destinations such as job centers, universities, or regional medical facilities. These routes operate only during peak periods, in the peak direction (from the station in the morning, and to the station in the afternoon). Metrolink stations served by the StationLink routes include:
    - » Orange Transportation Center
    - » Santa Ana Regional Transportation Intermodal Center (SARTC)
    - » Tustin Metrolink Station
    - » Irvine Metrolink Station
- **Express Routes:** Routes serving long trips during peak periods, primarily commute trips to job centers. Because these routes mainly target commuters who own automobiles, access to these routes is primarily by car and stops are frequently serve park-and-ride lots.

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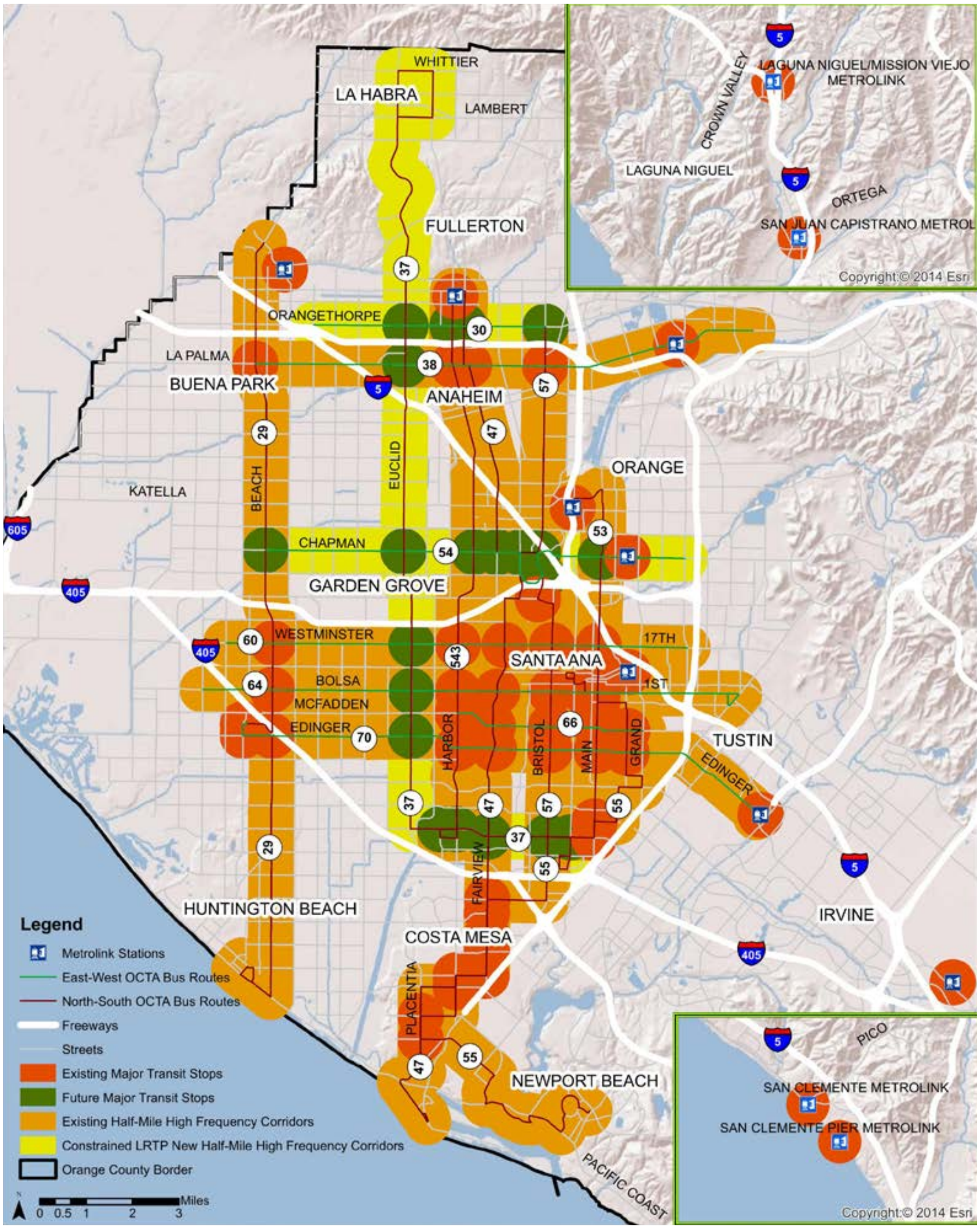
Figure 1: *Current bus system by service type*

HIGH FREQUENCY CORRIDORS

High frequency corridors (**Figure 2**) are defined as a route, or combination of routes, served by OCTA service types with peak period headways of 15-minutes or less and can include any of the service categories described above.

Figure 2: *Existing and future High Frequency Transit Corridors and major stations in Orange County*



2.1.2 OC Bus 360° Initiative

OCTA initiated OC Bus 360° in 2016 in response to shifting travel patterns and declining transit ridership. With a changing market and diminishing returns on traditional service adjustments, OCTA chose to implement a more innovative and comprehensive package of services with solutions targeted to its changing customer base. Changes to existing services and the introduction of new services as part of OC Bus 360° include:

- New and faster bus routes implemented including the Bravo! Route 529 limited-stop service along Beach Boulevard with a reduced number of stops (13 versus an average of 34 stops) resulting in an average time savings of 10-minutes per trip. Overall, six new high-frequency routes were added to the system.
- Reallocated bus service to areas with higher demand and reduced or eliminated unproductive and inefficient routes.
- Introduced new technology that made it more convenient to use the bus system including mobile ticketing allowing riders to purchase fixed-route bus fares and obtain real-time bus arrival information using their smartphones.
- Conducted a microtransit pilot program—OC Flex—an on-demand, curb-to-curb shuttle service serving the communities of Huntington Beach, Laguna Niguel, and Mission Viejo.
- Started OCTA's college pass program at Santa Ana College and expanded the program to Santiago Canyon College after a successful multi-year pilot. The program allowed students attending the colleges to ride OC Bus free using student ID cards. Ridership to the colleges grew by 12.6 percent in one year.
- Implemented a long-term strategic marketing campaign to increase ridership in targeted areas where bus routes were improved and expanded.

The initiative did successfully slow ridership decline and attracted new riders by optimizing the efficiency and effectiveness of the bus system. In one fiscal quarter, the average weekday OC Bus ridership on improved routes increased by nearly 4%, total fare revenue generated by OCTA's mobile ticketing was double the industry average at over 8%, and there was an increase of about 3% in OC Bus systemwide boardings per revenue hour.

BUS CAPITAL INVESTMENT GUIDELINES BY SERVICE TYPE CATEGORY

As described in the Transit Investment Framework in OCTA's long-range plan to improve the transit system (OC Transit Vision), capital investments in bus service fall into three categories: (1) vehicles; (2) transit-priority improvements to the right-of-way; and (3) major improvements to stops and stations (including operational improvements and enhanced passenger amenities).

Some of these investments can be implemented by OCTA; others, such as transit priority and operational improvements at intersections, are the responsibility of Orange County local agencies or Caltrans and require partnerships with other jurisdictions and agencies, particularly within long multi-jurisdictional corridors. Refer to Section 5.3 on Bus Stop Design, Section 5.10 on Transit Priority Measures, and Section 5.4 on Passenger Boarding Area and Amenities for guidelines on these capital investment areas.

For local agencies responsible for constructing new, or improving existing bus stops and responsible for operating streets with bus routes, OCTA's capital investment guidelines recommend the types of capital investments shown in **Table 1**. Regardless of service type, each bus stop has unique physical, contextual, operational and ridership characteristics that should be considered when identifying bus stop needs. Refer to Section 5.4.7 on Criteria for Installing Passenger Amenities, which outlines a point system for identifying or prioritizing passenger amenities based on several criteria.

Table 1: *Level and Types of Capital Investment by OCTA Service Category*

Service Category	Investment Level	Investment Type	Entity Responsible
Major Route	High	• Higher capacity vehicles • Vehicle branding (Bravo! Routes only) • Off-vehicle fare collection and all door boarding	OCTA
		• Transit priority treatments (refer to Section 5.10 on Transit Priority Measures) • Operational stop improvements and enhanced stop amenities (refer to Section 5.4 on Passenger Boarding Area and Amenities)	Local Agency
Local	Medium	• Signal timing improvements (refer to Section 5.10 on Transit Priority Measures) • Enhanced passenger amenities at busier stops (refer to Section 5.4. on Passenger Boarding Area and Amenities)	Local Agency
Community	Low	• Standard bus stop	Local Agency
Express	Medium	• Comfortable vehicles designed for longer trips	OCTA
		• High-occupancy vehicle facilities on freeways and direct access ramps (refer to Section 5.10.3 on High Occupancy Vehicle (HOV) Lanes)	Caltrans / OCTA
		• Enhanced passenger amenities at park-and-ride lots (refer to Section 5.4 on Passenger Boarding Area and Amenities)	Caltrans / Local Agency depending on jurisdiction over Park and Ride facility
StationLink	Low	• Standard bus stop	Local Agency and Agency with jurisdiction over rail station
Adapted from Figure 4-5 Bus Capital Investment Guidelines in the OC Transit Vision (Chapter 4 Transit Investment Framework).			

2.1.3 OC Streetcar Service

OC Streetcar is Orange County's first modern streetcar system. Currently under construction, the streetcar's 4.15-mile route connects the Santa Ana Regional Transportation Center (SARTC) / Metrolink and Amtrak Station in the City of Santa Ana with the Harbor Transit Center—a new transit hub located in Garden Grove.

From the SARTC, the streetcar route travels follows West Santa Ana Boulevard (utilizing a one-way couplet on West Santa Ana Boulevard and 4th Street) where it serves downtown Santa Ana and the government center and continues on West Santa Ana Boulevard to where the it terminates at North Raitt Street.

From there, the route continues within the right of way of the former Pacific Electric Railroad to Harbor Boulevard and Westminster Avenue, the eastern terminus of the streetcar route. **Figure 3** illustrates the streetcar route and its stops. As shown in the figure, ten stops are being constructed along the route with a future stop planned at Willowick. The downtown Santa Ana stops located on the Santa Ana Boulevard / 4th Street couplet are split stops.

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Transit in Orange County > **2.1** OC Transit Services Overview

The OC Streetcar will link regional rail and bus service (Metrolink / Amtrak / OCTA) and other transportation modes at the Santa Ana Regional Transit Center / Metrolink Station (SARTC) and effectively serve as a high-frequency, reliable and efficient first / last mile connection to the land uses along the streetcar route including important employment and retail centers, restaurant and entertainment areas, schools, and numerous residential neighborhoods. Over the length of the streetcar's route, the stops will have over 14 OCTA bus connections for transfers to other routes and service types. With the streetcar connecting to the SARTC it will provides riders with over 65 train connections.

Figure 3: *The OC Streetcar connects the Santa Ana Regional Transit Center, Metrolink, and Amtrak trains with the new Harbor Transit Center in Garden Grove on a four-mile route with ten stops.*

2.2 The OC Transit Vision

The OC Transit Vision is OCTA's long-range public transit service plan. Developed in 2018, OC Transit Vision is the Authority's response to the rapidly changing technological, cultural, and policy environment that public transit faces now and in the future. To adapt to these changes OCTA reevaluated the services it provides from the "ground-up". The resulting l ong-range plan is comprised of five elements for enhancing and expanding public transit service throughout Orange County for the next twenty years, as shown in **Figure 4**.

The Plan's vision statement for high-quality transit in Orange County is to:

Provide compelling and competitive transit service that expands transportation choices for current riders, attracts new riders, and equitably supports immediate and long-term mobility in Orange County.

The vision and its supporting goals were developed with input from an extensive public engagement process involving community members and stakeholders representing a broad cross-section of Orange County's population and businesses, as well as input from a Citizens Advisory Committee, elected officials, and municipal planning directors.

High-quality transit service, as envisioned by OCTA, follows a set of basic design principles that fall within the overarching tenets to provide direct connections that serve a variety of destinations and make improvements that help to increase transit speed and minimize delay.

Figure 4: *The five key elements comprising OC Transit Vision's long-range plan to enhance and expand public transit. Source: OC Transit Vision.*

The TSDG resulted from the vision's recommendation to provide transit-supportive design guidance to public and private partners and stakeholders in Orange County involved in land use planning and street design.

2.2.1 Summary of OC Transit Vision Recommendations

OC Transit Vision recommends strategies and improvements to OCTA's future services in three types of services:

1. Transit Opportunity Corridors – recommendations identifying corridors that have the potential for investment in high capacity transit, such as bus rapid transit (BRT) or rapid streetcar.
2. Existing Fixed-Route Service Improvements – recommendations for service improvements to Bravo!, local OCTA routes, special event service, and bus-rail connections.
3. Strategies for Other Types of Mobility – include demand response services, like OC Access paratransit, and OC Flex on-demand service.

OC Transit Vision includes a plan of action identifying necessary services, infrastructure, and specific projects, a timeline for implementing the recommendations, and potential funding sources for each service type as described in the following sections.

TRANSIT OPPORTUNITY CORRIDOR RECOMMENDATIONS

The OC Transit Vision identifies corridors—called Transit Opportunity Corridors (TOCs)—for future investment in rail or bus rapid transit (BRT) service. The OC Streetcar being constructed in the Santa Ana Boulevard / Pacific Electric Railroad right of way corridor is the first corridor selected for rail investment. Ten additional arterial and freeway corridors were identified as candidates for rail and BRT investments, but the vision recommended moving forward with the planning, design, and implementation for the three highest priority corridors as shown in **Figure 5** and listed below.

- Corridor-level studies of rail and other rapid-transit options in the North Harbor/ Santa Ana and Westminster/Bristol corridors.
- Introduction of Bravo! service in the Beach Boulevard corridor and development of a strategy to upgrade existing Bravo! corridors to BRT.
- A network study of freeway-based BRT corridors (Interstate 5 and State Route 55).

Source of image: SANDAG.

Typical Features of Bus Rapid Transit (BRT) Stops

- **Level boarding, using either low-floor buses or higher boarding platforms.**
- **Use of multiple doors for both boarding and alighting.**
- **Off-vehicle fare collection.**
- **Branded stop designs consistent with appearance of BRT vehicles.**
- **High-quality, attractive, and functional amenities.**
- **Use of technology for passenger information such as real-time "next bus" arrival information signs and smart fare payment apps.**
- **Transit priority measures including signal priority strategies, dedicated bus-only lanes, and queue jump lanes.**

2

Figure 5: *Map of OCTA's Transit Opportunity Corridors. Source: OC Transit Vision.*

Transit opportunity corridors will be planned for different forms of high-quality / high-frequency rail or BRT depending on the type of corridor (i.e., arterial, freeway), MPAH classification, and the physical and operational characteristics of the corridor. The forms of transit being considered for these corridors include:

- **Rapid Streetcar** – Although the current OC Streetcar project features closely spaced stops in its on-street segment in central Santa Ana, and more widely spaced stops in the off-street Pacific Electric right-of-way to Garden Grove, future streetcar service in longer corridors would have widely spaced stops (e.g., one-mile spacing corresponding to the distance between major arterials in the northern part of Orange County) to maintain higher average speeds and lower travel times.
- **Arterial Bus Rapid Transit (BRT)** – This form of BRT differs from other rapid services by implementing transit-only lanes on arterial streets.

- **Rapid Bus** – A service like the existing Bravo! service, operating in mixed traffic but distinguished from regular bus service by implementing transit-priority features such as signal priority and bus queue jump lanes designed to make the service faster and more reliable.
- **Freeway Bus Rapid Transit (BRT)** – Buses would operate in high-occupancy vehicle (HOV) or managed lanes on freeways and use offline stops at existing transit hubs near freeways (potentially with HOV / Bus Only on and off-ramps) and/or new online stops in the freeway right-of-way.

Transit opportunity corridors as they relate to planning regional transit networks are further discussed in Section 3.2 on Transit Network Planning.

2.2.2 Fixed-Route Service Recommendations

The following recommendations improve OCTA's existing fixed-route services:

- **Service Investments** – Upgrades to OC Bus routes to meet the headway and span standards adopted in the OCTA's Service Investment Guidelines.
- **Bravo! Upgrade Strategy** – Introducing Bravo! rapid bus service in additional corridors, incrementally upgrading existing Bravo! Routes, and establishing new Bravo! routes to improve operating speed and passenger amenity.
- **Seasonal and Special Event Services** – This recommendation considers convenient transit services to improve access to regular special events that attract large numbers of visitors. Similar existing services include the Laguna Beach Summer Breeze, OC Fair Express, and Angels Express. This recommended type of service is best applied where traffic and parking constraints make transit an attractive alternative.
- **LOSSAN/Metrolink Corridor Improvements** – Supporting improvements to Orange County rail service expansions planned by Metrolink and other partner agencies and advance plans to improve station access and eliminate at-grade road crossings.

2.2.3 Other Services and Additional Study Recommendations

The OC Transit Vision includes recommendations for other OCTA services including:

- **OC Flex** – Implemented one year ago, this on-demand "microtransit" shared-ride service is operating in limited areas of Aliso Viejo, Laguna Niguel, and Mission Viejo as part of a pilot program and could be expanded to locations throughout the county.
- **OC Vanpool Expansion** – An expansion of OCTA's existing program to incentivize employee vanpools by investing in continued expansion of the county's high-occupancy vehicle (HOV) lane network.
- **Paratransit Enhancements** – Implement strategies and best practices to manage the demand for ACCESS (OCTA's shared-ride paratransit service) to keep costs down and the program sustainable.
- **Additional Studies** – New and ongoing project development efforts in transit opportunity corridors, a countywide study of freeway-based BRT, and continued engagement efforts with local agencies, developers, and Los Angeles County Metro.

2.3 Roles of Different Agencies and Jurisdictions

There are distinct areas of responsibility in the planning, design, operation, and maintenance of transit systems and supportive infrastructure. In general, the transit authority is responsible for implementing, operating, and maintaining the mobile elements of the transit system (e.g., route and stop planning, rolling stock, services, etc.) and may own and operate the system's major transit centers or stations.

Agencies with jurisdiction over the roadways used by transit are responsible for many of the stationary elements of the transit system including bus stops, some transit centers and stations, access routes to stops, and traffic control and/or transit priority systems in transit corridors. Often, there are overlapping or shared responsibilities between the transit authority and the local agencies (or the State) requiring, at a minimum, regular coordination and communication.

Table 2 summarizes the general roles and primary responsibilities for the key federal, state, regional, and local agencies having jurisdiction over elements comprising Orange County's transit system. **Table 2** is not intended to be an exhaustive list of agencies and the roles they perform but rather to demonstrate to the practitioner using this guide the multitude of entities involved in the planning, design, operations, maintenance, and funding of Orange County's public transportation system:

- OCTA bus and rail services.
- Interconnecting bus and rail services from outside of Orange County.
- Road and highway infrastructure and traffic control systems.
- Transit facilities that include bus stops, rail stations, park and ride / transit centers, and support facilities.

OCTA interacts with each of the agencies listed in the table at some level or another ranging from coordination, at a minimum, to partnering on implementing and operating various services and capital projects, or the constant pursuit of federal and state funding.

Table 2: *Agency Roles and Responsibilities Related to the Planning, Design, Operation, and Maintenance of the Orange County's Transit System*

Agency	Agency Role and Primary Responsibility Related to Transit
Orange County Transportation Authority (OCTA)	• Transportation planning authority and public transit service provider for Orange County. • Plan and implement a variety of public transit services including fixed-route, express / rapid, rapid streetcar, and on-demand paratransit services. • Own and maintain fleet of transit vehicles and key facilities such as transit centers and maintenance yards. • Administer OC Go (Measure M) the 30-year half-cent sales tax funding for transportation improvements in Orange County. • Administer the Master Plan of Arterial Highways (MPAH) including the review and approval of amendments requested by local agencies.
Local Municipalities	• Plan, approve, and regulate land development within the limits of the municipality. • Plan, design, construct, operate and maintain roadways under the jurisdiction of the municipality except state highways and private streets. • Adopt and enforce policies related to land use and community planning, complete streets engineering, and programs and regulatory plans that guide the development of transit-supportive places. • In coordination with OCTA, construct and maintain bus stops on public roadways under the jurisdiction of the municipality.
State DOT (Caltrans)	• Operate and maintain the state highway system, conduct statewide planning, and support mass transit operations. • Plan and maintain High Occupancy Vehicle (HOV) and managed lane systems used by public transit. • Administer most of the state and federal transportation funding programs and activities.
California Transportation Commission (CTC)	• Programs and allocates most of the funds from state and federal transportation funding programs.
Southern California Regional Rail Authority (SCRRA) / Joint Powers Authority (JPA) and "Metrolink" Commuter Rail	• Joint powers authority (JPA) that operates Metrolink—the commuter rail system serving five Southern California counties including Orange County.
LOSSAN Rail Corridor Agency	• Joint powers authority that operates the coastal rail line (Amtrak Pacific Surfliner) serving a six-county coastal region in Southern California between San Diego, Los Angeles, and San Luis Obispo. OCTA staffs the LOSSAN agency.
Southern California Association of Governments (SCAG)	• Develops long-range regional transportation plans including the plan's sustainable communities' strategy and growth forecast components, manages regional transportation improvement programs, regional housing needs allocations, and a portion of the South Coast Air Quality management plans. • The designated Metropolitan Planning Organization (MPO), Regional Transportation Planning Agency (RTPA), and Council of Governments (COG) for six counties and 191 cities in Southern California.
Los Angeles County Metropolitan Transportation Authority (Metro)	• Plans, designs, builds, and operates Los Angeles County's public transportation system including bus and urban rail systems that extend into Orange County.
Federal Transit Administration (FTA)	• Manages transit funding programs authorized under the FAST Act including Urbanized Area Formula grants, Fixed Guideway Capital Investment grants for New Starts, grants for Enhanced Mobility of Seniors and Individuals with Disabilities, State of Good Repair grants, and capital funding for purchasing buses and constructing bus facilities.

2

2.4 The TSDG as Support to Other Documents

The TSDG is intended to support the OCTA policy and planning documents and regional guidelines listed below:

- OC Transit Vision- Transit Master Plan for Orange County, OCTA
- OC Transit Vision Appendix E- Transit-Supportive Design and Policy Handbook, OCTA
- OCTA Strategic Plan (2014-19), OCTA
- Master Plan of Arterial Highways (MPAH), OCTA
- Complete Streets Initiative Design Handbook, OCCOG

Recommended Resources

OC Transit Vision. OCTA. 2018. http://octa.net/Projects-and-Programs/Plans-and-Studies/Transit-Master-Plan/

Transit-Supportive Design and Policy Handbook, OCTA. 2018. https://www.octa.net/pdf/App%20E%20Trans-Supp%20Design-Policy.pdf

2014 – 2019 OCTA Strategic Plan. OCTA. 2014. http://octa.net/pdf/Master-Interactive%20SP.pdf

Guidance for Administration of the Orange County Master Plan of Arterial Highways (MPAH). OCTA. 2017. https://www.octa.net/pdf/mpah_guidlines.pdf

Complete Streets Initiative Design Handbook. Orange County Council of Governments (OCCOG). 2016. https://static1.squarespace.com/static/587121d0ebbd1ae2e3a080b3/t/58e2726cb8a79b14751cd0da/1491235470685/OC_Complete_Streets_Design_Handbook.pdf

Part II

Planning Principles

3 Transit-Supportive Planning Considerations

TRANSIT-SUPPORTIVE PLANNING CONSIDERATIONS

3.1 Transportation and Land Use

3.1.1 Transit and Land Use Planning Concurrency

One of the most important roles that cities and other public agencies play in supporting transit is as land-use policy makers. Policies that codify a desire for transit-supportive land uses and incentivize developers to play a role in achieving that vision are a proactive way that cities can help to increase transit use. Transit-accessible locations are good places to concentrate higher-density residential and commercial development, as traffic and other impacts are reduced by proximity to transit, and they make good sites for affordable housing, as lower-income residents benefit from access to transit. This role as a land use policy maker can have a direct impact on transportation behavior; over the last two decades a growing body of research has demonstrated clear links between the built environment and travel behavior, including mode choice and trip length.

The State of California has identified the coordination of transit and land use as a key strategy to reduce emissions and improve quality of life statewide. State Senate Bill (SB) 375 aims to tie land use and transportation by requiring Metropolitan Planning Organizations (MPOs) to prepare the Regional Transportation Plan (RTP)/Sustainable Communities Strategy (SCS) which looks at regional planning through this combined lens.

To comply with SB 375 requirements, Southern California Council of Governments (SCAG) prepares and adopts the RTP/SCS, which is a long-range plan that sets a vision for the Southern California region. It reflects Complete Streets values and prioritizes more sustainable modes of transportation, while creating more compact communities where residents live closer to their destinations and neighborhoods that are safer for bicyclists and more walkable. Connect SoCal, the 2020-2045 RTP/SCS, was adopted in September 2020 and outlines more than $638 billion in transportation system investments through 2045. The plan provides land use and transportation strategies that aim to increase mobility options and achieve a more sustainable growth pattern.

SCAG also identifies High Quality Transit Areas (HQTA) within half mile of major transit stops, and sets out a mandate for counties and local jurisdictions to concentrate growth in these areas (with the goal of having these areas accommodate 64 percent of forecasted household growth and 74 percent of forecasted employment growth between 2016 and 2045). This end goal of concentrating growth in HQTAs is to reduce travel distances, increase mobility options, improve access to workplaces, and conserve the region’s resource areas.

Reducing vehicle trips through improving transit and land use concurrency has very tangible benefits for Orange County:

- Walking and bicycling are zero-emission transportation modes, and transit is a lower-emissions mode. Using transit can help a solo commuter who switches from a 20-mile round trip commute by car to transit to reduce carbon dioxide emissions by 20 pounds per day, or more than 4,800 pounds in a year.[1]
- The majority of the census tracts within Orange County experience a Pollution Burden in the top 50th percentile for the State of California. Pollution Burden measures how exposed and affected census tracts are by multiple sources of pollution. Different indicators are used to reflect impact of air quality, water quality, and waste facilities within each census tract in California. A high pollution burden means a community is vulnerable to multiple sources of pollution. Orange County has several cities where the Pollution Burden exceeds levels in the 90th percentile, particularly in its more urban areas.
- Design elements of more transit-supportive areas work to reduce collisions and create street environments that are good for users of all ages and abilities.
- Transit-supportive areas have several economic benefits for communities, including increased sales tax and property revenues, and reduced cost for city services. Transit-supportive areas can also be great for local businesses, helping connect customers and employees to businesses.
- Transportation along with housing makes up a significant portion of household expenses, particularly for lower income families. Having reliable, affordable options for getting around and accessing work or key non-work destinations to meet daily needs, can help alleviate the high cost burden associated with auto ownership.

3.2 Transit Network Planning

3.2.1 Regional Transit Corridors

Increasing transit usage has many benefits for Orange County, including reducing congestion; improving air quality; increasing housing supply without impacting roadways; connecting communities to businesses, jobs, and recreation; and improving livability for residents of Orange County. However, for transit to make substantial gains, it must be a positive choice compared to driving. This requires both improving transit options and removing incentives to drive. To make transit a more competitive choice to driving, its reliability and travel time competitivity need to be improved, and it needs to be easy and comfortable for potential users to access stops and get timely information about their bus. To achieve these outcomes:

- Operational improvements could include dedicated transit lanes, bus signal priority, and operational traffic improvements ensure that transit vehicles experience minimal wait time at intersections and can move freely regardless of traffic congestion, providing a passenger experience competitive with driving.
- Improvements to access might include: high quality and availability of “first and last mile connections”, such as appropriate sidewalks and crossings, which are essential to the success of any community’s transit system, and traveler information like improved wayfinding and real-time transit information.

[1] “Public Transportation’s Contribution to U.S. Greenhouse Gas Reduction,” Science Applications International Corporation, September 2007

To meet this need and support Orange County's rapid growth, OCTA has developed several targeted goals and strategies through the OC Transit Vision. The Transit Vision identifies that a complete, integrated transit system contributes to broader regional goals through:

- Supporting a healthy environment and sustainable growth.
- Boosting the region's economy and attracting talent competitively.
- Contributing to active/healthy lifestyles and supporting accessibility, affordability, and mobility beyond cars.
- Addressing key community concerns about connectivity, real time information and enhanced amenities related to customer experience.
- Making OC a better place to live and visit overall.

To achieve these goals, a key deliverable of the OC Transit Vision is the designation of Transit Opportunity Corridors (TOCs). TOCs are corridors that have been evaluated and prioritized for high-quality transit service investment such as rapid streetcar, bus rapid transit, and rapid bus. Eight arterial and two freeway BRT corridors have been identified in OCTA's Transit Master Plan as Transit Opportunity Corridors. As shown in **Figure 6** these corridors are:

- Beach Boulevard from Fullerton Park-and-Ride to Downtown Huntington Beach.
- Harbor Boulevard from Cal State Fullerton to Hoag Hospital Newport Beach.
- State College Boulevard/Bristol Street from Brea Mall to the University of California, Irvine.
- Main Street from Anaheim Regional Transit Intermodal Center (ARTIC) to South Coast Plaza Park-and-Ride.
- La Palma Avenue/Lincoln Avenue from Hawaiian Gardens to Anaheim Canyon Station.
- Chapman Avenue from Beach Boulevard to Hewes Street.
- 17th Street/Westminster Avenue from Cal State Long Beach to Tustin Street.
- McFadden Avenue/Bolsa Avenue from Goldenwest Transportation Center to Larwin Square.
- I-5 from Fullerton Park and Ride to Laguna Niguel/Mission Viejo Station.
- SR-55 from Santa Ana Regional Transportation Center to Hoag Hospital Newport Beach.

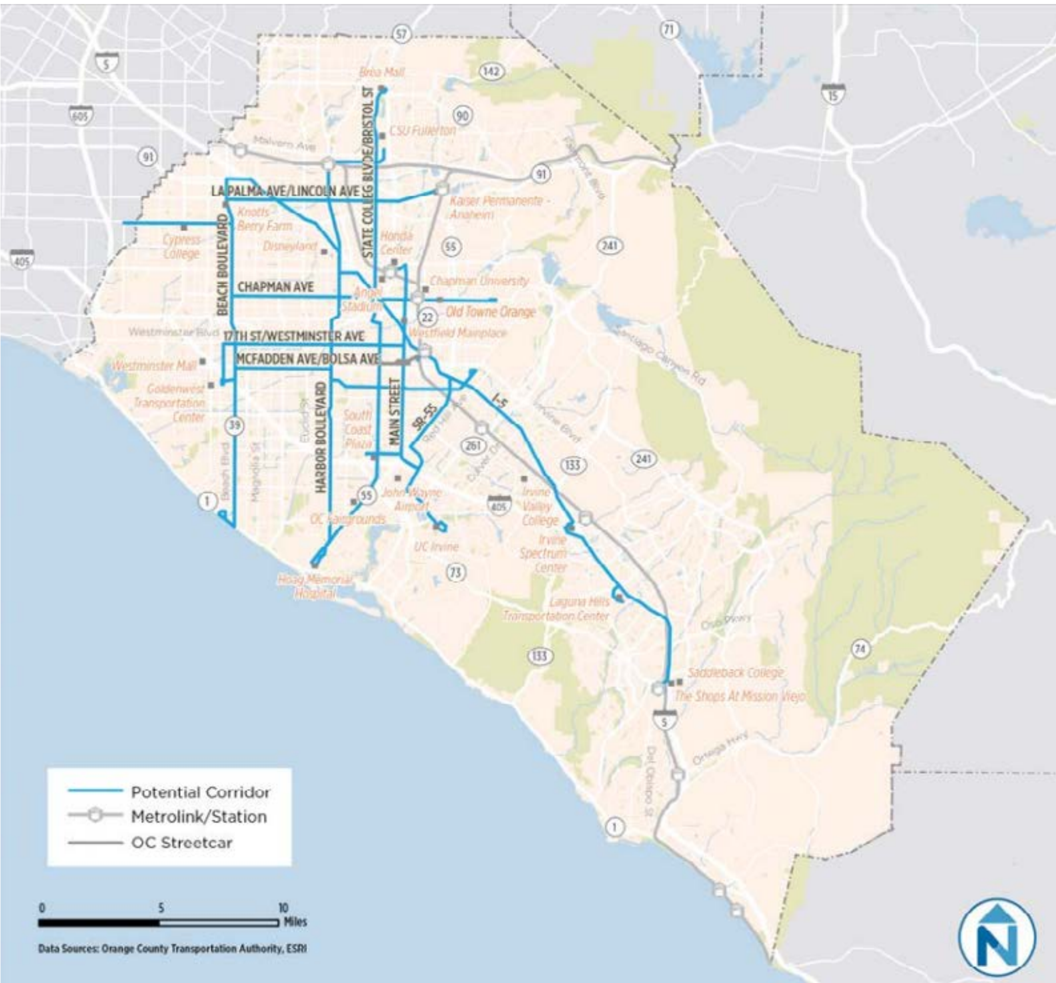


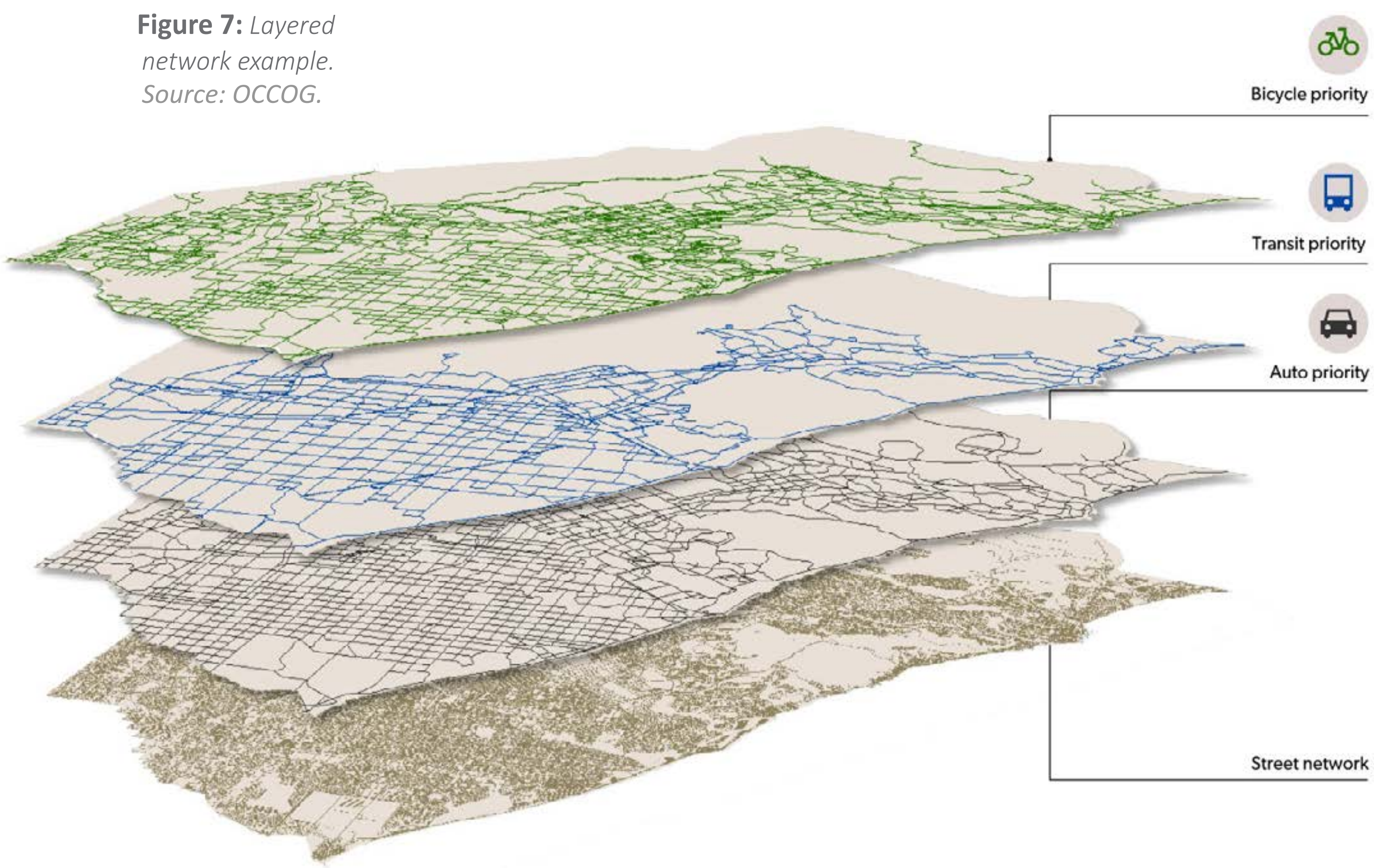
Figure 6: *Map of OCTA's Transit Opportunity Corridors. Source: OC Transit Vision.*

3.2.2 Layered Networks

A layered street network prioritizes streets for a specific mode (or multiple modes) with the intent of providing a complete network of streets that provide mobility for all users of all ages and all abilities. The layered network approach is considered a best practice in implementing Complete Streets principles, helping to inform network optimization for streets where competing modal priorities arise.

The layered network approach has become a recommended practice by the Institute of Transportation Engineers (ITE), allowing for mode-specific considerations for access and safety in addition to identifying network gaps and opportunities for improved connectivity and service integration. The concept of layered networks has been gaining traction throughout the Complete Streets community and is set out in OCCOG's Orange County Complete Street Initiative (OCCSI) handbook (**Figure 7**). It recognizes that not all streets can serve all users effectively; thus, a layered network identifies which streets should be prioritized for which modes with the goal of providing a comprehensive network of streets to serve specific user groups, such as those wishing to access parks and open spaces either on foot or by bicycle. This approach can also be adapted to identify which streets would be most suitable for creating green streets connecting communities to parks and open space.

Figure 7: *Layered network example. Source: OCCOG.*



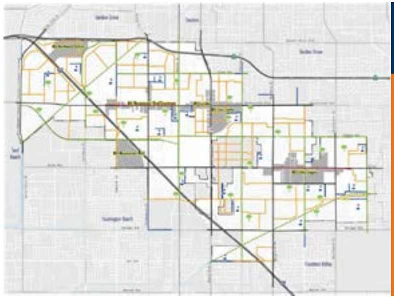
The layered network approach can be an important tool to inform decisions on transit-supportive design elements that are sensitive to their surrounding context. For example, while the Master Plan of Arterial Highway (MPAH) street type may set overarching requirements for a street, the layered network can be overlayed with that classification and used to set the modal priorities.

To develop a modal-priority layered network, local agencies should take these steps:

- Define the street network.
- Map the bicycle network.
- Map the transit network.
- Map the auto-priority network.
- Map the truck routes.
- Create the layered network.

Considerations should include:

- Understanding and mapping strategic movement demands by different transportation modes and users.
- Ensuring local level connectivity and continuity within city limits.
- Integration of network to provide regional connectivity with layered networks from neighboring cities.
- When a street is identified as a specific modal-priority it does not mean that there should be no provisions for other modes.



CASE STUDY **City of Westminster Layered Network**

Westminster's Mobility Element of the General Plan utilizes a layered networks approach to inform their approach to implementing complete streets. The city identifies preferred travel modes (auto, pedestrian, bicycle, and/or transit) for each street typology, and specifies that non-preferred travel modes are accommodated but not prioritized along the street. The city leaves open the possibility for priorities of streets to shift in the future.

3.2.3 Safety: Vision Zero

Vision Zero is a strategy to eliminate all traffic fatalities and severe injuries, while increasing safe, healthy, equitable mobility for all. The premise of Vision Zero is that traffic-related deaths are preventable through effective planning, design, and programmatic measures, and that traffic-related deaths are unacceptable. Vision Zero places the core responsibility for road collisions on the design of the infrastructure, anticipating human error. Vision Zero streets are designed with safety prioritized over speed, prompting the introduction of low urban speed limits, pedestrian zones, and safer crossings (see **Figure 8**).

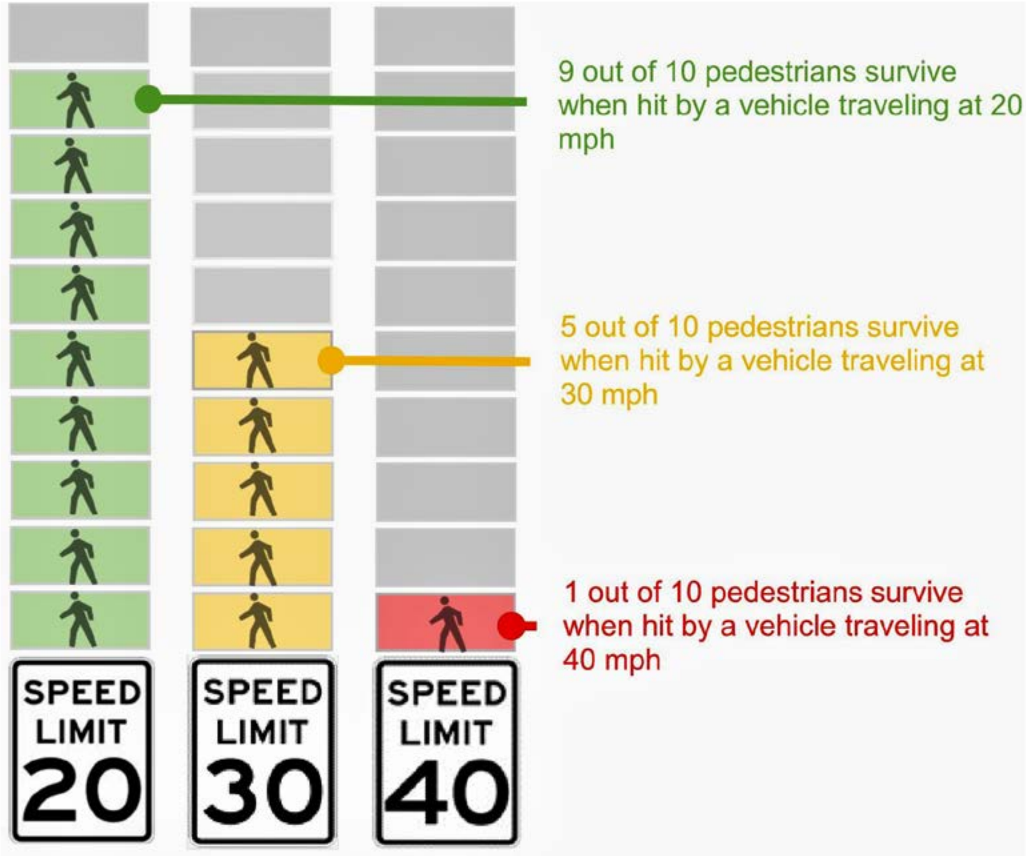


Figure 8: *Pedestrian survival versus vehicle speed.*

For example, in 2016 the City of Santa Ana developed their Safe Mobility Santa Ana Plan[2], which aimed to substantially increase safe mobility in all areas of the City, achieve zero fatal bicycle/pedestrian collisions, reduce vehicle speeds and minimize demonstrated collision patterns. The plan used collision analysis to identify hot spot locations and citywide collisions trends, which were then paired with locally responsive strategies including both physical and programmatic recommendations.

Street safety is a concern that directly impacts Orange County residents.
Between 2015-2019[3]:

- Orange County had 72,661 automobile collisions, with 984 (1.4%) people killed.
- 4,144 (5.7%) of these were pedestrian collisions, and 4,567 (6.3%) were bicycle collisions. While the bicyclist fatality rate was only slightly higher than all collisions at 1.6%, pedestrian fatality rate was much higher at 7.5%.
- Orange County had the second highest number of bicyclist collisions in the State, only following Los Angeles County.

Promoting safety for pedestrians and bicyclists is essential for creating transit supportive communities, as many riders access transit using active modes of transportation. Thinking about the transit user's experience from the perspective of their whole trip from door to door, brings into focus the importance of the first and last mile of a rider's journey including access to the transit stop from their origin, and connecting to their destination when

[2] https://www.santa-ana.org/sites/default/files/Documents/SafeMobilitySantaAnaFINAL.pdf

[3] *Transportation Injury Mapping System (TIMS), Safe Transportation Research and Education Center, University of California, Berkeley. 2021*

they alight. Ensuring safe, direct, and convenient paths for pedestrians and bicyclists to access transit is essential to providing a good transit-riding experience for users, as well as maintaining and growing ridership.

Orange County cities can contribute to achieving Vision Zero goals in their own communities through:

- Collecting and analyzing data to understand where collisions are occurring – The Transportation Injury Mapping System (TIMS) at SafeTREC UC Berkeley is an essential data source. It is a data aggregator, bringing together data from SWITRS, FARS, SRTS, and SHSP in a way that is manageable and has information, data analysis and mapping tools for safety related research.
- Advocate for pedestrian and bicycle infrastructure improvements on key first/last mile access routes to transit stops.
- Implementing a Vision Zero Policy or Action Plan.
- Creating an active transportation safety and encouragement campaign – SCAG has materials ready to use through their GoHuman Campaign.
- OTS Technical Assistance – a resource for performing safety assessments is Tech Transfer Program at UC Berkeley's Institute for Transportation Studies. Communities can apply to Tech Transfer to have a team of professionals perform a free Bike or Pedestrian Safety assessment.
- The number of assessments available is limited by OTS funding, however interested communities can also opt to use Tech Transfer's technical guide for these assessments in lieu.
- Incorporate behavior change elements into road safety campaigns.

3.2.4 New Mobility and Mobility as a Service (MaaS)

There has been significant, technology-driven innovation in urban mobility over the last decade, and this trend is likely to continue. New transportation service offerings have become increasingly more common place in Orange County, across Southern California and throughout cities nationwide. Examples of new mobility commonly seen today in Orange County include demand-responsive transit like OC Flex, Transportation Networking Companies (TNCs) like Uber and Lyft, and shared electric scooters, among others. These existing services make up only a small portion of new mobility options, and many cities and regions are exploring what new service offerings can help meet gaps in their existing transit networks or to help connect riders with existing services.

Some examples of new mobility include:

- Shared Micro-mobility, which includes a range of small, human and/or electric-powered transport devices which are managed as shared resources available to multiple users, and which typically operate at speeds below 15mph. The most widely available micro-mobility modes are bikes and scooters.

- Micro-transit, a type of demand-responsive transit that provides flexible routing and/or flexible scheduling of high-quality vans or minibus vehicles. Like other emerging mobility modes, micro-transit is enabled by smartphone technology that allows riders to request a ride in real time, navigate to a pickup/drop-off zone. On the back end, micro-transit utilizes algorithms to optimize routing in response to demand.
- Multimodal Integration refers to the steps taken to increase access to complementary modes that allow door-to-door travel without use a private car. It is characterized by two key features: integration of fixed-route transport modes with each other (such as bus and rail), and integration of other feeder modes such as ride-hailing, bike-sharing, walking, and cycling. This may include physical infrastructure such as mobility hubs, or apps that allow users to plan and book a route across multiple modes.
- Connected and Autonomous Vehicles (CAVs): Autonomous vehicle technologies allows for cars to drive themselves partially or fully from a starting point to a destination using various in-vehicle technologies and sensors. Connected vehicle technologies allow vehicles to communicate with each other and to the infrastructure around them, with the potential to improve safety, wayfinding, and localization among other benefits.

When successfully paired with transit, these emerging and integrated services have the potential to help build a transportation system that is more accessible, affordable and leads to potential model shifts away from single-occupant vehicle use. As these new modes become more integrated with transit, they become an essential component of the transit network itself, whether used for first/last mile access or used to replace traditional fixed route service where demand is low or inconsistent. As such, the scope of planning for transit supportive communities expands to include planning for streets that can accommodate and support these services.

There are a number of ongoing pilots for micro-transit services in Orange County including OC Flex in Huntington Beach, Westminster, Aliso Viejo, Laguna Niguel, and Mission Viejo and FRAN in Anaheim.

OCTA also has an initiative focused on multimodal integration currently underway through the Development of the Orange County Mobility Hub Strategy.

Mobility Hubs have the potential to benefit all stakeholders of the mobility ecosystem by boosting the public transit experience with predictable first/last mile options while increasing operating efficiencies of private on-demand new mobility. Integration of shared mobility and on-demand delivery services adds further convenience to users while helping to offset traffic bottlenecks and carbon emissions.

As Orange County grows rapidly, OCTA is tasked with creating a transit system that is responsive to changing user needs and regional demands. Mobility Hubs can help Orange County deliver a better public transit experience, and one that can remain the mobility backbone of future smart cities and connected communities. The benefits that Mobility Hubs can help OCTA achieve directly address key transit challenges set out in the OC Transit Vision, which include:

- Increase transit ridership via the integration of various first/last mile services.
- Reduce automobile dependence and support low-income and disadvantaged communities where cars ownership levels are low.
- Promote rideshare through integration provision of pooled rides, vanpools and carpools
- Reduce air pollution mobility hubs encourage use of sustainable transport modes (e.g. shared modes/rideshare) leading to reduced GHG emissions.
- Provide options for older adults, people with disabilities and residents of low income and disadvantages communities.
- Encourage more sustainable travel, create a sense of place for the community and improve accessibility for those with limited transport choice or no access to a car.

3.3 Transit-Supportive Communities

- Transit-supportive communities are places designed to be comfortable to walk or bike, to work and play or run errands. They are good for local businesses, attracting customers and making it easier for employees to access work.
- The core goal of transit-supportive community investment is to create urban environments that are supportive of transit use, walkable, activated, and healthy, and ultimately increase transit ridership while reducing private vehicle trips. Traditional growth and development patterns have created more barriers to using transit, such as disperse neighborhoods, long blocks, unfriendly arterial roads, unwalkable distances or disconnected destinations.
- Transit-supportive communities build on the principles of Transit Oriented Development (TOD) and extend site specific interventions around transit nodes to a neighborhood, corridor, or municipal scale, offering a paradigm-shift from traditional development patterns. Transit-supportive communities are tasked with addressing a multitude of barriers, including physical, cultural, and operational that contribute to a vehicle-oriented status quo.
- The benefits of transit-supportive communities in Orange County include:

Good for concentrating dense development	Healthier through encouraging more active trips	Reduces congestion, VMT, GHGs and improves air quality
Resilient and designed to adapt to change	Inclusive, providing destinations for a range of users	Friendly and safe for pedestrians, people of all ages and abilities
Attractive to developers, businesses, and customers	Vibrant, bring residents into the public realm, good for business	Increases transit use through making it more competitive with driving

Equitable Transit-Oriented Development (E-TOD) has recently emerged in relation to traditional TOD. E-TOD aims to address risks of TOD associated with gentrification to ensure that all community members can experience the benefits of pedestrian-oriented, walkable, healthy, and accessible TOD.

E-TOD is an important new practice to re-orient TOD concepts to achieve their goal of improving livability. E-TOD can work to advance racial equity, public health, economic and climate resilience. By contrast, TOD without an equity lens can have negative health and economic impacts on current residents through possible displacement because of gentrification if proactive steps are not taken. Without an equity lens on TOD, the benefits of transit — affordability, access to jobs, livable and walkable neighborhoods—do not accrue to those who stand the most to benefit from them.

To navigate the wide range of topics and strategies associated with creating equitable and transit-supportive communities, this topic is broken down into six design themes known as the 6 Ds: Diversity, Distance, Destinations, Density, Demand Management, and Design, as shown in **Figure 9**. To be effective, all 6 Ds need to work together, and at multiple levels of geography, including regional, corridor, neighborhood, and site scale. For this reason, the delivery of transit-oriented communities must also be in collaboration with different practitioners, including OCTA, municipalities, developers, and other regional and local stakeholders.

	DIVERSITY	DESTINATIONS	DENSITY	DISTANCE	DEMAND MANAGEMENT	DESIGN
CORRIDOR	●●●	●●●	●●	●	●●	●
NEIGHBOURHOOD	●●●	●●	●●●	●●●	●●●	●●
SITE	●●	●	●●	●●	●●	●●●

Level of Influence on transportation outcomes

●●● high
●● medium
● low

Figure 9: *The 6 Ds each have a different level of relative influence on transportation outcomes at the various scales of geography, which should be recognized during community design. Source: TransLink. BC.*

3.3.1 Diversity

ENCOURAGE A MIX OF USES

A vibrant land use mix helps to create complete, walkable neighborhoods around transit nodes, and supports a transit system that is well-utilized throughout the day. Transit-supportive communities should include a mix of businesses and destinations, a range of housing types including housing that is more affordable and should be an attractive and feasible area to live in for people from a diverse range of backgrounds and socioeconomic status. They should be active, healthy, and inclusive communities where people can access many destinations by non-driving modes.

There are four key aspects of diversity in transit-supportive design:

A. Encourage a mix of land uses immediately adjacent to frequent transit passenger facilities.

Areas within a quarter mile of transit facilities (especially stations and exchanges), are particularly valuable to encourage a mix of active land uses. People often like to combine tasks in one trip and, therefore, convenient access to goods and services makes transit much more attractive. Providing retail and community services near transit can also promote local business opportunities and can help to create a lively street life, a pleasant pedestrian environment, and a safe and secure public realm.

B. Encourage a mix of uses around frequent transit nodes to create complete neighborhoods.

Transit-supportive communities encourage a mix of land uses at both the neighborhood and corridor scales. Encouraging a diverse mix of land uses (residential, commercial, recreational, and civic) – for the quarter-mile area around bus stops and frequent transit corridors and the half-mile area around rapid transit stations – can help create neighborhoods where home, work, shopping, recreation, and transit services are within walking distance. Such neighborhoods enable residents to meet many of their daily needs within walking distance and to combine several errands on the same trip. This strategy supports both a higher walk and transit mode share for trips as well as reduced vehicle miles travelled (VMT) per capita. Most of the traffic reduction benefits of transit-supportive communities occur not because of increased transit ridership but, rather, because of increased walking for the 80% of household travel that is not commute-related.

C. Provide a mix of uses along frequent transit corridors to reduce peak crowding and spread travel demand throughout the day.

Land use diversity within transit corridors can help to balance the timing and directionality of transit demand and more effectively utilize transit capacity. Balancing the distribution of homes, schools, and employment locations along a transit corridor will enable transit to be well-utilized in both directions during peak periods, rather than being overcrowded in one direction and underutilized in the other. Distributing other land uses with more variable travel demand – such as retail centers, civic institutions, and entertainment venues – along a transit corridor (preferably in Urban Centers along the corridor) can also help to ensure that transit demand is more evenly distributed throughout the day. Such distribution also generates transit demand on weekends.

D. Provide a mix of housing types near frequent transit passenger facilities to create inclusive communities and promote equitable access to transportation.

A mix of housing types and tenures at a variety of affordability levels located near transit passenger facilities can promote access for those segments of the population that are more likely to use or rely on transit to meet their transportation needs. Housing mix can also allow communities to support residents at different stages of their lives, including students, single adults, families with children, and seniors aging in place. Diverse residential populations support transit use and activate areas around transit stops at different times of the day and week.

A poor mix of housing and other uses along a corridor leads to low bi-directional transit productivity and inactive neighborhoods. Source: TransLink. BC.

A rich mix of pedestrian-friendly uses and housing types, tenures, and price points distributed along a corridor helps optimize transit utilization. Source: TransLink. BC.

3

HOW TO APPLY

- Update zoning in areas with high-frequency transit to allow for dense, mixed-use development.
- Create or update specific plans including corridors with high frequency transit to encourage a mix of uses.
- Use land use designations, zoning, and other regulations to encourage a mix of building types and tenures.
- Develop an E-TOD policy or incorporate E-TOD principles into development agreements.
- Include affordable housing requirements for developers.

E-TOD is development that enables all people regardless of income, race, ethnicity, age, gender, immigration status or ability to experience the benefits of dense, diverse, mixed-use, walkable communities near high quality transit. This approach prioritizes investment and policies that close the socioeconomic gaps between neighborhoods and emphasizes "plan-to-stay" anti-displacement strategies. It emphasizes community-focused benefits such as affordable housing, public health, strong local businesses, and environmental sustainability.

3.3.2 Destinations

Coordinate Land Use and Transportation

When land use and transportation are well coordinated, transit can provide fast, direct, and cost-effective access to more destinations for more people. Being able to access a number of destinations conveniently by transit subsequently makes it a more attractive option for riders.

Land use and transportation can be coordinated in two ways: at a local level, locating most new development along reasonably direct corridors so that most destinations are 'on the way' to other destinations; and at the regional scale locating the highest densities of development and the most important destinations at the intersection of high quality transit corridors.

CASE STUDY

Chicago E-TOD

Since 2013, the City of Chicago has encouraged TOD near rail stations aiming to increase transit ridership and create walkable communities, reduce congestion and greenhouse gas emissions, and add to the City tax base. The January 2019 TOD ordinance amendment included a focus on equity and expanded the TOD focus to include corridors with frequent bus service and required the City to evaluate the performance of recent TOD projects. Upon finding that TOD projects were having negative equity impacts, the City developed an E-TOD policy to realign their approach to creating transit-oriented communities to achieve citywide goals.

This approach has two key benefits for Orange County:

1. It allows transit to provide fast, frequent service to areas with many destinations, making it a more attractive travel option for people who want to access areas with many places to go, or who must go to multiple destinations in one trip.
2. It is more cost-effective to operate transit in key routes which connect multiple destinations than to serve dispersed destinations across a larger geography. Focusing destinations and transit in key corridors is more cost-effective and therefore allows for more frequent and better transit service.

The desired outcome of this approach is for people in Orange County to have access to transit which connects the places they want or need to go. There are four key aspects to getting destinations right:

1. Ensure that major destinations are lined up along a reasonably direct corridor so they can be served by frequent transit.
2. Encourage the highest intensity of development in downtowns and at frequent transit nodes.
3. Focus additional growth toward existing and planned high quality transit corridors.
4. Do not forget about non-work destinations.

While destinations strategies are closely aligned with those related to density they are not completely overlapping. Encouraging density and locating it in transit supportive areas facilitates proximity and clustering of destinations. However, destination have a particular focus on attracting trips, while density can be related back to both attracting and generating trips. Destinations may also face challenges like high demand for parking which can make transit a more attractive alternative.

A. Ensure that major destinations are lined up along a reasonably direct corridor so they can be served by frequent transit.

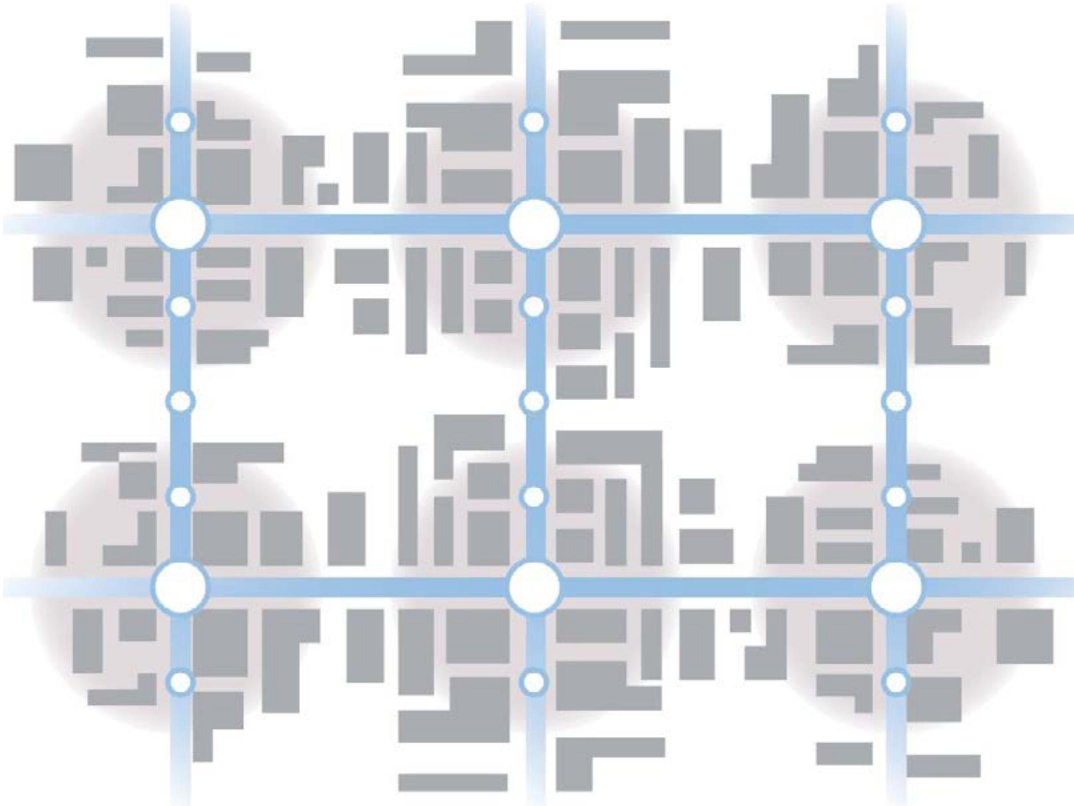
Transit can most efficiently serve destinations that are along the same corridor as other destinations. When destinations are located outside of a frequent transit corridor, transit service must either deviate from the corridor – costing passengers time and costing the transit service money – or not serve the destination at all. To help create an environment where transit is cost-effective and convenient, destinations should be aligned along a frequent transit corridor. Beach Blvd is a good example of a continuous corridor running throughout Orange County with many destinations and is served by OCTA Routes 29 and 529. The City of Anaheim has prepared a Beach Blvd Specific Plan which guides the development along the city’s 1.5-mile stretch of the street with the intention of reactivating the corridor as an economically vibrant focal point in Anaheim.

Locating destinations appropriately will improve the efficiency of transit corridors. Source: TransLink. BC.

B. Encourage the highest intensity of development in downtowns and at frequent transit nodes.

Destinations are best connected to the rest of the region when they are in downtowns or at frequent transit nodes along corridors with frequent transit or TOCs. Encouraging development in downtowns and HQTAs is aligned with the RTP/SCS mandate for focusing growth across the region and helps make transit a more viable alternative to driving in Orange County. Proximity to a well-served transit route has the compound impact of increasing the attractiveness of the corridor for office, commercial, retail, leisure, and entertainment activity, which then in turn increases the demand for frequent and connected transit.

3



By focusing density around frequent transit nodes, more people will be within walking distance of frequent transit service. Source: TransLink. BC.

HOW TO APPLY

- When planning new developments, prioritize projects in TOCs or HQTAs. Incentivize developers to locate in these areas and allow larger attractors in these areas.
- Inventory destinations in your city are connected to frequent transit services. Share information on destinations that can be accessed on frequent transit corridors with residents. This is a great opportunity to promote local businesses while encouraging transit use.
- Using transit to access local businesses helps connect businesses to customers while alleviating demand for parking. Encourage businesses to incentivize employees to commute by transit and encourage customers to use transit to access businesses as well.
- Identify essential non-work destinations which people can access by frequent transit. If there are key services missing (i.e. civic, groceries, childcare, recreation) consider strategies to connect people to essential services by transit or attract destinations that may be missing currently.

C. Focus additional growth toward existing and planned HQTCs.

In addition to downtowns, communities can focus growth toward established and planned frequent transit corridors to maximize the effectiveness of the region's transit investments. Concentrating residential and employment activity in HQTAs is a strategy in the region's RTP/SCS and is essential to achieving statewide goals related to mode-shift, reducing greenhouse gas emissions, and improving air quality. Providing optimal access to transit for those living and working in these areas will increase the demand for transit services and improve access to destination centers and frequent transit nodes. Major employment, business and service centers that serve the region or sub-regions should be prioritized within HQTAs.

D. Do not forget about non-work destinations.

When transit services are only planned around commuting or access to employment, key segments of the Orange County population are being left out of the conversation. People use transit not only to access jobs, but also to meet needs like accessing grocery stores, healthcare, schools, or recreation. Serving a larger range of users can lead to increased ridership, and a lower burden on households related to driving trips. When Livermore Amador Valley Transit Authority (LAVTA) began providing free trips for students, parents in Tri-Valley benefited significantly through reducing the number of car trips required to take children to school or activities.

CASE STUDY **Downtown Santa Ana**

Downtown Santa Ana is a great example of transit-supportive destinations and encapsulates many other qualities of other Transit-Oriented D's as well. The downtown has a diverse mix of land uses including shops, offices, restaurants, pop-up markets, art studios, government buildings, and breweries. The downtown area puts on several events on the street and in public spaces allowing visitors to experience different small business. Having a mix of destinations in a dense, walkable area, combined with temporary destinations creates through on-street events, Downtown Santa Ana stands out as a transit-supportive destination in Orange County.

3.3.3 Density

CONCENTRATE AND INTENSIFY ACTIVITIES NEAR FREQUENT TRANSIT

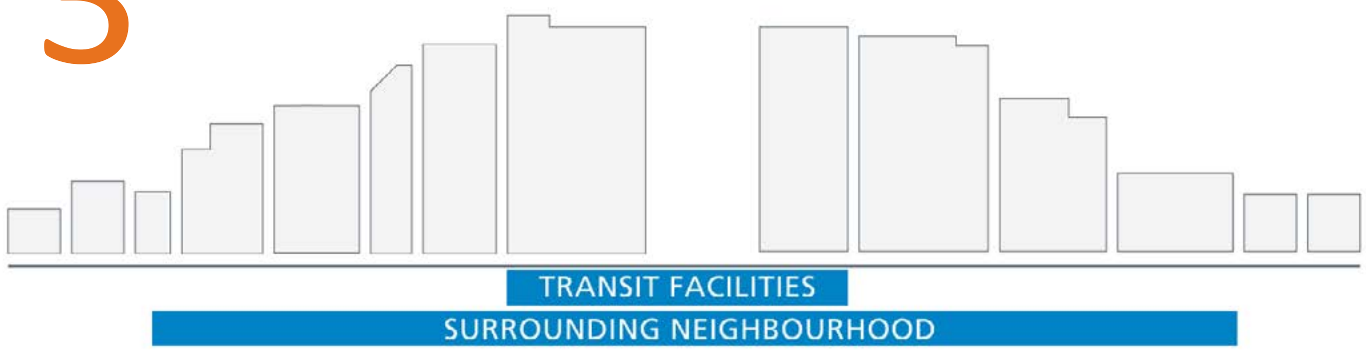
Transit-supportive communities concentrate growth and development within a short walk of frequent transit nodes. A higher density of homes, jobs, and other activities creates a market for transit, allowing frequent services to operate efficiently. Having effective transit in proximity to new development can also support development that is higher density, reducing the impact of congestion by spreading new residents or new attracted trips across different modes. High quality transit which supports higher-density development is more attractive to developers and will also result in further concentrating destinations in transit-rich areas.

Development form varies from community to community based on local goals, character, and needs, and there is no 'one-size-fits-all' approach to achieving an appropriate level of density to support transit:

- Focus density in downtowns or other areas with more destinations and around frequent transit corridors and nodes to support a strong demand for transit service.
- Plan for density that supports community character and promotes quality of life.

A. Focus density in downtowns or other areas with more destinations and around frequent transit corridors and nodes to support a strong demand for transit service.

OCTA and the municipalities can work both independently and in partnership to support sustainable modes of travel and minimize walking distances to and from transit by encouraging higher densities of homes, jobs, and services in downtowns or other areas with more destinations and in areas nearest to frequent transit nodes and corridors. This approach also contributes towards regional goals outlines in the RTP/SCS. Increased mixed-use density provides residents, employees, and visitors with more opportunities to access jobs, meet daily needs, visit local businesses, and gather with friends or family within an area that is accessible by transit, walking, and bicycling.



The highest densities should be reserved for those sites closest to frequent transit facilities. Source: TransLink. BC.

Coordinating development density and transit service type creates higher efficiencies.

HOW TO APPLY

- Incentivize developers in areas with high frequency transit through allowing more dense development, with a mix of uses.
- Develop or update existing specific plans to allow mixed-uses in areas of high-quality transit and Transit Opportunity corridors.
- Attract businesses or services that may currently be lacking, so residents can use transit to meet daily needs.

B. Plan for density that supports community character and promotes quality of life.

Orange County includes many different cities, neighborhoods, and communities, each with its own history, character, and mix of land uses. When promoting density in downtowns and near frequent transit, it is important to integrate new development into the existing character of the community.

3.3.4 Distance

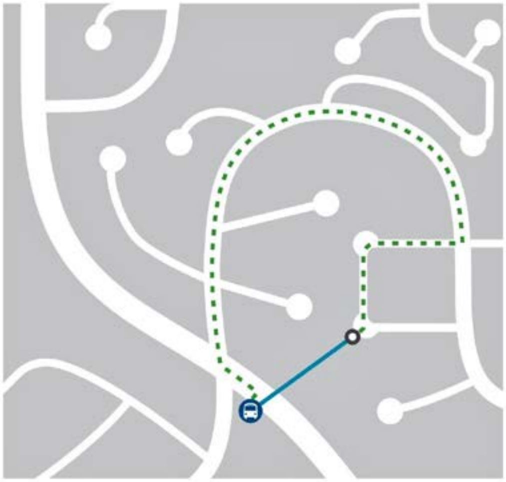
CREATE A WELL-CONNECTED STREET NETWORK

A well-connected street network shortens trip distance, making walking or biking a viable mode choice or a first/last mile connection to a transit trip. To support a successful and frequent transit service it is vital that people can access transit quickly and conveniently from the places they live, work, shop, and play. There are four key aspects to getting distance to transit services right:

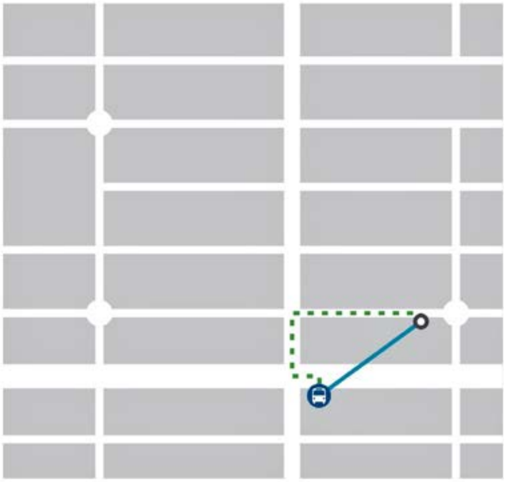
- Plan urban blocks to provide a fine-grained street network.
- Locate transit stops at accessible places on the street network.
- Plan walk and cycle routes that are direct, safe, and comfortable.
- Plan a layered network.

A. Plan blocks to provide a fine-grained street network.

Transit-supportive communities have a dense, coherent, and walkable network of streets, sidewalks, and off-street paths. A pattern of smaller blocks and connected streets makes it possible to travel along direct routes. A connected street network extends the reach of transit, walking, and bicycling and closes the gap between destinations; it also brings origins and destinations closer together and makes access to everyday activities more convenient by sustainable modes of travel. Street connectivity may be of highest priority in downtowns or corridors which are activated by many destinations and is most critical near frequent transit stops or stations.



A disconnected street network full of cul-de-sacs results in long walking distances, few route options, and less efficient transit operations. Source: TransLink. BC.



A well-connected, fine-grained street network enables shorter and more direct walking connections, provides greater choice of routes, and is easier to serve with cost-effective transit. Source: TransLink. BC.

Neighborhood porosity is a key issue in Orange County; even if downtown areas have good connectivity of streets, many residential developments have circuitous development patterns, and are walled off from adjacent movement corridors. These types of barriers increase the distance that residents need to walk to access transit on a main road and add time on to their trip. Additionally, infrequent pedestrian crossings across corridors can add significant distance for pedestrians who will need to walk to the nearest node to cross.

While these barriers may be more difficult to address in existing developments, requirements for new housing developments can be mindful to things like pedestrian connectivity. In development areas, new blocks should provide a fine-grained connected grid of streets that minimizes travel distances between points. Disconnected and winding streets with cul-de-sacs and dead ends should be avoided. Internal streets of large development projects should be open and accessible to the public, with permeability for pedestrians and bicyclists, and a high intersection density.

B. Locate transit stops at accessible places on the street network.

Transit facilities, such as transit centers, are important focal points for community and transportation activity. Even a simple bus stop can be a focal point. Wherever possible, facilities should be located where they provide convenient access to the pedestrian and bicycling networks, enable efficient intermodal connections, and support the development of higher density, mixed-use development. Distances to surrounding destinations may be reduced, not only by creating more connections, but also by locating transit facilities where existing connections intersect. The streetscape and wider urban environment around transit facilities needs to be structured and designed to promote facility visibility and provide clear navigation to and from it.

Paths of travel to and from transit facilities should be as direct as possible, both to minimize the distance people are required to walk to transit and to maximize the number of people who have convenient access to it. Routes should be designed with ‘first and last mile’ in mind, including design elements (crossings, sidewalks, curb cuts etc.) and infrastructure (lighting, bike lanes, etc.) to make sure routes between a transit stop and surrounding areas are comfortable, safe, and seamless.

- Provide guidelines or requirements for developers in areas surrounding transit, to design new buildings or develop street networks to provide a walkable environment for pedestrians.
- Review how transit stop locations relate to the street network and walking and bicycling networks. Can transit facilities be located to improve access to them? Do bicycle facilities need to be updated to serve transit stops?
- Identify what improvements are needed to make walking and bicycling routes more direct, comfortable, safe and seamless. These improvements can be included in specific plans or other citywide plans to move them towards implementation.
- Consider transit streets within the wider layered network – what design approach is needed for the modal priorities? (see Section 3.2.2. Layered Networks for detail).

TRANSIT USER POINT-OF-VIEW

When deciding whether to use transit, one of the most important factors people consider is the distance between their origin and a transit passenger facility (stop or station) and again to their destination. What matters for the traveler is not the straight-line or 'as the crow flies' distance but, rather, the actual walking distance using the available streets and paths. In an area with long blocks and dead-end streets, the walking distance can be much further than the straight-line distance. Some destinations that are physically very close to a transit stop or station may still require a long walk.

Opportunities to improve permeability in neighborhoods with these challenges should be explored, including by opening new pedestrian or bicycle connections where feasible.

HOW TO APPLY

- Review block sizes- are they scaled for walking? Can they be resized, or new connections added?
- Provide guidelines or requirements for developers in areas surrounding transit, to design new buildings or develop street networks to provide a walkable environment for pedestrians.
- Review how transit stop locations relate to the street network and walking and bicycling networks. Can transit facilities be located to improve access to them? Do bicycle facilities need to be updated to serve transit stops?
- Identify what improvements are needed to make walking and bicycling routes more direct, comfortable, safe, and seamless. These improvements can be included in specific plans or other citywide plans to move them towards implementation.
- Consider transit streets within the wider layered network – what design approach is needed for the modal priorities?

C. Plan walk and bicycle routes that are direct, safe, and comfortable.

The distances people are willing to walk to transit vary depending on transit service type, length and purpose of the trip and quality of the pedestrian environment, as well as on weather, topography, and other community-specific factors. Generally, people will walk further to access limited-stop transit services than local services and further still for rapid transit services.

Paths of travel to and from transit passenger facilities should be as direct as possible, both to minimize the distance people are required to walk to transit and to maximize the number of people who have convenient access to it. Routes should be designed with 'first and last mile' in mind, including design elements (crossings, sidewalks, curb cuts etc.) and infrastructure (lighting, bike lanes, etc.) to make sure routes between a transit stop and surrounding areas are comfortable, safe, and seamless.

D. Plan a layered network.

A well-connected street network provides the foundation for direct travel at the neighborhood scale. Building on this foundation, another important step for minimizing travel time and distance is to plan for complete, well-connected transportation networks for all modes at the local level. This layered network approach recognizes that not every street will serve every mode of transportation in the same way. A multi-modal network will include different types of streets and pathways that combine to provide optimal connectivity for all modes within a community.

3.3.5 Demand Management

Reduce Unnecessary Driving

Transit-supportive communities use Travel Demand Management (TDM) strategies to discourage unnecessary driving and to promote walking, bicycling, and transit use. TDM provides incentives and opportunities for residents to shift car trips to other modes where possible, through leveraging a number of strategies including increasing travel options, providing information and incentives for travelers, setting appropriate prices for parking or road usage, and allocating more road space and making it more comfortable and convenient to take transit, bike and walk. Two key transit-supportive approaches to demand management include:

CASE STUDY

City of La Habra Complete Streets Master Plan

For the development of the City of La Habra's Complete Streets Master Plan, an analysis of street connectivity was undertaken. Areas of the city that followed a grid development pattern, with shorter blocks showed better connectivity. Areas which were more circuitous or had sound walls separating them from surrounding areas showed much poorer connectivity.

- Manage parking supply and demand.
- Use TDM measures to encourage sustainable modes of travel.

A. Manage parking supply and demand.

Managing parking demand is an important strategy for shifting travel demand away from single-occupancy vehicle use toward walking, bicycling, and transit, especially as transit supply alone cannot meet the region's goals for sustainable travel mode share and emission reductions. Local governments can help foster this objective by coordinating the management of both on- and off-street parking through policies and pricing that together achieve transportation objectives, particularly in downtown areas with high parking demand, that is also served by high quality transit. This coordination is vital to successful parking management strategies. Many Southern California cities have seen positive outcomes of managing parking, which have positive impact not only to mode shift but also to bolstering downtown area, helping more customers access businesses, and reducing downtown congestion created by cruising for parking.

B. Use TDM measures to encourage sustainable modes of travel.

By offering tools, information, and a package of incentives and disincentives, TDM programs can encourage the use of transit along with other travel alternatives such as walking, cycling, and carpooling. These programs are usually targeted toward places of employment and education and other large trip-generating destinations (e.g., large, multi-unit residential developments). Local governments can work to establish TDM measures through regulations or voluntary agreements.

HOW TO APPLY

- Develop a parking management strategy or plan to manage parking effectively and thoughtfully in places that have high-demand and are well served by transit.
- Develop a citywide TDM plan or a TDM strategy in coordination with neighboring cities.
- Conduct a transportation behavior change outreach campaign to provide residents in transit-rich areas information on other options for getting around. Encourage residents to try other modes for short trips where a car is not needed or trips that can easily be made by bus. Similar campaigns in other areas have seen as much as an 11% increase in bus ridership on promoted lines.

CASE STUDY SmartTrips Tri-Valley

SmartTrips Tri-Valley is an example of using Transportation Demand Management strategies to encourage transit use and improve ridership. It is an individualized marketing program for Livermore Amador Valley Transit Authority (LAVTA) which provides targeted outreach to residents in the Tri-Valley area with the key objective of increasing bus ridership along high frequency routes. Conversations focus on promoting the bus services and outreach staff discussed with residents' barriers to trying transit, as well as potential benefits. In a past round of outreach, 20% of residents contacted participated in the program, and 48% of participants tried the bus service after speaking with outreach staff, 30% of participants increased the number of trips by bus they had taken in the past week, on average by an additional 4 bus trips/week, and boardings increased by 11% in the outreach zone.

3.3.6 Design

CREATE PLACES FOR PEOPLE

Creating places for people means designing the street environments to accommodate their needs regardless of their chosen mode of transportation, and to be accessible to individuals with a range of mobility needs and challenges. The public realm encompasses the areas in which people travel, and it should be a safe, comfortable, and inviting place that people want to use.

To meet these needs and aspirations, transit-supportive communities are built around a foundation of multi-modal, 'complete' streets that serve a range of users. Strategies include:

- Design multimodal streets.
- Design great public spaces.
- Seamlessly integrate development with frequent transit and the public realm.
- Design parking to support a pedestrian-oriented urban realm.

A. Design multimodal streets.

Most transit trips begin and end as a pedestrian trip; therefore, the starting point for transit-supportive community design is the pedestrian. Transit-supportive environments make walking safe, easy, convenient, and enjoyable. The Orange County Complete Streets Design Guidelines has guidance for designing components of the pedestrian and bicycle environments and can be used as a key reference when designing multimodal streets.

B. Design great public spaces.

To support transit-supportive communities, the public realm should be both functional and attractive, and it should be inviting for those walking, cycling, or gathering. High-quality public spaces can take on many different forms: from small, intimate spaces between buildings, to niches or steps that allow pedestrians to pause along a busy commercial corridor, to larger open plazas that can accommodate public gatherings and events and have convenient access to public transit. Creating great public spaces supports the interrelationship between placemaking, good design, and the experience of delight in the urban environment.

The Orange County Complete Streets Design Guidelines also have guidance for promoting streets as public spaces, as well as placemaking. Within the placemaking guidance, the guidelines provide key design consideration for each type of placemaking, and includes elements such as:

- Plazas and pocket parks.
- Reclaimed roadway spaces.
- Shared spaces.
- Parklets.
- Open Streets and other street events.
- Public art.

In recent years, many businesses, particularly restaurants, have taken steps to reclaim street or parking space to provide outdoor dining or shopping. Outdoor dining and reclaiming of street space for other uses has effectively been a pilot of design elements like parklets and reclaimed roadway spaces and has been popular among customers and residents. Cities may want to consider expanding this approach in appropriate areas.

C. Seamlessly integrate development with frequent transit and the public realm.

Building design that deliberately shapes and animates the public realm will encourage use of the street by pedestrians and cyclists, thereby supporting transit use. Cities can include guidance or requirements to developers on how to integrate new developments with frequent transit and public realm.

HOW TO APPLY

- Use the Orange County Complete Streets Design Guidelines to find support designing multimodal streets and designing public spaces.
- Prepare design guidance or requirements for developers to ensure new development aligns with city and regional goals.
- Develop a parking management strategy and plan for areas with many destinations and high demand.

CASE STUDY **Pasadena Old Town Parking Management Strategy**

In the early 90's, Pasadena adopted a Parking Benefit District model with the intent of revitalizing the Old Town area. Originally deemed the "Old Pasadena Streetscape and Alleyways Project", the city installed parking meters for on-street parking in Old Town Pasadena, a dense and walkable shopping district, with the stipulation that all revenues would be invested back into street improvements, including street furniture, trees, lighting and the conversion of alleys to public spaces. The project is credited with the revitalization of the Old Town area. The Pasadena model uses common-sense parking management strategies, through pricing the most desirable parking spots to manage utilization while providing inexpensive or free off-street parking ensure parking for visitors.

D. Design parking to support a pedestrian-oriented urban realm.

It is important to have a parking management approach that is strategic, context sensitive and supports transit-supportive goals and objectives. Integration of parking, demand-based parking requirements and parking management strategies and tools are critical elements necessary to avoid overparking and undermining the effectiveness of transit.

Surface parking in high-density areas along commercial and mixed-use corridors can be reduced by placing parking underground, behind buildings, or in above-ground parking structures that are designed with architectural screening or that are wrapped with retail uses to animate the pedestrian realm. This approach will create a continuous street edge that is visually pleasing and that promotes interaction between the public and private realms. Similarly, in some cases on-street parking can enhance the pedestrian experience by serving as a buffer between sidewalks and vehicle travel lanes. A thoughtful parking strategy and management plan will serve both to reinforce concepts like walkability, provide additional revenue for cities in areas of high demand, and provide clear wayfinding for parking to drivers to reduce congestion from instances of 'cruising for parking'.

Recommended Resources

Complete Streets Initiative Design Handbook. Orange County Council of Governments (OCCOG). 2016. https://static1.squarespace.com/static/587121d0ebbd1ae2e3a080b3/t/58e2726cb8a79b14751cd0da/1491235470685/OC_Complete_Streets_Design_Handbook.pdf

Transit Oriented Development. C40 Cities. https://c40-production-images.s3.amazonaws.com/good_practice_briefings/images/10_C40_GPG_TOD.original.pdf?1456789145

TOD Standard: Version 3.0. Institute for Transportation & Development Policy. 2017. https://www.itdp.org/publication/tod-standard/

More Development for Your Transit Dollar: An Analysis of 21 North American Transit Corridors. Institute for Transportation & Development Policy. 2017. https://www.itdp.org/publication/more-development-for-your-transit-dollar-an-analysis-of-21-north-american-transit-corridors/

Planning for Transit-Supportive Development: A Practitioner's Guide. New Jersey Institute of Technology. 2015. https://www.transit.dot.gov/funding/funding-finance-resources/transit-oriented-development/planning-transit-supportive

Transit Oriented Communities Policy. Los Angeles Metro. 2019. https://media.metro.net/projects_studies/joint_development/images/toc_policy_final.pdf

What's eTOD? Elevated Chicago. https://www.elevatedchicago.org/whats-etod/

Transit Oriented Development. http://tod.org/

Center for Transit-Oriented Development. http://ctod.org/

4 Transit-Supportive Design Strategies

TRANSIT-SUPPORTIVE DESIGN STRATEGIES

4.1 Complete Street Design Strategies

This chapter is intended to support development of high-level design strategies or planning for specific streets or street networks, by applying a Complete Streets approach. This is the step that precedes development of geometric design or engineering of specific details (these are covered in Chapter 5). The OCCSI handbook provides further planning and design guidance on implementing Complete Streets in Orange County.

Complete Streets are streets that are planned, designed, operated, and maintained to provide safe mobility for users of all ages and abilities. Complete Streets recognize the variety of users, but importantly, the variety of non-automotive users. In Orange County, the range of people who use streets is wide, and includes bicyclists, pedestrians, persons with disabilities, transit users, truckers, motorists, neighborhood electric vehicles, equestrians, scooters, and skateboarders. A Complete Streets approach considers who uses different streets and prioritizes modes accordingly.

Complete Streets can be applied as a standalone project to improve transportation facilities along a street; however Complete Streets can also be applied as a network-based approach. A network-based approach means a more comprehensive view to achieve the goal of providing residents with the ability to traverse a city safely and comfortably, regardless of transportation mode.

Transit is one component of a Complete Street. Complete Street design strategies should be developed to ensure the subsequent design development embeds needs of transit operations and users and integrates it with other modes of transportation according to the mix of modal priorities required on a specific street or street network.

The design strategy establishes a broad approach to space allocation and placement of specific street elements, but not geometric design. In essence it sets a brief for the subsequent, technical design stages.

Key design strategy elements may include:

- Relationship to context, e.g. land uses, attractions, activity, built form, heritage
- Pedestrian elements, e.g. sidewalks, crossings.
- Bicycle infrastructure, e.g. bike lanes, intersection components, parking
- Transit, e.g. integration of stops and hubs.
- New mobility, e.g. integration of micro- and shared-mobility like e-scooters, bikes/e-bikes etc.
- Curbside activity, e.g. on-street parking/ loading
- Public realm, e.g. public spaces, landscape including trees and planting, and streetscape including seating, lighting, and other amenities

These are explained on the following pages.

4.1.1 Context Sensitive Design

Context Sensitive Design is an approach to develop better and improved ways of designing roads, highways, and other transportation facilities that are integrated with their environment and are more consistent with the needs of the communities they serve, thereby achieving planning and design excellence. It is about merging the function of a street design project with its setting, so that the project respects community values, physical needs, natural environment, social needs, cultural characteristics, aesthetics, and transportation needs.

Context sensitive planning integrates transportation with characteristics valued by the community. Source: Avenue of the Arts Design Guidelines. Sasaki.

The "context" of the project can include a variety of elements such as:

- **Land use** – general character and typical activities generated by uses such as residential neighborhoods, commercial districts, industrial zones, business parks.
- **Destinations** – specific places which are destinations, generating activity and providing identity, such as schools or colleges, malls, performance venues etc.
- **Heritage** – historic districts or specific buildings, cultural landmarks, places of local importance.
- **Landscape** – natural setting, geographic features such as coastline or rivers, parks and gardens, local flora etc.
- **Community** – the socio-demographic context of the communities within a place, considering those who live, work, or visit a street.

A context sensitive design approach is an integral part of all Complete Streets projects. Broadly, the design approach should:

- Relate to the intrinsic character of the area.
- Be aesthetically pleasing.
- Minimize impacts to the existing environment and be environmentally sustainable.
- Be consistent with the surrounding land use and neighborhood requirements.
- Preserve the historic character of the district.
- Involve the community from the outset and throughout all project phases.

4.1.2 Supporting Pedestrians

Every transit trip begins and ends as a pedestrian trip; therefore, the starting point for transit-supportive street design is the pedestrian.

SIDEWALKS

Within a street environment, pedestrian access to the transit network is via the sidewalk. Sidewalks should be designed with adequate space to allow seamless, safe, and comfortable access to transit. OCTA has a sidewalk inventory which can be used to help plan street redesign projects.

The most comfortable and functional sidewalks have zones that vary depending on surrounding land uses, street activity, and pedestrian volumes.

- **Frontage zone:** Commercial streets ideally have frontage zones to allow for restaurant seating, merchandise displays, planters and benches, awnings, or canopies. On residential streets in high density neighborhoods frontage zones may be sized to allow for front stoops or waiting areas at front doors. Street furnishings may be in the frontage zone on streets with narrow sidewalks.
- **Pedestrian through-zone:** Space for people to walk along the street, which needs to be adequate for current and future volumes for movement. At a minimum it needs to be wide enough for a wheelchair to move unobstructed and occasionally allow passing. This zone should widen at transit nodes with high demand or frequent services.
- **Street furniture/ landscape/ buffer zone:** This is the section of the sidewalk between the curb and the pedestrian through-zone that provides separation and protection from moving vehicular traffic. It provides space for placement of various street elements, such as landscaping, street furniture, and utilities (both above and below ground). Where transit stops adjoin this zone, the space should be kept clear for stop infrastructure and passengers to board/alight from transit and may include features such as curb-extensions.

CASE STUDY City of San Clemente Design Guidelines

In 1991 the City of San Clemente adopted Design Guidelines to preserve and strengthen the city's unique atmosphere and historic identity as "The Spanish Village by the Sea" and maintain high quality public spaces. Specifically, the guidelines set out to develop and improve the Del Mar Commercial District as the "Village" of San Clemente, a unique pedestrian-oriented business district. Over a decade later the Del Mar Commercial District has sustained its distinctive built environment through the adherence to the guidelines and the preservation and enhancement of historical features. The area continues to develop and meet modern community needs while maintaining a sense of place.

(City of San Clemente. Design Guidelines. San Clemente. 2015. http://bit.ly/23xW9Kn)

CROSSWALKS

Placement and alignment of street crossings mapped to pedestrian desire lines is essential so people can walk comfortably and safely and conflict with other modes is reduced. Crosswalks should be located on pedestrian desire lines, and near to transit stops to minimize crossing distances between transit connections. Crossings between pairs of bus stops on either side of the street allow people to make round trips or to safely transfer between services.

Crossings may be at intersections or midblock. Clear sight lines and visibility for both pedestrians and motorists must be maintained on the approach to crosswalks. Transit vehicles have different visibility requirements to other vehicles. Raised crosswalks can help improve pedestrian visibility but need to be designed for buses to traverse them safely and comfortably.

UNIVERSAL ACCESS

Designing streets and sidewalks to provide convenient access for all users, including those with reduced levels of mobility, will increase access to transit. Making the public realm more universally accessible to all of Orange County's diverse communities will make using transit and sustainable modes of travel more attractive. The Americans with Disabilities Act (ADA) sets out requirements for disabled access. Key design considerations in relation to transit include space for wheelchair users waiting at stops, level boarding/alighting from vehicles, step-free access along the sidewalk and connections into the neighborhood, gradients of routes, and various design details to activate or indicate crossings and warn of potential hazards.

Sidewalk Zones.
Source: Complete Streets Initiative Design Handbook. Orange County Council of Governments (OCCOG). 2016.

Crossings may be at intersections or midblock. Clear sight lines and visibility for both pedestrians and motorists must be maintained on the approach to crosswalks. Transit vehicles have different visibility requirements to other vehicles. Raised crosswalks can help improve pedestrian visibility but need to be designed for buses to traverse them safely and comfortably.

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4.1.3 Supporting Cyclists

Streets should be considered and planned for in terms of their role in the wider bicycle network. This includes planning of specific bicycle infrastructure on designated streets, as well as understanding how streets may be used by cyclists regardless of whether infrastructure is present.

BICYCLE NETWORK

Designate a well-connected network of bicycle lanes, routes, and paths that provide direct connections to local destinations. The bicycle network should also provide strong connections to important transit nodes. Consider the specific street's role as part of this wider network. This will inform the need for bicycle facilities on the street. Key network development considerations include:

- **Safety** – cycle facilities that provide safe routes for all ages and abilities, with clear sightlines for cyclists to clearly see and be seen by other road users. Busy transit stops should connect to designated bicycle routes with high-quality facilities (e.g. off-street paths, separated or buffered on-street lanes, or prioritized treatments on lower volume streets).
- **Comfort** – ensuring 'low-stress' for less confident riders, with dedicated space for a comfortable ride and to buffer from vehicles, along with a smooth, consistent surface.
- **Signage and markings** – information to clearly communicate wayfinding, distances, priorities, and how space is shared.
- **Connectivity** – providing a comprehensive network that gives equitable access to cycle facilities and infrastructure across a neighborhood and provides continuous and connected facilities that are as direct as possible with frequent, short, high-visibility crossing to allow cyclists to reach destinations.
- **Parking** – providing well-sited safe, secure, sturdy, and ideally sheltered parking that caters for different bicycles (including non-standard), meets demand, and is near to destinations.

BICYCLE FACILITIES

Anticipated bicycle volumes, traffic volumes and curbside access requirements are key considerations in terms of the specific type of bicycle facilities required and will need to be considered at this stage of planning. Where a combination of high bicycle volumes and high traffic volumes are present, exclusive facilities that are physically separated from the main roadway can improve safety and increase the attractiveness of cycling. Shared or preferential use facilities may be appropriate on lower volume streets.

- **Sidewalk buffer zone:** This is the same as the street furniture/ landscape/ buffer zone referred to in the 'Supporting Pedestrians' section. When adjacent to sidewalks or pedestrian spaces, cycle facilities should be physically separated for the comfort of both pedestrians and cyclists. It discourages pedestrians from walking in the cycle facility and cyclists from riding on the sidewalk. It can also be used for elements like cycle parking or wayfinding. If no sidewalk buffer is provided, cycle facilities should be grade separated with a curb.
- **Cycle through-zone:** The cycle facility should provide a clear, continuous cycling path free of obstructions. The path width may vary whether bidirectional or one-way and on level of demand.
- **Vehicle buffer zone:** This provides a separation between the cycle facility and moving or parked vehicles. Buffers can be raised or at-grade, with separation by physical or painted means.

TRANSIT STOPS ADJACENT TO BICYCLE FACILITIES

Cycle facilities require careful planning in relation to transit stops. This should be considered at planning stage as it has important implications for both transit and cycle networks. For example, bike lanes can be routed: 1) behind a transit boarding island; 2) across a bus bulb-out; 3) behind a boarding island. Chapter 5 provides more detail on the different approaches.

4.1.4 Supporting Public Transit Services

Many of Orange County's transit services are provided by buses operating on streets in mixed traffic. Planning streets to allow for faster and more efficient movement of transit vehicles has two key benefits:

1. Quicker journey times attract more passengers and,
2. Higher vehicle speeds mean lower operating costs because most transit operating costs vary with time, not distance.

Transit priority measures can also manage demand for vehicle trips by providing a fast and reliable alternative to the private automobile.

TRANSIT PRIORITY

Dedicated transit lanes along busy arterial road corridors mitigate impacts of traffic congestion and delay by improving transit speed and reliability. Street design strategies for such corridors should consider incorporating transit lanes. These need to be designed with enough space for transit vehicles to operate safely and efficiently. The impact on other general traffic needs to be considered.

Hours of operation of transit lanes can be adjusted to manage levels of congestion. Streets where frequent transit services experience delays due to traffic congestion, may benefit from continuous transit-only lanes all day, or during peak periods if there are two or more lanes in each direction. Removal or timed restriction of curb-side parking can also be used to support transit priority.

On streets where transit operates in mixed-flow conditions, measures can be introduced at specific locations instead of along the entire corridor, e.g. transit 'queue-jumper' bypass lanes at congested intersections to reduce transit delays, or signal priority for transit vehicles at traffic signals.

TRANSIT STOPS

Planning and placing a transit stop within a street corridor is important in terms of transit operations and passenger access. Section 4.3 provides more detail about different approaches to stop placement.

4.1.5 Supporting Curbside Activity

On-street stopping space for parking and servicing activity is often required to support adjacent land uses. Developing a street design strategy should consider curbside access requirements and where this should be located along the street to best meet business needs without causing delays to transit.

ON-STREET PARKING

The presence of on-street parking, if well designed and managed, can help enhance the pedestrian environment by providing a buffer between pedestrians and traffic while also providing convenient access to adjacent businesses.

Parking should be located so it does not block cyclist, pedestrian, or automobile sightlines, and also does not interfere with transit operations. Visibility between transit drivers and passengers waiting at stops is key.

Dedicated electric vehicle (EV) parking spaces have charging infrastructure alongside, which needs to be accessible and kept clear from areas where transit is maneuvering.

Where appropriate, existing on-street parking spaces can be repurposed as additional public realm, e.g. for temporary or permanent use as café seating, bicycle parking, landscape etc.

Consider management of parking facilities in the wider area around the street considering supply, price, and regulation. Efficient management can help reduce required parking supply which can support transit though increased land use intensity, mix of uses, wider sidewalks, and bike networks.

SERVICING AND DELIVERIES

Consider requirements for vehicles undertaking loading (e.g. deliveries), servicing (e.g. rubbish collection) and highways maintenance. Clearways may be needed in specific locations.

DYNAMIC MANAGEMENT
City authorities are increasingly looking to understand, allocate, and manage curbside space more effectively. A dynamic model which provides ability for uses to book curbside space can provide market-driven access to those who depend on it. This can help relieve curbside pressure, create efficiencies for users, and improve safety. Data collected can also inform jurisdictions how to price for curbside space to balance economic goals with public needs, and policy priorities like equity and environmental quality.

4.1.6 Supporting New Mobility

New mobility includes a wide range of options. These have different spatial requirements and should be considered as part of a street design strategy.

SHARED MICRO-MOBILITY
Shared micro-mobility includes bikes, e-bikes and e-scooters. These vary and can include dockless and docked solutions. Parking of dockless solutions are increasingly geo-fenced to certain zones within a street. Consider where within a street environment these should be placed, to be accessible and useful, without obstructing pedestrian movement or transit access.

MICRO-TRANSIT
Demand-responsive transit that provides flexible routing and/or flexible scheduling of vans or minibus type vehicles. This is enabled by smartphone technology that allows riders to request a ride in real time, navigate to a pickup/drop-off zone. Consider where on a street micro-transit can stop, and implications in terms of other curbside activity including scheduled public transit or clearways.

MOBILITY HUBS
Mobility hubs are locations where multiple transit options are integrated to enhance connectivity and user experience. They allow people to switch between transport services easily. A mobility hub is clearly identified with branding and information, co-locates one or more public and shared transit modes, provides for micro-mobility, and provides safe and secure bicycle storage. The type and number of components of mobility hubs vary depending on location, specific local services, and needs. They can include elements such as covered waiting areas, seating, lighting, planting, wi-fi and charging facilities, and parcel pick-up lockers. Consider if mobility hubs are appropriate for the street, and where these are best placed to be advantageous for transit users as well as other modes. Chapter 5 also discusses mobility hubs.

CONNECTED AND AUTONOMOUS VEHICLES (CAVS)
CAVs partially or fully drive themselves from a starting point to a destination using various in-vehicle technologies and sensors. In terms of curbside activity, the future adoption of CAVs could mean a change in demand for fixed on-street parking, and more demand for places to hop-on drop-off (HODO). This will need to be coordinated with transit services to avoid obstruction. Designated HODOs can be located along a street, spaced appropriately (e.g. one per block). Larger mobility hubs can also integrate facilities for CAVs.

4.1.7 Providing Public Realm

The term public realm includes the street environment generally as well as specific public spaces on or adjacent to it. Street design strategies should consider how to make the public realm inviting for people to visit, spend time in and move through. Providing functional and attractive public realm helps support transit use.

Public spaces can take on many different forms: from small, informal places to pause in front or between buildings, to larger open plazas that can accommodate public gatherings and events. Great public spaces support the interrelationship between placemaking, good design, and the experience of delight in the urban environment. Regardless of size public spaces can be used in such a way as to relate to and support convenient access to public transit.

LOCATION AND SCALE OF SPACE

When planning a street design project consider existing public realm provisions and opportunities for new areas of public realm. Ensuring spaces are located near to active land uses can help ensure they are appropriately used and feel secure. Creating spaces that are appropriately sized in relation to the built environment and at a human scale ensures that pedestrians feel protected and part of the urban fabric, thus freeing them to relax, observe, and engage in the public realm. Consider relative size of new public spaces to ensure that the space fits the people and the functions it will serve.

AMENITIES

Think about what types of amenities might be needed within the street's public realm to make it inviting, comfortable, and encourage active uses. Typical amenities can include seating, bicycle parking, public art, wayfinding, and pedestrian-scale lighting. At the strategy development stage this means thinking about distribution of amenities within the street, not the specific design of them. Programming of streets and spaces can also help provide amenity, e.g. with food vendors, market stalls, or performances.

PROTECTION FROM THE ELEMENTS

Designing the public realm to contend with sun, wind, and rain is an important step toward building a transit-supportive community. Pedestrians, particularly those travelling to and from or waiting for transit, must be offered adequate shelter to promote the use of transit services. Consider the role of elements such as trees, awnings, umbrellas, colonnades, galleries, archways, or overhangs to supplement shelters at transit stops. These elements also add visual interest to the street.

TREES AND LANDSCAPING

Street trees and landscaping can provide character and identity, and uplift the public realm aesthetically, environmentally, and socially. They also offer shade, improve air quality, alleviate heat island effects, provide natural stormwater management, and provide a habitat for wildlife. Street trees and landscaping can be used to provide a visual buffer between the sidewalk and roadway, creating a sense of enclosure and helping articulate pedestrian areas and delineate public spaces. An overarching approach to landscape along a street is a vital component of a street design strategy, e.g. to guide placement and spacing of trees along it, identify focus areas for greening, and consider the relationship to landscape in the wider area.

HOW TO APPLY

The design strategy is used to establish a broad approach to space allocation and placement of specific street elements, but not geometric design. In essence it sets a brief for subsequent, technical design stages. Transit is one component of a Complete Street design strategy. This includes transit infrastructure such as stops and priority measures as well as relationship to other modal infrastructure and design.
The following question help frame the development of a Complete Streets strategy:

- What is needed to ensure the needs of transit operations and transit riders are addressed in subsequent design stages?
- How does transit relate to the modal priorities of the street and network?
- How does the street relate to its surrounding context and how does the context inform the design approach?
- What are the key community characteristics such as land uses, attractions, activity, built form, heritage and how do these characteristics inform the design approach?
- What improvements to pedestrian infrastructure such as wider sidewalks and improved crossings are required to ensure good access to/from stops, along the street, and into wider network?
- What role does the street have in the bicycle network and how to ensure the bicycle system complements and supports transit?
- What is the current and future role of new mobility services on streets and the network and what are the potential impact of these services on available street and curb space?
- How can micro- and shared mobility be accommodated on streets with other competitive modal demands?
- Are mobility hubs appropriate and where could they be optimally located to make the most effective use of transit?
- What are the priorities of the curbside activity requirements including on-street parking, loading, and servicing within different contexts and how do these requirements inform the design approach?
- Are special curbside zones required such as valet parking or building security?
- Can special curbside zones be relocated to avoid impacts to bus stop placement, passenger access and transit vehicle maneuvering?
- How can transit enhance the public realm in terms of the general street environment and incorporation of public spaces (large or small)?
- Where are existing and potential opportunities for new public spaces and how can these spaces be used?
- How can landscape and streetscape elements be used to add visual interest and character to the street, support environmental goals, provide amenity, and support access to transit?

Recommended Resources

Complete Streets Initiative Design Handbook. Orange County Council of Governments (OCCOG). 2016. https://static1.squarespace.com/static/587121d0ebbd1ae2e3a080b3/t/58e2726cb8a79b14751cd0da/1491235470685/OC_Complete_Streets_Design_Handbook.pdf

Transit Street Design Guide. National Association of City Transportation Officials (NACTO). 2016. https://nacto.org/publication/transit-street-design-guide/

Urban Bikeway Design Guide. National Association of City Transportation Officials (NACTO). 2014. https://nacto.org/publication/urban-bikeway-design-guide/

Urban Street Design Guide. National Association of City Transportation Officials (NACTO). 2016. https://nacto.org/publication/urban-street-design-guide/

4.2 MPAH Classifications and Complete Streets

OCTA wants to encourage a Complete Streets approach to street design. This includes streets which are classified as part of the Master Plan of Arterial Highways (MPAH). The MPAH is a regional arterial roadway network that allows the cities of Orange County and the County of Orange to work cooperatively in developing the countywide circulation system. To be eligible for all Measure M2 revenues as well as programs, a local agency's General Plan circulation element must be consistent with the MPAH. Local agencies may freely determine whether to maintain consistency with the MPAH. Consistency with MPAH facilities should be considered, and OCTA is eager to see local agencies work within these designations to ensure that non-automobile users also benefit from street redesign projects, and that a context-sensitive approach to street design is followed.

MPAH CLASSIFICATIONS AND TRANSIT ROUTES

Ten corridors have been identified in OCTA's Transit Master Plan as Transit Opportunity Corridors. Two of these are freeway BRT corridors. The other corridors are arterial roads, classified as:

- Principal Arterial
- Major Arterial
- Primary Arterial
- Secondary Arterial

Transit routes may also be located on other MPAH classifications. To implement Complete Streets projects or design elements, an amendment to the MPAH will be required if, for example, the project would result in a street segment not meeting minimum number of through lanes. Refer the MPAH map to determine whether the facility is on the MPAH and the Guidance for Administration of the Orange County MPAH for additional details on the MPAH amendment process.

4.3 Planning and Placing Transit Stops

4.3.1 Relationship to Context and Activity

Bus stops should be located so they relate to concentrated commercial, residential, office, or industrial development that generate high passenger demand. For example:

- Downtown areas or major employment zones
- Regional shopping centers
- College or school campuses
- Hospitals
- Neighborhood centers

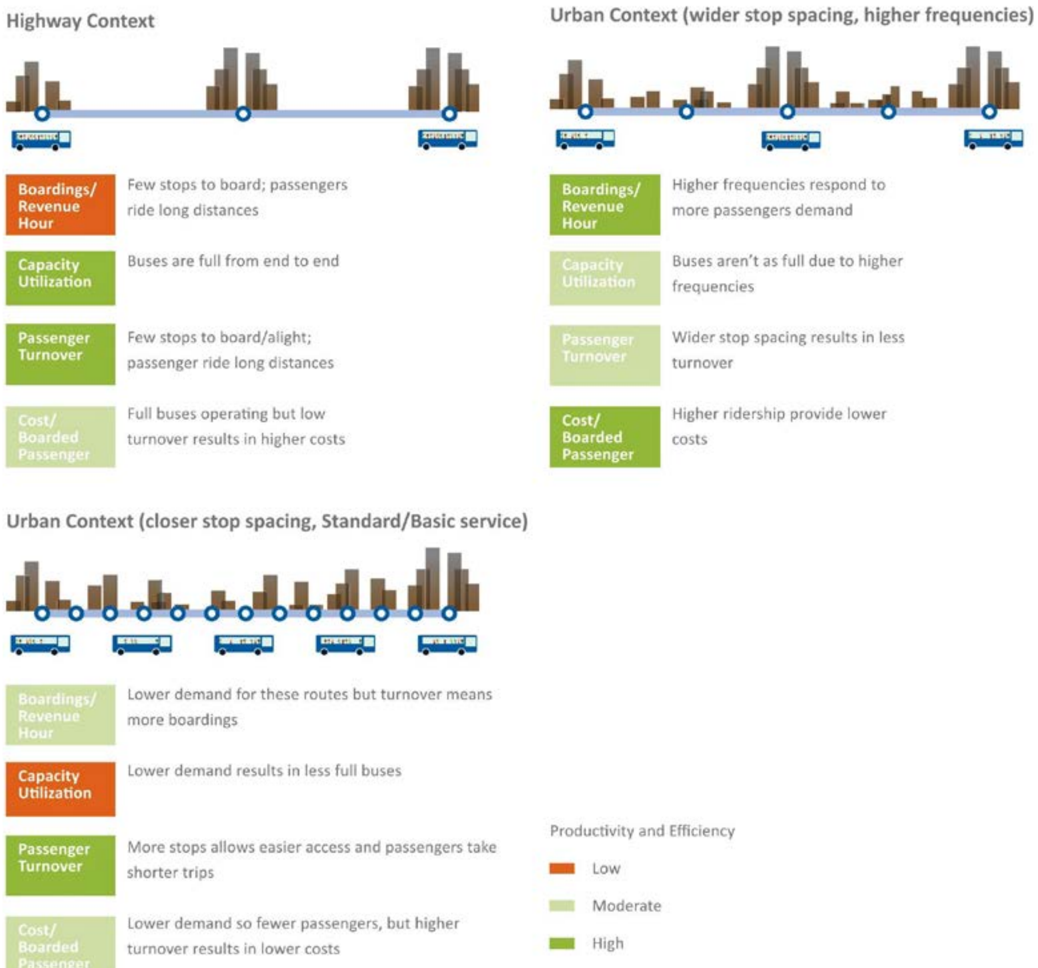
They should also be located at transfer points, e.g. interchanges with other transit modes or services. There is a relationship between bus stop location based on activity and spacing of stops based on frequency of service, however locating stops near to important activities takes precedence over spacing considerations.

4

4.3.2 Bus Stop Spacing

Between major generators of demand and transfer points, stops should be spaced based on operating characteristics, land use, and catchment area size. Frequent transit services with many local stops, spaced every 275-450 yards, provide convenient local access but have slower journey times than limited stop frequent rapid transit services which have faster journey times but less convenient local access with stops spaced every 0.6 to 1 mile. See **Figure 10**.

Figure 10: *Bus stop spacing based on context and frequency of service. Source: TransLink. BC.*



All else being equal, people will walk farther to access faster, more reliable services. The distances people are willing to walk to transit vary depending on service type, trip length and purpose, weather, topography, demographics, and pedestrian environment quality. International practice assumes that, typically, most people will walk up to 10-12 minutes (0.5 miles) to access a frequent limited-stop service running in an exclusive right-of-way; 6-8 minutes (650 yards) to access frequent limited stop service in mixed traffic; and 5-6 minutes (0.25 miles) to access a frequent local stop service. While actual pedestrian catchment areas will vary according to context, these general guidelines are useful to help plan transit-supportive communities.

4.3.3 Bus Stop Placement

Having decided that a bus stop is warranted based on general spacing and demand requirements, the placement of the stop needs to be considered. Placement will be one of two standard locations—the farside or nearside of an intersection. Only under special circumstances should a new midblock bus stop be considered. These circumstances are described in the Bus Stop Placement Checklist in **Appendix E**.

Table 3 presents the advantages and disadvantages of the two standard bus stop placements. Bus stop placement is covered in greater detail in Chapter 5.

Table 3: *Advantages, Disadvantages, and Recommended Uses of Bus Stop Placement Options*

	Farside	Nearside
Advantages	• Saves route running time • Eliminates conflicts with right turning vehicles • Facilitates bus re-entry into the traffic stream • Requires shorter deceleration distance • Encourages pedestrians to cross behind the bus	• Allows transit drivers to utilize the intersection and available sight distance when pulling away from the curb • Provides pedestrian access closest to the crosswalk
Disadvantages	• Potential for intersection blockage by queued buses • Potential for increased rear-end collisions • Queuing buses can obstruct sight distances for vehicle and pedestrians crossing through the intersection	• Potentially creates double stopping at intersection • Generates conflicts with right turning vehicles and cyclists • Potential for through lane blockage by queued buses • Obstructs sight lines for crossing pedestrians • May result in increased delay to buses and other vehicular traffic
Recommended Uses	• When nearside traffic is heavier than farside traffic • At intersections with medium to heavy right turn volumes • At intersections with transit signal priority	• When farside traffic is heavier than nearside traffic • At intersections with pedestrian safety concerns on the far side

Recommended Resources

Transit Street Design Guide. National Association of City Transportation Officials (NACTO). 2016. https://nacto.org/publication/transit-street-design-guide/

Transit Signal Priority (TSP): A Planning and Implementation Handbook. ITS America. 2005. https://nacto.org/wp-content/uploads/2015/04/transit_signal_priority_handbook_smith.pdf

2010 ADA standards for accessible design. ADA. 2010. https://www.ada.gov/regs2010/2010ADAStandards/2010ADAStandards.pdf

Crime Prevention Through Environmental Design (CPTED) for Transit Facilities. APTA Standards Development Program Recommended Practice. American Public Transportation Association (APTA). 2010. https://www.apta.com/wp-content/uploads/Standards_Documents/APTA-SS-SIS-RP-007-10.pdf

Urban Street Design Guide. National Association of City Transportation Officials (NACTO). 2016. https://nacto.org/publication/urban-street-design-guide/

Urban Bike Design Guide. National Association of City Transportation Officials (NACTO). 2014. https://nacto.org/publication/urban-bikeway-design-guide/

Designing Walkable Urban Thoroughfares: A Context Sensitive Approach. Institute of Transportation Engineers (ITE). 2010. https://ecommerce.ite.org/IMIS/ItemDetail?iProductCode=RP-036A-E

Implementing Context Sensitive Design on Multimodal Corridors: A Practitioner's Handbook. Institute of Transportation Engineers (ITE). 2017. https://ecommerce.ite.org/IMIS/ItemDetail?iProductCode=IR-145-E

Design Guidelines Accommodating Peds & Bikes at Interchanges. Institute of Transportation Engineers (ITE). 2016. https://ecommerce.ite.org/IMIS/ItemDetail?iProductCode=RP-039A

ITE Application Supplement to the NACTO Transit Street Design Guide. ITE. 2016. https://ecommerce.ite.org/IMIS/ItemDetail?iProductCode=IR-143-E

Curb Appeal: Curbside Management Strategies for Improving Transit Reliability. NACTO. 2017. https://nacto.org/wp-content/uploads/2017/11/NACTO-Curb-Appeal-Curbside-Management.pdf

Curbside Management Practitioner's Guide. ITE. 2017. https://www.ite.org/technical-resources/topics/complete-streets/curbside-management-resources/

Blueprint for Autonomous Urbanism: 2nd Edition. NACTO. 2019 https://nacto.org/publication/bau2/

Transit Service Guidelines. TransLink (Vancouver, BC area). 2018. https://www.translink.ca/-/media/translink/documents/plans-and-projects/managing-the-transit-network/transit-services-guidelines-public-summary.pdf

Rhode Island Bus Stop Design Guide. Rhode Island Public Transit Authority (RIPTA). 2017. https://www.ripta.com/projects/rhode-island-bus-stop-design-guide-2017/

Bus Stop Design Guide. Maryland Department of Transportation (MDOT) and Maryland Transit Administration (MTA). 2019. https://www.mta.maryland.gov/bus-stop-design-guide

Multimodal Corridor Guidelines. AC Transit. 2018. https://www.actransit.org/website/uploads/AC_Transit_Multimodal_Corridor_Guidelines_Final.pdf

Transit Supportive Guidelines. Pace (Chicago, IL area). 2013. https://www.pacebus.com/sites/default/files/2020-04/Transit_Supportive_Guidelines.pdf

Bus Stop Planning & Design Guide. Massachusetts Bay Transportation Authority (Boston, MA area). 2018. https://cdn.mbta.com/sites/default/files/engineering/001-design-standards-and-guidelines/2018-04-01-bus-stop-planning-and-design-guide.pdf

Transit Supportive Guidelines. Pace (Chicago, IL area). 2013. https://www.pacebus.com/sites/default/files/2020-04/Transit_Supportive_Guidelines.pdf

What are Complete Streets? Smart Growth America. https://smartgrowthamerica.org/program/national-complete-streets-coalition/publications/what-are-complete-streets/

Empty Spaces: Real Parking Needs at Five TODs. Smart Growth America. 2017. https://smartgrowthamerica.org/resources/empty-spaces-real-parking-needs-five-tods/

Orange County Mobility Hub Strategy. OCTA. Forthcoming

Part III

Engineering Design Guidance

5 Bus Stop Design Specifications and Vehicle Operations

5

BUS STOP DESIGN SPECIFICATIONS AND VEHICLE OPERATIONS

5.1 Vehicle Operations

5.1.1 Vehicle Types and Characteristics

VEHICLE TYPES IN OCTA'S REVENUE FLEET OF BUSES

The dimensions of buses and their performance characteristics are essential inputs for designing streets and intersections to accommodate them as well as bus stops and their components. This guide includes design parameters for two basic vehicle types in OCTA's revenue fleet: a 40-foot long coach and a 60-foot long articulated bus. Smaller vehicles are included in OCTA's non-revenue fleet (such shuttle buses), but generally their characteristics are not critical in designing streets and transit facilities.

All buses in the OCTA fleet are wheelchair lift equipped and their requirements need to be considered in bus stop design. Whenever possible, bus stop design should be based on the design parameters for articulated buses, but in constrained locations and where routes are known to only utilize non-articulated vehicles, bus stops can be designed for 40-foot coaches. **Photo 1** shows a typical OCTA 40-foot bus while **Photo 2** shows an OCTA 60-foot articulated bus.

Photo 1: *Typical 40-foot bus.*

Photo 2: *Typical 60-foot articulated bus.*

OCTA's fleet is comprised of buses from several manufacturers with various models, series, and ages and as a result, the dimensions and characteristics vary to some degree. **Appendix A** contains OCTA's Fleet Data Sheets which include dimensioned drawings and technical specifications for their revenue fleet covering manufacturers and models from 1997 through 2019.

CRITICAL VEHICLE CHARACTERISTICS FOR DESIGN

The most important dimensions and characteristics of the design vehicles for use in street and bus stop design are shown in **Table 4**.

Key roadway design features, such as lane and shoulder widths, lateral and vertical clearances, vehicle storage dimensions, and minimum turning radii are traditionally based on the standard 40-foot bus. The articulated bus, while longer, has a "hinge" near the center of the vehicle that allows for greater maneuverability comparable to the 40-foot bus.

Table 4: *Critical Vehicle Specifications for Design*

	Standard 40-Foot Bus	Typical 60-Foot Articulated Bus
Overall Dimensions		
Length:	40' 8"	60' 10"
Wheelbase:	24' 4"	43' 6"
Length of bike rack when deployed:	32.5"	32.5"
Width (including mirrors):	10' 6"	10' 5"
Height:	11'	11'
Distance between centerline of front and rear doors:	21'	40' 5"
Front overhang:	7' 1"	7' 3"
Rear overhang:	9' 8"	9' 11"
Wheelchair Lift Dimensions		
Width:	30.5"	33.3"
Extension (from edge of bus):	54.5"	47.6"
Turning Radius		
Centerline turning radius :	43' 11"	44'
Weight		
Gross vehicle weight:	42,540 lbs	67,890 lbs
Front axle:	14,780 lbs	14,780 lbs
Center axle:	N/A	25,350 lbs
Rear axle:	27,760 lbs	27,760 lbs

Recommended Resources

Transit Cooperative Research Program (TCRP) Report 19 Guidelines for the Location and Design of Bus Stops. Transportation Research Board. 1996. http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_19-a.pdf

Guide for Geometric Design of Transit Facilities on Highways and Streets. American Association of State Highway Transportation Officials (AASHTO) 2014. https://trid.trb.org/view/1320922

Bus Infrastructure Design Guidelines. TransLink (Vancouver, BC area). 2018. https://www.translink.ca/-/media/translink/documents/plans-and-projects/managing-the-transit-network/bus_infrastructure_design_guidelines-sept_2018.pdf

5.1.2 Vehicle Paths, Radii, and Turning Requirements

OCTA's fleet of two-axle coaches have an overall length of 40-41 feet, a wheelbase of 21-24 feet, and a front overhang of about 7 feet. The authority's fleet of articulated buses have an overall length of 61 feet, a front wheelbase of 19 feet, and a front overhang of about 7 feet. **Appendix A** provides information on OCTA's revenue fleet vehicle specifications.

TURNING RADIUS TEMPLATE

Appendix B provides bus turning radii templates for a 40-foot and 60-foot articulated vehicles. The templates illustrate the swept path of the bus—the envelope swept out by the sides of the bus body, or any other part of the structure of the bus, not just the wheel tracks. These templates may be used in bus route planning and the design of intersections to determine required combinations curb return radii and pavement width and identify locations where vehicle encroachment may occur. When reviewing the turning radii of buses, additional allowance should be made under special circumstances such as:

- Bus speeds greater than 10 miles per hour.
- Sight distance limitations.
- Bike racks on front of bus (which add three feet to the length of the bus).
- Changes in pavement grade.
- Swept path of the bus overhang.

INTERSECTION CORNER RADIUS DESIGN

The corner radius at street intersections is a common transit related design problem. Some intersections are difficult to negotiate with a bus. Several advantages of a properly designed corner radius are:

- Fewer bus/auto conflict at heavily used intersections.
- Higher bus operating speeds and reduced travel time.
- Improved bus rider comfort.

The design of intersection radii should consider the following elements:

- Size and type of vehicle (including bike racks).
- Bus turning radius (including swept path of the front overhang).
- Width of shoulders, on-street parking, bike lanes, and combinations of these elements.
- Available right of way if reconstructing the corner.
- Allowable bus encroachment into other traffic lanes traveling in the same direction.
- Pedestrian crossing distances.

Many of OCTA's fleet have bike racks mounted on the front of each bus and have the capacity to carry up to two bicycles. Because of the bicycle rack, the turning radius of OCTA's buses increases an additional three feet.

If the facility being designed is intended to be used exclusively by transit vehicles, a bus would be an appropriate choice for a design vehicle. If, however, the facility is to be used by general traffic, the selection of either a single unit truck or a tractor-semitrailer may be more appropriate. In the latter case, a design based on the operating characteristics of a truck should be checked to ensure that a bus would also be satisfactorily accommodated.

The width of the roadways involved enters the design because as the width increases, the length of the radius required to accommodate the turning vehicle decreases. For example, if the width of both roadways is 12 feet, a single curve with a radius of approximately 50 feet is required to accommodate a 90 degree turn by a bus with no encroachment outside the 12-foot lanes. If the width of both roadways is increased to 16 feet, the radius required to accommodate the bus with no encroachment outside the 16-foot lanes decreases to 40 feet.

The "effective" curb radius of a corner includes the combined width of the travel lanes and the width of adjacent shoulder, parking lane and/or bicycle lane. Use of the effective curb return radius allows for a larger bus turning radius while maintaining a smaller curb return radius which is an important factor in the distance pedestrians must walk at crosswalks.

At intersections, as the size of the curb return radius increases, the walking distance across the intersection increases. Designers should be aware of this pedestrian factor and be prepared to accommodate the pedestrians if the length of a crossing increases to the point where it may create safety and operational concerns such as:

- Long pedestrian crossings increase pedestrian exposure to traffic and may necessitate the need for a pedestrian refuge island in the median to accommodate slower pedestrians.
- At signalized intersections, long pedestrian crossing times require longer minimum walk times which may increase the signal's cycle length and delays for buses and general traffic.

Another element of corner radius design is the amount of lane encroachment which can be tolerated. This tends to be a subjective decision made by the designer based on an evaluation of the speed and volume of the vehicles involved and the functional classification of the roadways. In general, there should be no encroachment. However, in low speed, low volume situations, some encroachment into adjacent lanes may be acceptable.

When designing a new facility, the designer should select the design vehicle, the roadway widths, and determine the amount of encroachment which can be tolerated. **Figure 11** shows appropriate corner radii for transit vehicles and various combinations of lane widths and turning maneuvers. **Figure 11** does not present all situations, so it should be used as a starting point and turn radii must be checked with an appropriate turning radius template before being incorporated in a final design.

Figure Index	Street A		Street B		Actual Curb Return Radius	"Effective" Curb Return Radius
	Parking	Bike Lane	Parking	Bike Lane		
A	✓	✓	✓	✓	15 feet	28 feet
B	✓	X	✓	X	20 feet	28 feet
C	✓	X	✓	X	30 feet	30 feet
D	X	X	X	X	50 feet	50 feet

- DESIGNER SHOULD PLAN FOR AN EFFECTIVE RADIUS OF 28' (RIGHT REAR WHEEL).
- TRANSIT VEHICLES ARE ASSUMED TO BE 44' IN LENGTH (WITH BIKE RACK) BY 10'4" IN WIDTH.
- ASSUMES NO ENCROACHMENT INTO OPPOSITE LANES.
- ASSUMES PARKING IS PROHIBITED WITHIN 20' OF END OF CURB RETURN.
- THESE ARE EXAMPLES, APPROPRIATE CURB RADII MUST BE DETERMINED ON A CASE BY CASE BASIS BY THE LOCAL JUSRISDICTION.

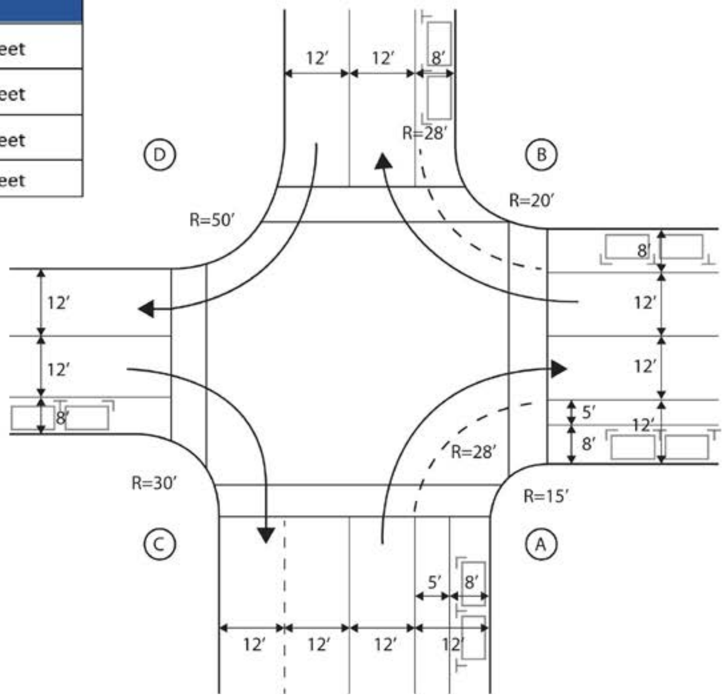


Figure 11: *Intersection design for transit turns.*

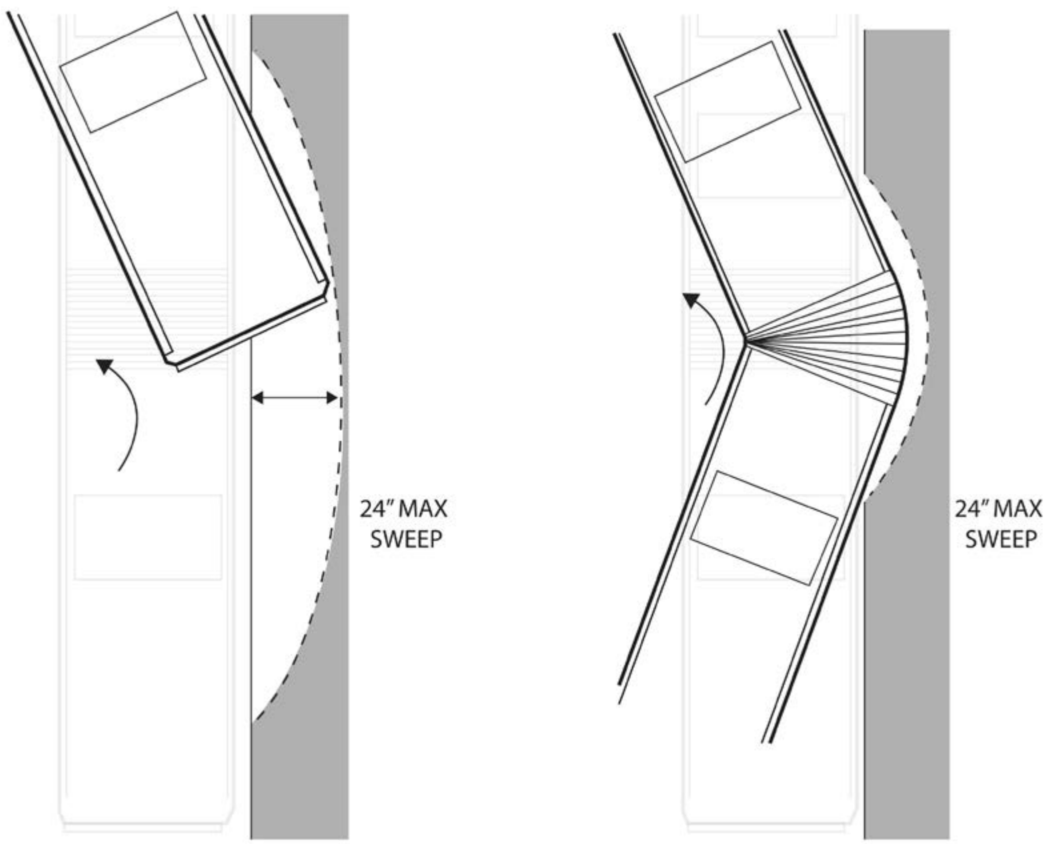
If an existing intersection or driveway is to be evaluated for transit operations, a layout showing existing lane widths and corner radii should be prepared. Check the layout with the appropriate turning radius template (see **Appendix A**) and determine the resulting encroachment, if any. Determine if the amount of encroachment can be tolerated and identify potential remedial efforts such as increases in lane width or corner radii. The use of AutoTurnTM software can assist in the evaluation by accurately plotting the swept path of a bus.

The single radius curve is the simplest corner radius which will be encountered in typical urban designs. This curve uses a uniform radius connecting the points of tangency of the intersecting streets. However, in some special situations such as a skewed intersection or when it is desirable to allow turns at higher speeds, the designer should consider using a compound curve. Compound curves are a combination of simple curves with different radii joined. Compound curves have an advantage over simple curves because they more closely fit the natural turning paths of design vehicles. Design procedures using compound curves and the channelization which frequently accompanies them can be found in the list resources for this topic.

SWEPT PATH OF BUSES DEPARTING BUS STOPS

As buses pull away from a bus stop, the lateral path of a bus can cause the rear overhang of a 40-foot coach to “sweep” across the curb and sidewalk in an arc with a maximum lateral width at the center of the arc. This lateral sweep occurs when a bus pulls away from the curb using the maximum turn of the steering wheel. Articulated buses also produce rear overhang sweep but also by the accordion at the at the articulation point. **Figure 12** illustrates the swept path of the rear of a standard coach and the accordion of an articulated bus departing from a curb bus stop. The maximum lateral sweep for both 40-foot coaches and 60-foot articulated buses is approximately 24-inches. Street furniture, landscaping, pole, and other vertical appurtenances should be set back a minimum of this distance from the curbside.

Figure 12: *Sweep lines of buses departing curbside bus stops. Source: TransLink. BC.*



Recommended Resources

Transit Cooperative Research Program (TCRP) Report 19 Guidelines for the Location and Design of Bus Stops. Transportation Research Board. 1996. http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_19-a.pdf

Guide for Geometric Design of Transit Facilities on Highways and Streets. American Association of State Highway Transportation Officials (AASHTO) 2014. https://trid.trb.org/view/1320922

Bus Infrastructure Design Guidelines. TransLink (Vancouver, BC area). 2018. https://www.translink.ca/-/media/translink/documents/plans-and-projects/managing-the-transit-network/bus_infrastructure_design_guidelines-sept_2018.pdf

5.1.3 Visibility Zones

There are limited lines of sight for a bus operator to see other vehicles, pedestrians, and bicyclists along the sides and to the rear of buses. These limited sight lines affect the placement of bus stops and curbside features that may further obscure bus operator visibility. **Figure 13** illustrates areas of visibility from the bus operator's perspective.

Operator sight lines should be confirmed for different models of buses and at new or relocated bus stops.

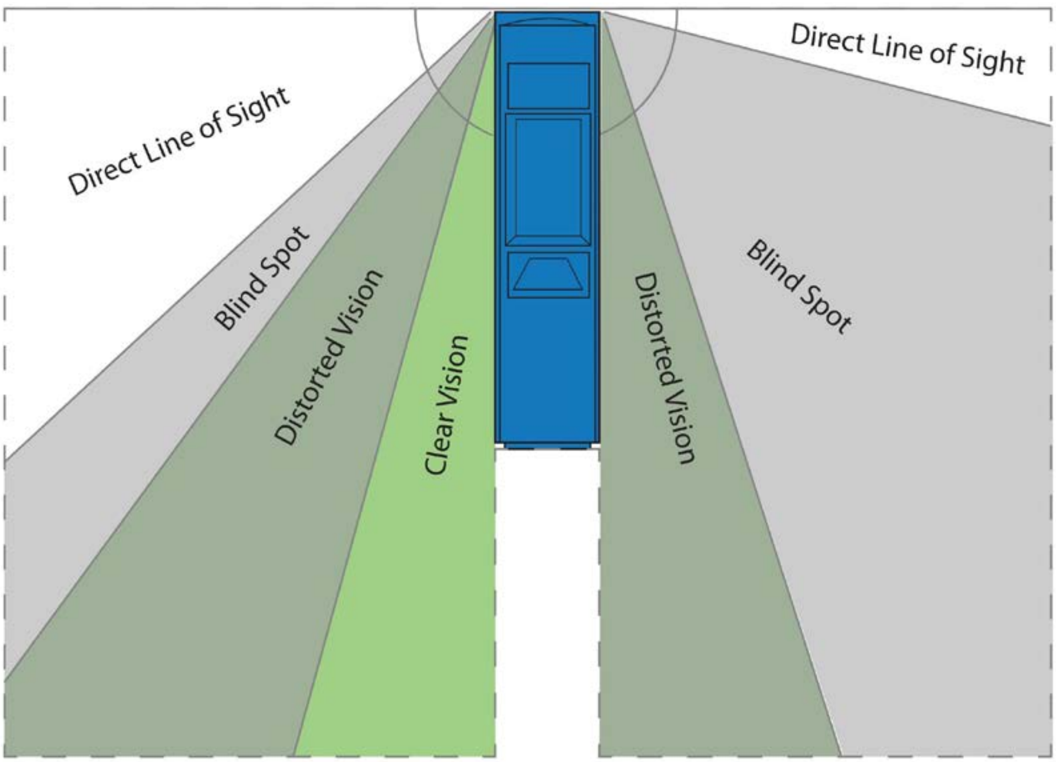
The practitioner should consider the following when planning and designing bus stops:

- The right side of the bus the operator has a narrow direct line of sight through the door and adjacent windows, a distorted line of sight using the right-side mirror, and a substantial blind spot not observable by the operator's direct line of sight or by using the mirror.
- To view passengers and approaching vehicles, the operator usually relies on the right-side mirror because it is difficult to observe the area adjacent to the bus through the right-side windows due to passengers obstructing line of sight and other factors. Buses are usually equipped with a convex mirror on the right side which provides a wider, but distorted, view of the area adjacent to the bus. This mirror allows the operator to check that passengers have completely exited the bus and observe passengers coming towards the bus to board. However, the distortion caused by convex mirrors makes it difficult to accurately judge the distance of vehicles (including bicycles) approaching from behind. The distortion of the mirror also affects the visibility required when merging to the right over a short distance or making a left turn from the inside lane(s) of an intersections with multiple left turn lanes. Where buses turn left at intersections with multiple left turn lanes, it should be standard practice for buses to use the outside turn lane.
- On the left side of the bus the operator has a larger direct line of sight by looking over their left shoulder through the operator's left side window, a narrower blind spot, a clear line of sight from the flat mirror mounted on the left side of buses, and a wider, but distorted, view from the small convex mirror typically mounted on the bottom of the flat mirror.

- The flat mirror allows the operator to accurately judge the distance of a vehicle approaching the bus from behind and determine when there is an adequate gap in traffic to merge left or re-enter the stream of traffic from a stop. The left side convex mirror is used to observe a vehicle in the lane immediately adjacent to the bus before merging into the next lane. Because of the visibility limitations on the left side of the bus, avoid locating a turnout or curbside bus stop downstream of a convex horizontal curve in the roadway where approaching vehicles may fall into the operator's blind spots or distorted view.

Many of OCTA's bus fleet are equipped with one or two curbside and streetside cameras providing 75 degrees of visibility along the sides of the bus.

Figure 13: *Bus operator visibility zones. Source: TransLink. BC.*



Recommended Resources

Bus Infrastructure Design Guidelines. TransLink (Vancouver, BC area). 2018. https://www.translink.ca/-/media/translink/documents/plans-and-projects/managing-the-transit-network/bus_infrastructure_design_guidelines-sept_2018.pdf

5.1.4 Wheelchair Lifts

The wheelchair lift is an important part of the vehicle design. Currently, OCTA buses have either a front door, rear door, or front/rear door lift configuration. Since there is no way to predict whether the wheelchair lift will be at the front or rear door, bus stop design needs to accommodate for either possibility. For design purposes, the maximum width of a wheelchair lift is 4 feet, while the maximum extension from the edge of the bus is 54.5 inches for a 40-ft. coach (47.5 inches for a 60-ft. articulated bus at the front door only).

Regardless of the bus stop location, adequate clearance for deploying a wheelchair lift must be provided at both front and rear bus stop boarding areas with clear areas measuring a minimum of 5-feet wide by 8-feet deep, as required by ADA. Because the distance between front and rear doors can vary by bus manufacturer, model and series, the clear area for the rear door of 40-foot buses should be 10-feet wide by 8-feet deep. Critical dimensions for a wheelchair lift are illustrated in **Appendix C**.

Recommended Resources

Federal Transit Administration. ADA Regulations. Part 37—Transportation Services for Individuals with Disabilities. ADA Standards for Transportation Facilities. https://www.transit.dot.gov/regulations-and-guidance/civil-rights-ada/ada-regulations.

5.1.5 Street Pavement Requirements

Roadway pavements need to be of sufficient strength to accommodate repetitive bus axle loads of 27,760 pounds, the rear axle load of a large or articulated bus. Exact pavement designs will depend on site specific soil conditions. Areas where buses start, stop, and turn will be of particular concern for pavement design. Concrete pavement is desirable in these areas to avoid deformation and failure problems that are experienced with asphalt. Under these circumstances, concrete pavement can have a lower life cycle cost than asphalt.

CONCRETE BUS PADS

Concrete bus pads are recommended for all stops because they protect the roadway and can withstand the weight of a bus better than asphalt bus pads, particularly during acceleration and braking. OCTA recommends that bus pads be considered at the earliest phase of project development because it is advantageous to install concrete pads before road construction is complete.

Concrete pads should be designed to avoid pavement seams in adjacent crosswalks and bike lanes, which can affect wheelchairs and bikes. For technical specifications and dimensions for concrete bus pads, refer to the specifications in **Appendix C**.

Recommended Resources

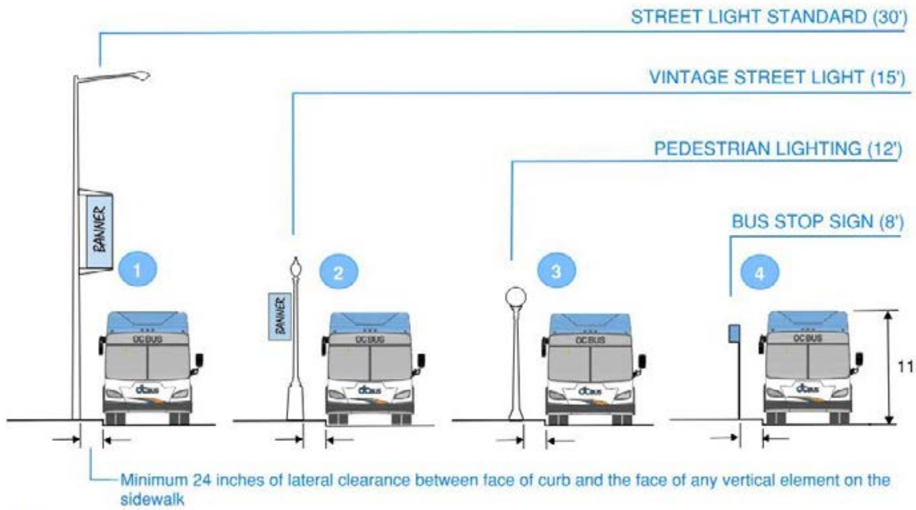
Transit Street Design Guide. National Association of City Transportation Officials (NACTO). 2016. https://nacto.org/publication/transit-street-design-guide/

Bus Infrastructure Design Guidelines. TransLink (Vancouver, BC area). 2018. https://www.translink.ca/-/media/translink/documents/plans-and-projects/managing-the-transit-network/bus_infrastructure_design_guidelines-sept_2018.pdf

5.1.6 Clearance Requirements at Bus Stops

Buses usually travel in the curbside traffic lane and make frequent stops to pick up and drop off passengers. Therefore, it is important to consider the vertical and horizontal clearances at curbside bus stops as shown **Figure 14**.

Figure 14: *Vertical and horizontal clearances at bus stops.*



1. The bottom edge of banners (48" x 72") mounted on the street side of street light standards must be a minimum of 13 feet from the street pavement.
2. Banners (24" x 48") on street light standards with a height between 15 and 20 feet should be mounted on the sidewalk side of the light standard with the bottom edge of the banner at least 7 feet above the sidewalk surface in conformance with ADA requirements.
3. Pedestrian scaled light standards between 12 and 15 feet should not have any horizontally extended device mounted on the standard except on the sidewalk side with the bottom of the device at least 7 feet from the sidewalk surface.
4. Bus stop signs must be placed at the far end of the bus stop boarding area and denote where the front of the bus should stop. The pole must be at least 24 inches from the face of curb and the bottom edge of the sign must be at least 7 feet from the sidewalk surface.

Street Trees and Horizontal and Vertical Clearance at Bus Stops:
At bus stops, trees should be planted behind the sidewalk so that as the tree matures branches will not interfere with bus operations. Street trees in tree wells or planting strips adjacent to the curb within the boarding area, unless branches are properly and continuously pruned, may eventually encroach into the bus lane resulting in damage to vehicles and trees.

Other considerations include:

- Overhead obstructions should be a minimum of 12 feet above the street surface.
- For future street improvements, obstructions should not be located within a minimum of two (2) feet of the edge of the street to avoid being struck by a bus mirror. (This lateral clearance is not only important at ground level, but it is also necessary at the top of the bus.)
- The desirable curb lane width (including the gutter) is 14 feet and the minimum width is 12 feet (refer to Section 5.2.1 on Lane Widths).
- When buses pull out of the bus zone to reenter traffic, on occasion the rear of the bus will pivot and extend over the curb line. If above grade obstacles are located too close to the street, buses could sideswipe these fixtures causing damage. The rear overhang swing should be checked, possibly requiring a lateral clearance greater than two (2) feet. Refer to Section 5.1.2 Vehicle Paths, Radii, and Turning Requirements.

For clearances related to persons with disabilities refer to Section 5.6 Americans With Disabilities Act (ADA) Requirements and Section 5.1.4 (Wheelchair Lifts). For longitudinal curbside clearances for bus operations at bus stops refer to **Appendix C**.

5.2 Roadway Geometric Design

5.2.1 Lane Widths

A traffic lane used by buses should be wide enough to permit adequate maneuvering space for pulling into and out of bus stops, turning corners and to avoid sideswipe accidents, but not too wide so that motorists perceive the width as two lanes and attempt to pass buses. Since the maximum bus width including mirrors of OCTA's current bus fleet is 10'-6", the minimum lane width (including the gutter) should be 12 feet.

Depending on the presence of on-street parking or bicycle facilities, the outside lane width can vary but the available width for a bus should be 12 feet. **Table 5** lists the outside lane width for various roadway configurations, including the typical minimum width allowed. The width of the outside lane as it approaches a bus stop should not exceed 14 feet to avoid vehicles behind a stopping bus attempting to pass in the same lane.

More spacing information is covered in Section 5.1.6 Clearance Requirements for Bus Stops.

Table 5: *Recommended Outside Lane Widths for Bus Routes*

On-Street Parking?	Bike Facility?	Outside Lane Width
No	No	Minimum of 12 feet (including gutter)
Yes	No	19-20 feet including 7-8-foot parking lane
No	Class II Bike Lane Buffered Bike Lane	16-20 feet including 4 to 8-foot Class II or buffered bike lane (Refer to Section 5.3 for more information regarding bicycle facilities and bus stops)
	Sharrows	14-16 feet (> 16 feet should consider a dedicated bike facility)

5.2.2 Bus-Only Lanes and Streets

Bus-only streets and outside bus-only lanes should adhere to the lane widths defined in **Table 5.** If the lane is a median bus-only lane, the minimum width is 12 feet for streets with a speed limit of 40 mph or less and 13 feet if the speed limit is above 40 mph.

Recommended Resources

Guide for Geometric Design of Transit Facilities on Highways and Streets. American Association of State Highway Transportation Officials (AASHTO) 2014. https://trid.trb.org/view/1320922

Transit Cooperative Research Program (TCRP) Report 183 A Guidebook on Implementing Transit-Supportive Roadway Strategies. Transportation Research Board. 2016. https://www.nap.edu/catalog/21929/a-guidebook-on-transit-supportive-roadway-strategies

Transit-supportive Guidelines. Pace (Chicago, IL area). 2013. https://www.pacebus.com/sites/default/files/2020-04/Transit_Supportive_Guidelines.pdf

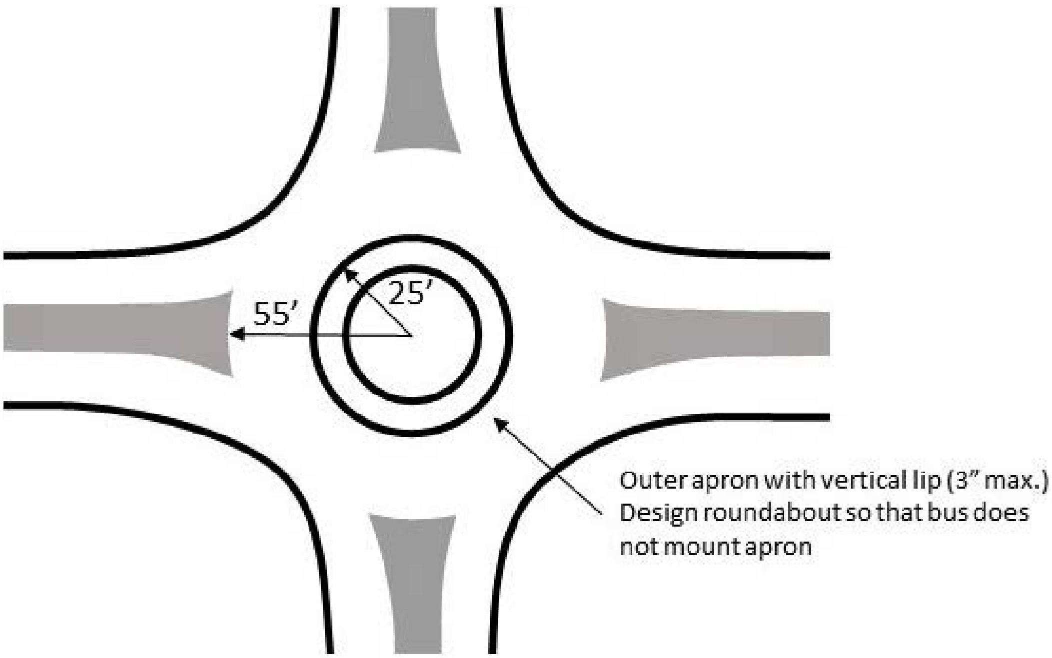
Bus Infrastructure Design Guidelines. TransLink (Vancouver, BC area). 2018. https://www.translink.ca/-/media/translink/documents/plans-and-projects/managing-the-transit-network/bus_infrastructure_design_guidelines-sept_2018.pdf

5.2.3 Roundabouts

MINIMUM SPECIFICATIONS FOR BUS ROUTES

Many roundabouts provide a mountable apron for large vehicles, but It is preferred that buses not use this type of intersection, as it can be uncomfortable for passengers.
To accommodate buses so they do not have to mount the apron, the outer radius of the roundabout should be at least 55 feet (preferably greater) and have a circulating roadway width of at least 30 feet, as shown in **Figure 15**.

Figure 15:
Minimum outside radius for a single lane roundabout to accommodate buses.



Should a roundabout on a transit route provide a mountable apron, it should have a curb slope no more than 2:3.

Traffic circles and mini roundabouts are suitable tools for traffic calming, and can be designed to accommodate buses, but are not recommended along transit routes, particularly where buses would need to turn left.

LOCATING BUS STOPS AT ROUNDABOUTS

If a bus route with a roundabout cannot be avoided and a bus stop is required at the intersection, farside stops are preferred to maximize pedestrian visibility. The back of the bus stop should be at least 10 feet from the crosswalk and up to 200 feet away or more if the roundabout is complex, high speed, or multi-lane. This A turnout bus stop is recommended when one or more of the following characteristics exist:

- A single lane roundabout
- More than 10 buses serve the stop per hour
- Bus dwell time is > 30 seconds on average

Recommended Resources

Roundabouts: An Informational Guide. U.S. Department of Transportation. Federal Highway Administration. 2000. https://www.fhwa.dot.gov/publications/research/safety/00067/00067.pdf

Bus Infrastructure Design Guidelines. TransLink (Vancouver, BC area). 2018. https://www.translink.ca/-/media/translink/documents/plans-and-projects/managing-the-transit-network/bus_infrastructure_design_guidelines-sept_2018.pdf

Transit Design Guide: Standards & Best Practices. Capital MTA (Austin, TX area). 2014. https://capmetro.org//docs/default-source/plans-and-development-docs/transit-oriented-development-docs/transit-design-guide.pdf?sfvrsn=f7e538aa_2

5.3 Bus Stop Design

5.3.1 Bus Stop Configuration Types

Bus stops may be configured differently depending on the characteristics of the surrounding context, the type transit service, and the classification and the multimodal function of the street. The following types of bus stop configurations are considered in this section.

- Curbside bus stop
- Curb extension or bulbout bus stop
- On-street bus transfer center
- Turnout bus stop
- Boarding island bus stop

CURBSIDE BUS STOPS

Curbside bus stops can be located on streets with on-street parking (pull-in stops) and without on-street parking (in-lane stops). At pull-in bus stops, buses move out of the travel lane and into the bus stop (refer to Section 5.3.2 Bus Stop Layout for configuration options). When departing, the bus pulls back into the travel lane. At in-lane bus stops where the travel lane is adjacent to the curb the bus pulls up to the curbside bus stop but remains in the travel lane until it departs. Curbside bus stops may be configured as nearside, farside, or midblock stops and on streets with or without bicycle lanes. **Figure 16** shows a conceptual example of a curbside pull-in bus stop. Details and dimensions of this stop configuration are in **Appendix C. Table 6** compares conditions describing when to use pull-in versus in-lane curbside bus stop configurations.

Figure 16: *Conceptual example of a Curbside Pull-In Bus Stop Configuration.*

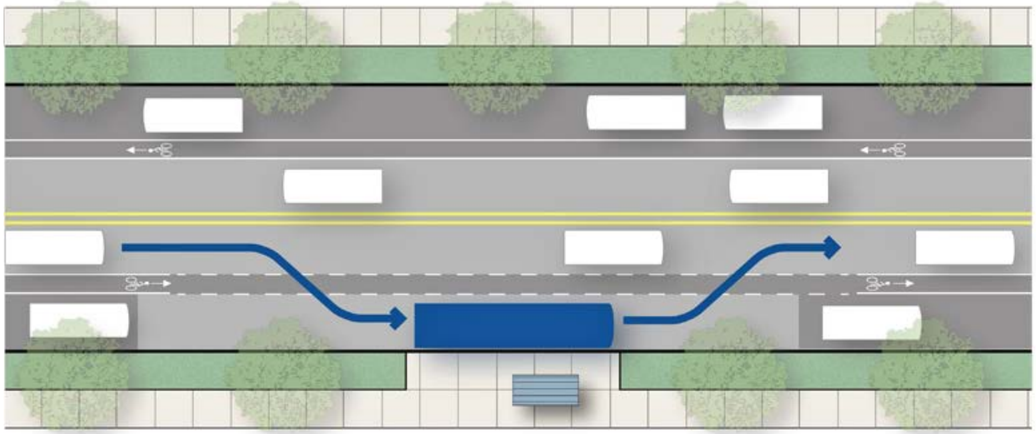


Table 6: *When to Use Pull-In Versus In-Lane Bus Stop Configurations*

When to Use Pull-In Curbside Bus Stops	When to Use In-Lane Curbside Bus Stops
On streets with parking where it is infeasible or too costly to provide a curb extension or bulbout bus stop.	On streets without parking or wide shoulders.
When traffic flow of the adjacent street is a high priority such as on certain MPAH corridors.	On lower volume, lower speed streets with typically short stops and infrequent use of wheelchair ramps
In locations where bus layovers are required.	At signalized intersections where signal phasing is advantageous for buses to board and alight when traffic is stopped. This is applicable to both nearside and farside bus stops.
Where curb space is at a premium a farside pull in bus stop is the most efficient configuration because the deceleration zone occurs in the intersection.	At locations where through traffic does not yield to buses attempting to re-enter travel lane and significantly delays bus operations.
On streets where obstructing bike lanes is to be avoided and the parking lane is wide enough to accommodate the width of the bus.	
Where a queue jump lane is desired, use a nearside pull in stop in either an exclusive bus lane or a right turn lane.	

CURB EXTENSION OR BULBOUT BUS STOP

Curb extension bus stops are the most efficient for bus operations and minimize clear curb requirements and thus impacts on parking. Curb extension bus stops operate as in lane stops and have the same advantages, impacts and applications as in lane stops as this configuration eliminates the need for any diverging and merging into the traffic stream, thereby increasing the efficiency with which buses are able to stop, load and unload passengers, and continue.

Curb extension bus stops require more infrastructure than curbside bus stops and can result in high construction costs. This configuration of bus stop can be applied at farside, nearside or midblock locations on streets with parking but are most effectively applied at the farside and/or nearside of intersections and in combination with pedestrian curb extensions at crosswalks. **Figure 17** shows examples of curb extension bus stops at the farside and nearside of an intersection. Details and dimensions of this stop configuration are in the **Appendix C.**

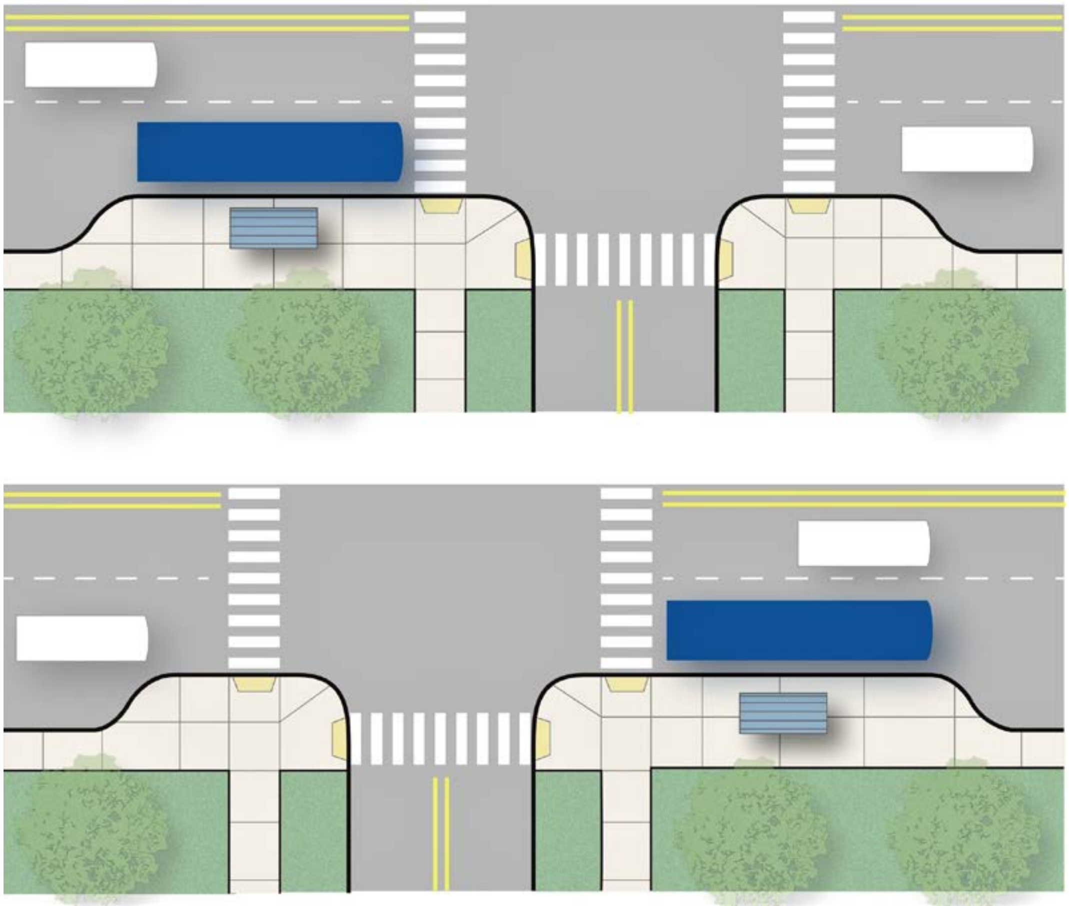


Figure 17: *Curb extension bus stops at the nearside and farside of an intersection.*

WHEN TO USE CURB EXTENSION BUS STOPS

- On streets at or near capacity where pull-in curbside stops experience operational delays.
- On express routes to minimize operational delays.
- On streets with relatively low operating speeds and frequent traffic signals.
- Where curb space is needed for other important functions such as on-street parking.
- At bus stops with high passenger volumes that require more space for waiting passengers and amenities.
- At locations with crowded sidewalks to maintain space for pedestrian throughway.
- Where layovers or timepoints are not required.
- On streets without bike lanes.
- Where nearside or farside curb extension bus stops may be created by extending existing intersection curb bulbouts used to reduce crossing distances at intersection crosswalks
- Midblock curb extension bus stops may be applied:
  - On very long blocks at specific destinations.
  - Where adjacent intersections are too complex or unsafe to provide nearside or farside bus stops.
  - Where controlled midblock pedestrian crossings exist or can be implemented.

MULTI-ROUTE LAYOVER ZONE BUS STOP

Multi-route layover zone bus stops are typically used where many bus routes converge on the same street. They combine several bus boarding areas in series, creating an area where several buses can board and alight passengers at the same time and can be used where timed transfers or layovers take place. **Figure 18** illustrates the configuration of multi-route layover zone bus stop.

This bus stop configuration may be used adjacent to off-street transit centers, potentially using a sawtooth bus bay arrangement, to provide additional capacity or used as a layover area. On-street transfer centers typically assign one or two routes to each individually signed boarding and alighting area along the curb. **Figure 19** illustrates a sawtooth berth arrangement for a multi-route layover zone bus stop.

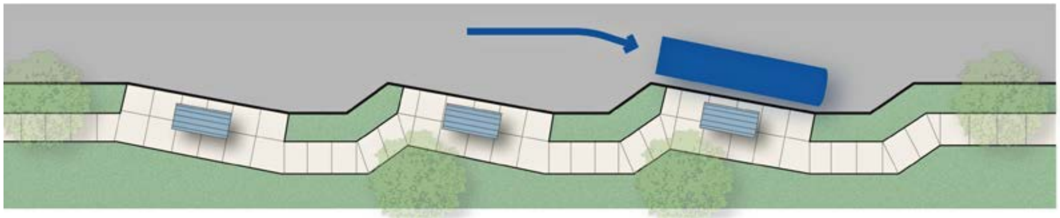
Details and dimensions of this stop configuration are in **Appendix C**.

TURNOUT BUS STOP

A turnout bus stop allows buses to pull into a recessed bay separated from the travel lane. Turnout bus stops are typically used on high-speed and high-volume arterial streets or expressways where it is impractical and unsafe to impede traffic with an in-lane stop and where buses require a long pull-out zone to accelerate back into the travel lane. The design of a turnout is dependent on the street's speed to provide the appropriate deceleration and acceleration transitions at each end of the turnout. Turnout bus stops may also be used at the nearside and farside of intersections allowing the elimination of an acceleration or deceleration transition where space is limited.

Figure 18: *Conceptual configuration of a multi-route layover zone.*

Figure 19: *Conceptual example of a sawtooth arrangement of a multi-route layover zone.*



WHEN TO USE MULTI-ROUTE LAYOVER ZONE BUS STOPS

- Where multiple bus routes converge on the same street at the same time
- Where transfers occur, especially timed transfers
- Where bus layovers occur
- On streets with adequate shoulder width for buses (in-lane stops are not feasible)
- Where sufficient sidewalk width exists (or can be acquired) to provide space for passengers, amenities, and a pedestrian throughway
- Adjacent to off-street transit centers where additional capacity is needed
- Consider a saw-tooth bus bay configuration where curb space is limited, and the width of the outside lane can accommodate the front overhang of the bus as it pulls away from the curb
- On short blocks, or where curb space is limited, a skip-stop configuration may be used with one transfer center on the nearside of an intersection and another transfer center on the farside

Figure 20 illustrates the basic configuration of a turnout bus stop. Details and dimensions of this stop configuration are in **Appendix C**.

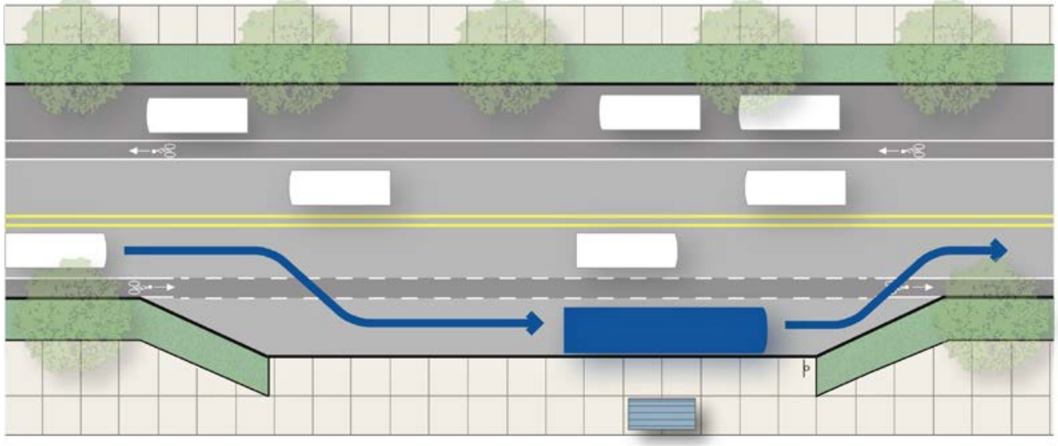


Figure 20: *Conceptual example of a turnout bus stop.*

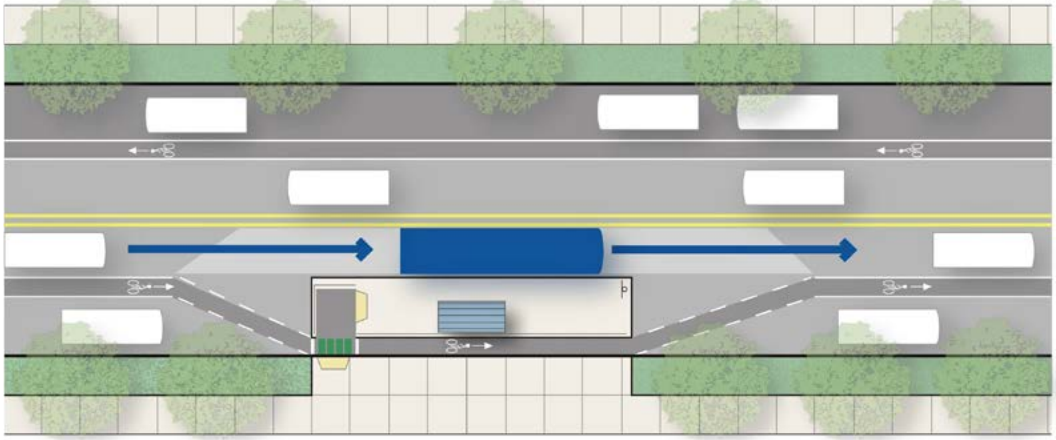
WHEN TO USE TURNOUT BUS STOPS

- On high-speed and high-volume arterials or expressways where a stopped bus might negatively impact the operation and safety of the street.
- On streets with single lane operation in each direction where passing sight distance for other traffic is not available at the bus stop.
- On streets where the sight distance to the stop prevents traffic from safely stopping behind a stopped bus.
- At a bus stop with a schedule timing point where a bus may layover for an extended period of time.
- At a destination where boarding and alighting times are long such as at regional shopping centers, transit centers, colleges, etc.
- At locations where sufficient right-of-way exists to accommodate the turnout and its transitions without impacting pedestrian movement.
- On streets with bicycle facilities where sufficient right-of-way exists to accommodate the turnout and its transitions so that buses do not impede bicycle movement.

BOARDING ISLAND BUS STOP

The boarding island stop is a bicycle facility-friendly alternative to either the curbside or the curb extension bus stop. It may also be used for passenger boarding of bus rapid transit (BRT) systems with center running ways. Boarding islands are boarding, and alighting areas separated from the sidewalk by a bike channel accommodating either a single one-way bike lane or a two-way separated bikeway. With bicycle traffic traveling behind the stop rather than in front of it, the boarding island eliminates the conflicts between buses and bicycles at in-lane stops, making the boarding island the recommended bus stop configuration for streets where bicycle facilities exist on or are planned for the right side of the street. **Figure 21** illustrates the conceptual configuration of a boarding island bus stop.

Figure 21: *Conceptual configuration of a boarding island bus stop.*



WHEN TO USE BOARDING ISLAND BUS STOP

- On streets with bicycle lanes or two-way separated bikeways.
- On streets with bicycle facilities where sufficient right-of-way exists to accommodate a boarding island of sufficient size for ADA compliant accessibility features (i.e., ramps), passenger volumes and desired amenities
- Where the bicycle channel can be differentiated from the sidewalk and bus stop by using contrasting materials or green color treatments typical for bicycle facilities.

Appendix E provides a comprehensive bus stop placement checklist.

Recommended Resources

Guide for Geometric Design of Transit Facilities on Highways and Streets. American Association of State Highway Transportation Officials (AASHTO). 2014. https://trid.trb.org/view/1320922

Transit Cooperative Research Program (TCRP) Report 19 Guidelines for the Location and Design of Bus Stops. Transportation Research Board. 1996. http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_19-a.pdf

Transit Street Design Guide. National Association of City Transportation Officials (NACTO). 2016. https://nacto.org/publication/transit-street-design-guide/

Rhode Island Bus Stop Design Guide. Rhode Island Public Transit Authority (RIPTA). 2017 https://www.ripta.com/projects/rhode-island-bus-stop-design-guide-2017/

Bus Stop Design Guide. Maryland Department of Transportation (MDOT) and Maryland Transit Administration (MTA). 2019. https://www.mta.maryland.gov/bus-stop-design-guide

5.3.2 Bus Stop Layout

Bus stops are comprised of zones but depending on the configuration type and the number of buses that would regularly use the stop, not all zones are required in all configurations. Bus stop zones include:

- Deceleration zone or corner clearance – the section of curb with restricted parking required for a bus to shift out of the travel lane, decelerate and pull into the curb at the bus stop—sometimes referred to as the "entry taper". Deceleration zones are required at midblock and nearside bus stops. At farside bus stops deceleration occurs in the intersection and the no parking zone behind the bus stop is the corner clearance required to keep crosswalks clear. The length of this zone is longer at farside stops after buses turn left or right.
- Stopping zone – the length of curb where buses stop while passengers board and alight. The length of this zone varies with the type of and number of vehicles using the stop. Stops with multiple positions requires additional distance between bus lengths to allow for independent departure.
- Acceleration or pull out zone – the section of curb immediately forward of the bus length zone that allows the bus to pull away from the curb and accelerate into the travel lane—sometimes referred to as the "exit taper". At nearside bus stops this zone is the corner clearance required to maintain sight distance for crosswalks and traffic control devices.

Typical bus stop zone layouts for one position stops for nearside, midblock, and farside curbside bus stops are shown in **Figure 22**. A typical layout for stops with multiple positions is shown in **Figure 23**.

CURBSIDE BUS STOP DIMENSIONS

The dimensions of bus stop zones will vary based on several conditions including:

Vehicle and Operations

- The type of vehicle(s) expected to use the stop (standard coach, articulated).
- The type of bus stop configuration (nearside, farside, midblock, turnout, curbside, in-lane, curb extension, boarding island).
- The number of buses regularly using the stop simultaneously, and layover requirements.
- Whether bus route includes a left or right turn immediately prior to, or after, stopping.

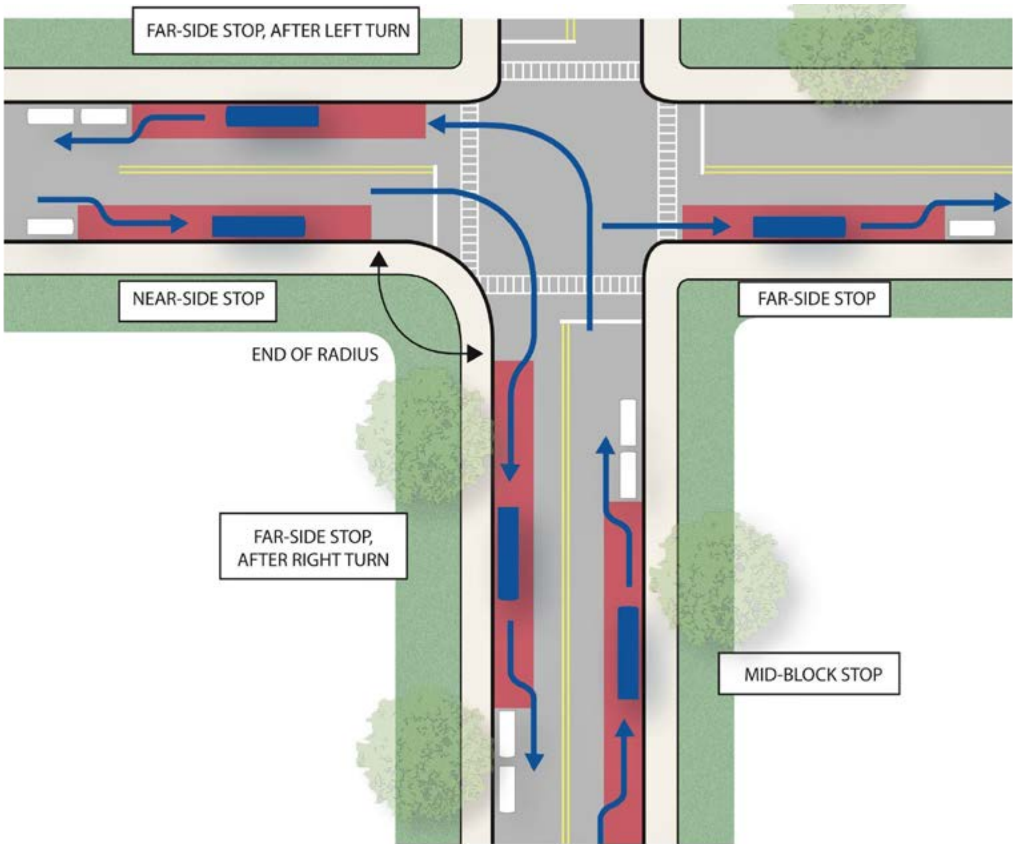


Figure 22: *Layout options for nearside, farside, and midblock bus stops.*

Roadway Characteristics

- Design speed and posted speed limits.
- Operator sight distance.
- Number of through lanes.
- Number and proximity of intersection turning lanes.
- Queue-jump lanes.
- On street parking, bicycle facilities, and location of crosswalks.

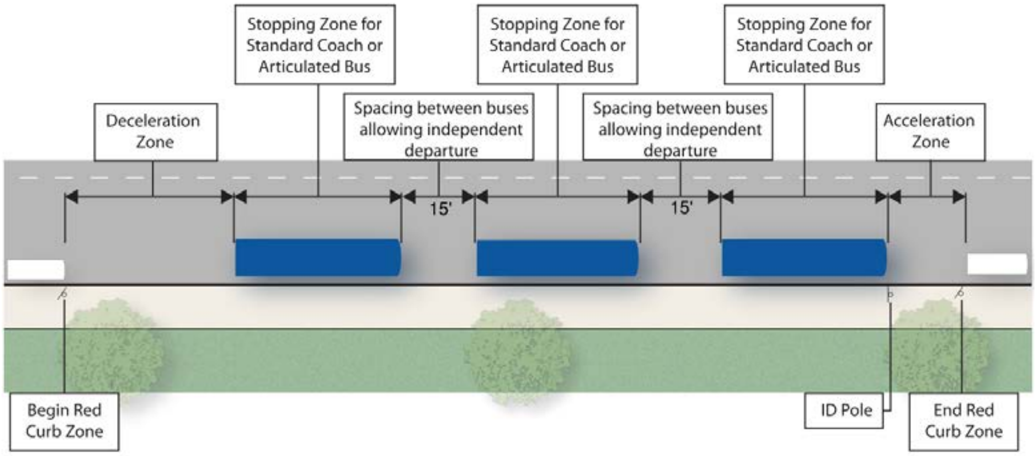


Figure 23: *Curbside layout for multiple position stops allowing independent departure.*

Appendix C provides drawings for placement and dimensions of common on-street stop conditions. In addition, the recommended resources at the end of this section include a publication by the Florida Department of Transportation's Public Transit Office titled Transit Facilities Guidelines. These guidelines provide design criteria and dimensions in the form of engineering drawings for an extensive list of bus stop configuration types and roadway configurations and includes useful "decision trees" for selecting the appropriate engineering specifications under various conditions.

Recommended Resources

Transit Facilities Guidelines. Florida Department of Transportation Public Transit Office. 2017. https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/transit/documents/transitfacilityguidelines-8-4-2017.pdf?sfvrsn=6d929e38_2

Transit Cooperative Research Program (TCRP) Report 19 Guidelines for the Location and Design of Bus Stops. Transportation Research Board. 1996. http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_19-a.pdf

5.4 Passenger Boarding Area and Amenities

The bus stop passenger boarding area at a typical on-street bus stop is defined as the area passengers wait for, board, and alight buses. The design of bus stop waiting areas and provision of amenities that enhance the passenger experience plays a significant role in a person's decision to use transit. Design of bus stops can affect a person's actual or perceived sense of safety, comfort, and convenience. The following sections identify the factors to consider and provide guidelines for designing passenger waiting areas.

5.4.1 Passenger Boarding Area

The passenger boarding area is adjacent to the curb face and is either part of the sidewalk or an extension of it. It is an area described as a firm, solid, level platform, standardized by OCTA's fleet dimensions (see Section 5.1.1 Vehicle Types and Characteristics for critical bus dimensions, Section 5.1.4 for wheelchair lift characteristics, and **Appendix A** for complete bus dimensions). Due to the different sizes of various buses, all are equipped with either a front door or rear door wheelchair lift, the boarding area must include a front and rear loading area free of obstacles. The boarding area may also be an accessible pathway but requires greater clearance than a standard sidewalk to allow deployment of the wheelchair lift (see Section 5.6 for a complete discussion of ADA requirements related to bus stops). The following photo shows a basic passenger boarding area.

5

The passenger boarding area extends from the signpost to at least the rear door of the largest sized bus using the stop, although it may extend further to accommodate multiple buses or space for amenities. The space required for the boarding area is dependent on the expected maximum number of waiting passengers and the desired amenities while maintaining space for mandatory accessibility features and the pedestrian throughway function of the sidewalk.

The following minimum features must be incorporated into the passenger boarding area:

- Bus stop signpost.
- Front and rear door clear area free of obstacles sidewalk to allow deployment of wheelchair lift and conforming with ADA requirements (refer to Section 5.6 Americans With Disabilities Act (ADA) Requirements) with respect to clearances, surface material, slopes, etc.
- ADA compliant pedestrian access to, and through, the boarding area (refer to Section 5.6 Americans With Disabilities Act (ADA) Requirements for accessible pedestrian access requirements).

Details, dimensions, and permutations of passenger boarding areas are in **Appendix C**.

5.4.2 Other Site Design Considerations

The following should be considered when designing bus stop boarding areas.

GENERAL

- Driveways should be kept at a minimum in and adjacent to the bus stop area (see Section 5.9 on bus stop relation to driveways).
- Whenever possible, avoid placing a bus stop such that the bus's wheels will cross over a catch basin as it pulls to the curb causing the bus to lurch and possibly throw off passenger balance. Additionally, it could eventually cause excessive settlement of the catch basin's structure.
- Whenever possible, a bus stop should not be located adjacent to a long-term construction zone. The local jurisdiction should ensure that a proper platform and access way is maintained or move the bus stop temporarily to a nearby location that allows safe and accessible boarding and alighting.

PASSENGER BOARDING AREA DESIGN

- Boarding areas should be large enough to accommodate the anticipated number of passengers during the busiest part of the day.
- Boarding areas must have a smooth broom finished surface to accommodate wheelchairs and must have high strength capacity to bear the weight of a shelter.
- Approved pavers (textured/decorative tiles) can be used in combination with the concrete pad to provide tactile differentiation from the sidewalk and for aesthetic purposes.
- Locate bus stops where there is a standard barrier curb in good condition or can be reconstructed. Boarding areas are designed with the assumption that the bus is the first step upon boarding or alighting. It is more difficult for the elderly and mobility impaired passengers if the curb is absent or damaged.

- The slope of the boarding area should match the slope of adjacent sidewalk and allow drainage of pad (refer to Section 5.6 Americans With Disabilities Act (ADA) Requirements).

ACCESS TO BOARDING AREA

- In a separated sidewalk situation (e.g. parkway between curb and sidewalk):
  - » Provide a landing area adjacent to the curb for a minimum distance of 34 feet in length and a minimum of 8 feet in depth; and
  - » Provide an accessible connecting pathway from sidewalk to landing area.
- Provide convenient pedestrian pathways/access ways to and from adjacent buildings.
- Ensure a minimum clearance distance of 10 feet between a pedestrian crosswalk and the front or rear of a bus stopped at a bus stop.
- Locate the bus stop to allow operator's clear visibility of passengers and to allow passengers a view of the oncoming bus (see Section 5.1.3 on visibility zones).

LANDSCAPING

- Landscaping near the passenger boarding area is encouraged to improve passenger comfort, but far enough back from curb face as not to interfere with boarding area clearances. Landscaping should be carefully located so as not to obstruct the shelter canopy or obscure sight lines at the stop. Shade trees are desirable, and the preferred location is at back of sidewalk at bus stops.
- Landscaping elements that grow to heights that would reduce visibility into and out of the bus stop should be avoided. Low-growing shrubbery and ground cover and deciduous shade trees are preferred at bus stops. Evergreen trees create a visual barrier and should be avoided.

STREET FURNISHING

- All street furniture should maintain a minimum of 48 inches of horizontal clearance wherever possible for access and maintenance between components and switch boxes, mailboxes, etc.
- Maintain a minimum 48 inches clearance between bus stop components and other street appurtenances such as utility poles, newspaper vending boxes, etc. Utility and irrigation vaults, and space for their lids/doors to open, need to remain accessible for maintenance workers.
- Street furniture over 2-1/2 feet high should be placed in such a way to provide motorists exiting nearby driveways clear visibility of the street and the bus stop.
- All bus stop component should avoid sharp edges or components that could harm passengers or passing pedestrians.

PASSENGER SECURITY

Passenger security is one of the primary issues associated with the design of bus stops. Personal security is consistently mentioned in transit studies as a major concern among transit users. The following guidelines should be considered to improve passenger security:

- Place bus stop in locations providing illumination of the passenger waiting area and boarding area. If street lighting does not exist, solar lighting could be considered to enhance security at night (see Section 5.8 on lighting).
- Ensure adjacent shrubbery is trimmed low and thinned so passengers can view over and behind hedges. Consider using plants that are open and do not form solid hedges of vegetation resulting in a continuous barrier.
- Ensure clear visibility of, through, and around the bus stop for both passenger surveillance of environment and for police surveillance from the street. Provide adequate lines of sight as passengers and police approach the bus stop.
- If possible, ensure that the pedestrian circulation routes through bus stops and waiting areas are not blocked from view by walls or other structures.
- In placing bus stops avoid nearby edges and corners of walls that create blind spots.
- Avoid design features that degrade access and security including soundwalls or similar structures that isolate passengers from surrounding neighborhoods. In general, there is no reason to locate bus stops adjacent to sound walls or tall fences, as these locations preclude direct access from adjacent land uses. If unavoidable, provide a pedestrian accessway through the wall.
- Consider installation of emergency call boxes at isolated locations.
- If possible, provide multiple exits for bus shelters.
- Remove all evidence of vandalism as soon as practical and regularly repair and maintain benches and shelters to provide passengers a sense of security.

5.4.3 Passenger Amenities Placement and Design Guidelines

Bus stop amenities provide comfort for passengers, improve the passenger waiting experience and help increase the identity and visibility of bus stops. If properly placed and secure, amenities can help to retain and attract additional transit riders to the service. Shelters provide protection from the elements, benches allow passengers to rest while waiting for a bus, trash receptacles help keep the stop clean, maps and schedule displays provide rider information, and bike racks provide bicyclists with a secure place to lock their bicycle while using the transit system. Lighting maintains stop visibility and helps transit patrons feel safer while waiting for a bus at night. Landscaping, particularly trees, provide dual functions of aesthetics and providing shade if placed appropriately. **Table 7** compares the advantages and disadvantages of passenger amenities at bus stops.

Table 7: *Reasons for Implementing Passenger Amenities at Bus Stops*

Amenity	Reasons for Implementing Amenity
Benches	• Provide comfort for waiting passengers • Help identify the bus stop • Low cost amenity when compared to installing a shelter
Trash Receptacles	• Provide place to discard trash and discourage littering • Keep bus stop and surrounding area clean
Shelters	• Provide comfort for waiting passengers • Protect passengers from climate-related elements (sun, glare, wind, rain, snow) • Help identify the stop and the transit system • Provide opportunity to install lighting at the bus stop • Provide opportunity to provide real time bus arrival information • Can provide space to install route and schedule information
Shelters (Advertising)	• Can be installed and maintained by advertising company • Provides opportunity for a shelter at stops that would otherwise not be considered for shelter installation • Provide opportunity to install lighting at the bus stop
Lighting	• Increase visibility • Increases perception of security for waiting passengers • Discourages inappropriate use by transients
Bicycle Parking	• Provides location for bicycling transit passengers to secure bicycles • Increases the first / last mile range of passenger access to bus stop
Vendor-Based Convenience Amenities (Newspaper/Vending Machines)	• Provide desirable and convenient service for waiting passengers
Route and Schedule Information	• Useful for first time riders • Help identify the stop and the transit system • Can communicate general system information and local area wayfinding

BENCHES AND TRASH RECEPTACLES

Guidelines for providing passenger benches and trash receptacles at bus stops include:

- Benches should be placed facing the street.
- Benches should be placed on the back side of sidewalk a minimum of five to six feet from the bus signpost, to allow pedestrians to move past people sitting on the bench and meet ADA requirements.
- Both benches and trash receptacles should be anchored to prevent unauthorized movement or theft.
- Mount benches for easy removal and replacement to allow for bus stop relocations, route changes, street improvement projects, replacement in case of damage, etc.
- Materials, coatings, and surfaces should be resistant to graffiti and dirt, and minimize becoming excessively hot in direct sunlight.
- Seating areas should be shaded, if possible, either using trees preferably planted at the back of the sidewalk, or existing buildings including awnings. A caution regarding the placement of trees at bus stops—horizontal and vertical clearance of the front and rear door boarding area is a higher priority than the provision of shade trees at a bus stop.
- At busy bus stops consider the use of leaning rails to supplement benches.
- The selection of bus stop furniture may incorporate designs and colors and aesthetic elements as part of the municipalities' adopted streetscape or urban design theme.
- Trash receptacles should be designed compatible with other bus stop components and with removable plastic liners for a standard 35-gallon minimum capacity. Top opening should be small to avoid deposits of household trash.
- Avoid installing trash receptacles with design features that permit liquids to pool or remain near the receptacle and attract insects.

Typical bench and trash receptacle layout.

- If possible, install trash receptacles in shaded areas a minimum of 3 feet (preferably 4 feet) from a bench or shelter to allow passage by persons in wheelchairs. Additionally, when trash receptacles are installed in areas that receive direct sunlight most of the day, the heat may cause foul odors to develop.

See Section 5.6 on Americans With Disabilities Act (ADA) Requirements for minimum requirements for the design and placement of benches at bus stops. As stated earlier, additional details, dimensions, and permutations of passenger boarding areas including placement of benches and trash receptacle are in **Appendix C**.

PASSENGER SHELTERS

Passenger shelters are provided to enhance the safety, security, and comfort of transit passengers while waiting for a bus. Shelters can be provided in many ways and can take almost any form or appearance since local municipalities typically select and install their own shelters. However, many municipalities contract with advertising agencies to install and maintain their shelters in return for revenue from shelter mounted advertisements.

Typical shelter.

SHELTER PLACEMENT CONSIDERATIONS

The guidelines presented in this section are most applicable to free standing passenger shelters. When placing passenger shelters local agencies should consider the following:

- Anticipated number of passengers using the bus stop.
- Type and intensity of adjacent land uses.
- The availability of necessary right-of-way and/or the ability of adjacent property owner to dedicate the necessary right-of-way.
- Sidewalk condition at the bus stop and accessibility to and from the stop.
- Location of doors/wheelchair lifts on OCTA buses.
- Visibility of the shelter and visibility impacts of the shelter. Ensuring shelter is located where it will not impede sight lines from nearby streets and driveways.
- Location of other street furniture and appurtenances, avoiding crowding of street furniture and ensuring ample and accessible waiting space around the shelter.
- Appropriate drainage to ensure water does not pool near shelter.
- The availability of electrical service.
- Accessibility for elderly and mobility impaired persons (see Section 5.6 for ADA Requirements).

SHELTER DESIGN GUIDELINES

The following guidelines will assist local agencies in placing and designing shelters after it has been determined a shelter will be placed at an existing bus stop (see passenger amenity warrants later in this section):

- Applicable requirements under "General Site Design" and "Benches and Trash Receptacles" should be met.
- Minimum ADA requirements must be met including a minimum space of 36 inches by 48 inches of clear floor space within the shelter for people in wheelchairs (see Section 5.6 on Americans With Disabilities Act (ADA) Requirements).
- A minimum overhead canopy of 72 square feet with a minimum width of 6 feet is desired.
- A minimum 7.5 feet clearance between underside of roof and sidewalk surface is desired or as required by ADA.
- Shelters should be placed at back of the boarding area with the interior facing the street, however, where this is not feasible, and the shelter must be placed in the front of the boarding area, a minimum of two feet (preferably four feet) of clearance between the overhead canopy and the curb face is required.
- The shelter canopy should be waterproof with provisions for drainage away from waiting passengers and boarding area.
- The shelter should have owner's name and 24-hour telephone number displayed for emergency purposes or to report maintenance needs.
- Seating for at least four people, in addition to one person in a wheelchair, located under the shelter canopy is desired.
- For passenger comfort and convenience and where practical a minimum lighting level of two footcandles should be provided throughout the shelter. Solar powered lighting should be able to produce this minimum output for an entire night. Motion sensitive lighting may be considered where power is unavailable or solar power is inadequate for an entire night.

- Accessories to be added to the transit shelter and passenger boarding area (such as water fountain, additional information panels, etc.) are a decision for the local agency 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 in reasonably proximity to where the front door of the bus will open to facilitate timely passenger loading.
- Shelter screens should maintain a minimum 6 inches vertical clearance from sidewalk to avoid collection of trash and debris.
- The back of the shelter should be located at least 12 inches (preferably more) 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.
- Shelters should allow passengers to easily see arriving buses and bus operators to see waiting passengers, especially if buses stop only on demand.
- It is preferred the shelter have an open design or glass walls to allow for visibility from the outside.
- Shelters should be constructed out of durable materials that withstand heavy use and exposure to the elements and be resistant to graffiti and fire. If a shelter is located where it could be struck by a vehicle, it should be designed to break away or bollards should be installed to prevent contact.

The photographs below left illustrate the layout of a multiple shelter bus stop and a shelter installation on a narrow sidewalk adjacent to a landscaped berm.

Bus stop with multiple shelters.

Bus shelter on narrow sidewalk.

5.4.4 Bicycle Parking

Bicycle parking facilities, such as bike racks, are often provided at bus stops for the convenience of bicyclists using transit where the cyclist prefers not to bring their bicycles on their bus trip. The provision of secure devices discourages bicycle riders from locking bikes onto bus stop components such as signposts, benches, or shelters, or on adjacent property where the property owner may have them removed. Proper placement of bike racks can reduce visual clutter at a stop by confining bikes to one area. The provision of bicycle parking devices at bus stops should consider the following:

- Install bike racks on a paved surface contiguous with the bus stop passenger area while meeting required clearances with bicycles attached to the rack.
- Locate the bike rack away from other pedestrian or patron activities to improve safety and reduce passenger waiting area congestion.
- Where multiple bike racks are installed in a row, they should be placed 3 feet apart.
- Where possible, install the bike rack where it can be illuminated by existing (or new) street lighting or bus stop lighting.
- Avoid placing bike racks where view of the bicycles is restricted by the shelter, landscaping, or existing site elements, such as walls.
- Regular maintenance tasks should include inspection of bicycles on bike racks for abandonment. Remove abandoned bicycles within a reasonable period to free up bike rack space.

5.4.5 Public Art

Public art may be used to improve the look and feel of the bus stop, as well as the area surrounding the bus stop. Public art may be used to create an identity and provide a welcoming feeling for passengers and passers-by. According to Capital Metro (transit provider for Austin, TX), other benefits include:

- Encouraging ridership.
- Improving perception of transit.
- Conveying customer care.
- Enhancing community livability.
- Improving customer experience.
- Improving municipal or organizational identity.

Public art can be in many forms, ranging from the design of stop amenities such as shelters, benches, and trash receptacles to separate art installations. It is the local agency's decision to incorporate public art at a bus stop, as part of the municipality's streetscape and/or urban design theme, or as required by ordinance for new development. The placement of public art installations, if within the functional area of a bus stop, must meet the same requirements as any other bus stop component or amenity.

5.4.6 Other Passenger-Focused Elements

- Signage and information at bus stops is covered in Section 5.15.
- Bus stop lighting is an important element in designing a safe bus stop area for passengers. Lighting is covered in depth in Section 5.8.

Vendor-based convenience amenities can be installed near stops. Vendors need to coordinate the installation of their equipment with the local agency responsible for the stop and ensure they will not interfere with passenger loading/unloading, sightlines, and ADA clearance areas. These amenities also need to be assessed for their potential to increase trash and whether that increase can be properly addressed with trash collection. Vendors must also be responsible for maintaining their equipment. Examples of vendor-based amenities include:

- Vending machines.
- Newspaper stands.
- Private shipper boxes (e.g., UPS, FedEx).

5.4.7 Criteria for Installing Passenger Amenities

A sheltered, paved waiting area outside the flow of pedestrian traffic and secure from automobile traffic is important to the transit customers. The goal is to provide this protection at as many stops as practical to encourage transit ridership. However, since resources are limited, a system to identify and prioritize bus stop improvements is desirable. **Table 8** shows one way of establishing priorities for justifying installation of bus stop amenities. It is recognized that the limiting of criteria and ordering of priorities are subjective, however this scoring methodology is an attempt to bring order to the selection process.

If a bus stop meets the criteria it may be considered for a bench and trash receptacle and/or shelter(s) by the local agency responsible for the bus stop. Meeting these criteria should not guarantee shelter installation.

Table 8: *Bus Stop Amenities Criteria*

Points	Criteria
7	High boarding count – stops where the number of patrons boarding all buses using the stop exceeds the following based on context: Urban: greater than 50 boardings per day Suburban: between 25 and 50 boardings per day Rural: between 10 and 25 boardings per day
5	Connectivity – stop serves as a common transfer point to other routes or modes
4	Special needs – stops that serve land uses (within a ¼-mile radius of stop) and people with special requirements for amenities that might not qualify based on boarding counts (senior and disabled housing, senior citizen centers, assisted living facilities, dialysis centers, pharmacies and medical clinics, public libraries, stop utilized by significant numbers of elderly persons and/or persons with disabilities)
4	Activity center – Locations with high density of people and thus high potential for ridership (apartments, high rise office buildings, shopping centers, schools and universities, hospitals, etc.)
3	Exposure to elements – Locations with no landscape or buildings to offer shade/ rain protection, no seat walls, no area to stand outside of sidewalk, and 2-3 lanes of traffic of 40 mph or more, giving patron no feeling of security at stop.
2	Frequency of service / long waiting time for bus – stops at which patrons wait 30 minutes or more between buses.
2	Bus stop passes site suitability tests: • Adequate physical space and clearances • Proximity of proposed shelter to bus stop not greater than 25’ from passenger boarding area • Permission from abutting business or resident to install shelter in front of property • Meets ADA accessibility requirements
1	Bus stop is in a disadvantaged community
1	Bus stops with existing shelters in deteriorating condition
1	Request for improvement – citizen or business requests improvements at stop.
Scoring	
Total Points	Amenities to Consider
6+	Bench and trash receptacle
10+	Shelter
Note: The warrants serve to direct an agency’s limited resources when not every location can be improved. Ideally, every bus stop should have at least one bench and a trash receptacle. If a stop has limited space, no more than two (2) pieces of furniture should be placed at the stop.	

Existing site conditions and pedestrian infrastructure, public right-of-way availability, accessibility, safety issues, and particularly, available funding must be reviewed and addressed before future shelter or bench placements are confirmed.

OCTA does not own, install, or maintain benches or shelters so the decision to place amenities lies solely with the local agency. Before a shelter, bench, or trash receptacle is placed, it is recommended that the local agency provide OCTA with site plans. This will give the Authority an opportunity to review proposed amenity placements to ensure adequate clearances and/or operational requirements are maintained. This will avoid costly relocations if the amenities are not placed per the criteria suggested in these guidelines.

5.4.8 Rural or Undeveloped Area Bus Stop Consideration and Design

In rural or undeveloped areas where there are no sidewalks and/or roads have open drainage ditches along the sides, care should be taken when locating potential bus stops. Every effort should be made to find a flat level area in which to place the stop. If funding is available, a concrete or asphalt waiting and boarding area, up to 8 feet wide and 35 feet in length, should be placed. In these cases, curb ramps and a compacted and stabilized decomposed granite, asphalt, or, preferably, a concrete sidewalk to the nearest intersection or development should also be considered. On roads without curbs, the local jurisdiction should consider placing a tactile warning device (such as grooved concrete or truncated domes) between the road's shoulder and the passenger waiting area. Also see Section 5.4.4 on Bus Stop Access in Rural and Undeveloped Areas.

5.4.9 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 "General Site Design." Developers are encouraged to place shelters that conform to local recommendations for passenger recognition and ease of maintenance. Local cities may elect to submit a copy of all street improvement or re-development plans to the Authority to ensure proper placement of transit amenities (turnouts, bus pad, etc.).

5.4.10 Bus Stop Maintenance

Well maintained bus stops are crucial to the image of the transit system. Damaged street furniture, graffiti, and trash build-up should be tended to immediately to create a positive impression for transit patrons and the public.

OCTA does not own nor maintain shelters or benches systemwide. The owners of the street furniture have the obligation to maintain their furniture, and the local agency should be responsible for monitoring these items for compliance.

Maintenance frequency of not less than once per week should include:

- Collection of refuse from trash receptacles and replacement of receptacle liners (this maintenance requirement may be more frequent if receptacles fill quickly).

- Litter pick up around stop or shelter/accessories.
- Wipe down of glass or plastic surfaces.
- Maintenance frequency of once per month (or as needed) should include:
- Full wash down of shelter and bus stop furniture (including power washing of bus stop waiting and boarding areas).
- Removal of all dirt, graffiti, and pasted material (graffiti should be removed as soon as practical).
- Manual or chemical removal of weeds.
- Pruning of obstructing foliage.
- Touch up of marred paint.
- Verify shelter lighting levels and replace bad bulbs and ballasts.
- Inspect bike racks for abandoned bicycles or locks.

Repair of items that pose a safety problem should be performed promptly or at least within 24 hours of notification. Repairs that do not pose safety problems should be completed within three (3) days.

5.4.11 Maintenance Agreements with Private Entities

For shelters installed and maintained by advertising companies or adjacent developments, a maintenance agreement should be in place and include daily, weekly, monthly, and on-demand inspections, tasks, and schedules. Local agency maintenance crews should have authority to notify private entities of maintenance issues requiring immediate attention.

Recommended Resources

Transit Cooperative Research Program (TCRP) Report 19 Guidelines for the Location and Design of Bus Stops. Transportation Research Board. 1996. http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_19-a.pdf

Transit Street Design Guide. National Association of City Transportation Officials (NACTO). 2016. https://nacto.org/publication/transit-street-design-guide/

Crime Prevention Through Environmental Design (CPTED) for Transit Facilities. APTA Standards Development Program Recommended Practice. American Public Transportation Association (APTA). 2010. https://www.apta.com/wp-content/uploads/Standards_Documents/APTA-SS-SIS-RP-007-10.pdf

Bus Infrastructure Design Guidelines. TransLink (Vancouver, BC area). 2018. https://www.translink.ca/-/media/translink/documents/plans-and-projects/managing-the-transit-network/bus_infrastructure_design_guidelines-sept_2018.pdf

Bus Stop Planning & Design Guide. Massachusetts Bay Transportation Authority (Boston, MA area). 2018. https://cdn.mbta.com/sites/default/files/engineering/001-design-standards-and-guidelines/2018-04-01-bus-stop-planning-and-design-guide.pdf

Rhode Island Bus Stop Design Guide. Rhode Island Public Transit Authority (RIPTA). 2017. https://www.ripta.com/projects/rhode-island-bus-stop-design-guide-2017/

5.5 Pedestrian Access

The process of designing and locating a bus stop should begin with understanding the experience of accessing the stop from home or work. Good pedestrian access can be achieved by considering the following guiding principles:

- Provide a safe pedestrian environment – sidewalks, walkways and street crossings should be free of hazards, well lit, have minimal conflicts with vehicular traffic and have a firm, stable, and slip-resistant surface.
- Provide an accessible pedestrian system – pedestrian routes to bus stops should be designed to meet the needs of all users, particularly the disabled, the elderly, and children (see Section 5.6 on ADA Requirements).
- Provide direct connections between places – the pedestrian system should be comprised of continuous and direct routes and convenient connections between destinations including residential areas, schools, shopping centers, public services and institutions, recreation, and transit.
- Provide a pedestrian system that is easy to use – the pedestrian system should be designed so people can easily find the most direct route to their destination with appropriate wayfinding signs if necessary.

The following guidelines can help achieve the guiding principles.

5.5.1 Coordination with Land Uses

Land uses that are designed for proper pedestrian access are located and concentrated in ways that minimize the distances between the development and the transit services. Land uses should be arranged to facilitate the movement of people from their origins to the bus stop or local transit center and back again. To best create the optimal environment for pedestrian access, coordination with new development should occur during the planning and design phases.

- Bus stops should be located so that passengers do not have to walk more than ¼ mile from major employment centers, residential development, or retail centers.
- Main entrances to commercial buildings should face the street with close pedestrian access to the nearest bus stop.
- Link access routes to bus stops or transit centers with building entrances by developing walkway systems and plazas that emphasize and naturally guide pedestrian activities and access.
- 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. Municipalities can encourage this strategy by reviewing zoning policies, development standards, setback guidelines, building orientation guidelines, and parking requirements to encourage transit-supportive development. This often involves locating buildings closer to the street and placing parking lots to the rear and/or sides of the building.

- Provide breaks in walls between properties to allow pedestrian access to bus stops, especially in new residential developments
- Incorporate walkways through parking lots.

5.5.2 General Design and Maintenance Considerations

The following provide general considerations for pedestrian facilities and maintaining those facilities:

- 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 as straight of a path as possible.
- Eliminate barriers to pedestrian activity. This includes landscaping, berms, or fences which impede pedestrian access or visibility. If there is restricted access, gates should be installed at access points.
- 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 street lighting, if not, consider installation of pedestrian scaled lighting or illuminated shelters at the bus stop.
- Pedestrian connections should be buffered from adjacent traffic using planting strips with street trees that also provide shading.
- Pave pedestrian pathways and ensure they are accessible to people with disabilities. Provide wheelchair accessible circulation routes, including curb cuts, ramps, and railings where needed. Place ADA compliant curb ramps at each corner of an intersection. See Section 5.6 on ADA Requirements.
- Where a bus stop serves as a transfer point, there should be a paved, ADA compliant connection to the connecting route stops.
- To the extent possible, crosswalks with curb ramps should be provided at all intersections that permit unprohibited crossings. Consider enhanced crossing treatments to shorten/improve crossing distances such as curb extensions, refuge islands, and raised crosswalks for locations with significant pedestrian activity, high vehicle speeds, and/or limited sight distances. Midblock or unsignalized intersections may benefit from a HAWK (High intensity Activated crossWalK) beacon or signal or Rectangular Rapid Flashing Beacons (RRFB).
- Adequate drainage should be provided to avoid pooling and muddy conditions.
- Sidewalks should be in good repair and free of trip hazards. Vegetation growth along sidewalks should also be maintained so as not to narrow the usable width of the sidewalk.
- Avoid curving sidewalks and paths, opting instead for the most direct path to/from the stop.

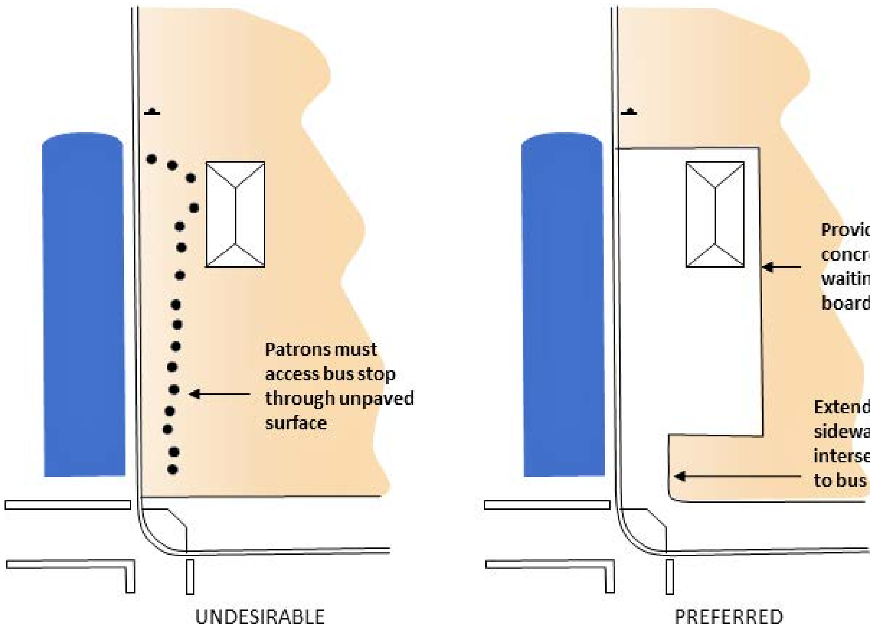
5.5.3 Pedestrian Pathway Design Characteristics

Refer to Section 5.6 on ADA Requirements for specific minimum accessible pathway criteria and design guidance.

5.5.4 Bus Stop Access in Rural and Undeveloped Areas

In rural and undeveloped areas, a concrete waiting area should be provided if possible. To improve access, a segment of sidewalk from the bus stop to the nearest intersection(s) should be provided if possible, even if no other sidewalk access currently exists, as illustrated in **Figure 24**.

Figure 24: *In undeveloped areas it is preferable to provide an asphalt or concrete sidewalk from the nearest intersection and an asphalt or concrete waiting / boarding area.*



If a concrete waiting area and sidewalk connection cannot be provided, a shoulder of decomposed granite, compacted and stabilized, should be provided if possible.

5.5.5 Audits

Walk and/or bus stop audits can be useful efforts to help in identifying deficiencies and barriers to accessing bus stops and surrounding areas. Such audits involve in-person assessment of the facility, often with multiple people to gain perspective on the pros and cons of the current state of the facility, and how to improve it for a greater cross-section of users.

Recommended Resources

Transit Cooperative Research Program (TCRP) Report 19 Guidelines for the Location and Design of Bus Stops. Transportation Research Board. 1996. http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_19-a.pdf

Toolkit for the Assessment of Bus Stop Accessibility and Safety. Easter Seals Project ACTION. www.projectaction.org

Rhode Island Bus Stop Design Guide. Rhode Island Public Transit Authority (RIPTA). 2017 https://www.ripta.com/projects/rhode-island-bus-stop-design-guide-2017/

5.6 Americans With Disabilities Act (ADA) Requirements

5.6.1 Introduction

According to the National Aging and Disability Transportation Center (NADTC), "For people with disabilities, inaccessible bus stops often represent the weak link in the system and can effectively prevent the use of fixed-route bus service. Physical, cognitive and psychological barriers associated with bus stops can severely hamper bus ridership by the disability community, thus limiting their mobility and potentially leading to increased paratransit use and the resulting increase in costs."

Practitioners designing bus stops and routes accessing bus stops should familiarize themselves with the most current regulatory requirements published by the U.S. Access Board in the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and particularly the guidelines adopted by U.S. Department of Transportation in its ADA Standards for Transportation Facilities for the following requirements (see resources at the end of this section):

- Location of Accessible Routes (206.3).
- Detectable Warnings on Curb Ramps (406.8).
- Bus Boarding and Alighting Areas (810.2.2).

5.6.2 Principles of Accessible Bus Stop Design

BARRIER-FREE DESIGN

Barrier-free design refers to an unimpeded connection between a bus stop and a sidewalk which provides access to adjacent or nearby land uses. The practitioner designing a bus stop needs to ensure that the bus stop is accessible to a connecting sidewalk or other pathway and that the sidewalk or pathway meets accessibility requirements accessing the bus stop. Most bus stops are integral to the sidewalk, but the practitioner should work with the municipality so that the sidewalk is accessible to and from nearby destinations.

The principles of barrier-free design include:

- Review and possibly modify sidewalk appurtenances or building elements to minimize obstacles and eliminate travel hazards, such as support cables for utility poles and low signage protruding into the travel path.
- Position street furniture and stop amenities such as benches, route maps, shelters and trash receptacles in a manner that makes them accessible from the bus stop boarding area, connected to the accessible pathway and out of the main flow of pedestrian traffic.
- Avoid grade-level changes in sidewalks and platforms wherever possible.
- Provide a slip-resistant finish, good grip, and sure footing to ensure surfaces are safe.
- Supply seating adjacent to sidewalks and pathways.

WAYFINDING

Wayfinding is a system of information, visual and tactile cues that guide people through a physical environment and assist them in understanding the space they are in and how to move towards a destination. For people with disabilities, wayfinding assists in determining their location within a setting, determine their destination, and provides direction that will take them from their current position to their destination.

The principles of wayfinding include:

- Provide consistency and uniformity of access routes and bus stop layout and design components.
- Simplify orientation by using right angles in bus stop layouts and placement of design components.
- Provide tactile as well as visual cues and landmarks within designs (e.g., sidewalks with grass shoulders or borders; street furnishings such as benches; trash receptacles; planters located adjacent to, but not within, the path of travel; and high contrasts on shelter door frames).
- Illuminate walkways, hazards and waiting areas for orientation and security purposes.
- Provide logical, continuous, and accessible travel paths from the sidewalk to the bus boarding area.
- Use color contrast, light, and shade to accentuate travel paths between the shelter, sidewalk, and bus boarding area.

SAFETY AND WARNING

As with all aspects of street and intersection design and bus operations, an important element in the design of bus stops is safety and warning.

The principles of safety and warning include:

- Provide a bus stop with good ergonomics and effective wayfinding elements.
- Place street furniture such as benches, planters, and railings to create barriers from hazards.
- Provide street lighting and/or direct lighting from bus stop poles and shelters. Allow lighting from adjacent land uses such as store fronts to illuminate access routes and bus stops.
- Ensure unobstructed visibility of routes to bus stops and bus stops from the adjacent streets and the surrounding land uses.
- Highlight the existence of potential hazards using distinctive markings, signs and higher light levels where inadvertent exposure to hazards cannot be removed or blocked with barriers such as railings.

5.6.3 Minimum ADA Requirements

Providing accessible bus stops requires choosing appropriate locations or improving the existing location. Coordination and cooperation with public works agencies, municipal government and adjacent business owners can enhance the connectivity between the land use and the bus stop. To ensure optimum bus stop placement, coordination should occur during the planning/development phase.

As mandated by the U.S. Access Board, bus stops must meet the following requirements:

BOARDING AND ALIGHTING AREA

- A firm, stable, and slip resistant surface.
- A minimum clear length of 8 feet (96 inches), measured perpendicular from the curb or vehicle roadway edge and a minimum clear width of 5 feet (60 inches), measured parallel to the curb or vehicle roadway (refer to Section 5.3.2 on Bus Stop Layout and Section 5.1.4 on Wheelchair Lifts).
- A maximum cross slope of 1:48 (2.08%) on the boarding and alighting area perpendicular to the roadway.
- The slope of the boarding and alighting area parallel to the roadway shall be the same as the roadway slope to accommodate wheelchair lift ramp alignment when deployed.
- Bus stop boarding and alighting areas must have an accessible connection to streets, sidewalks, or pedestrian paths.
- Bus stop route identification signs must comply with the visual signage requirements of ADAAG Section 703 (e.g., finish and contrast, style, character proportions, height, and spacing).

BUS STOP SHELTERS

If provided, install new or replace bus shelters to accommodate the following (refer to Section 5.4.3 on Passenger Amenities Placement and Design Guidelines):

- A minimum clear floor area of 30 inches by 48 inches, entirely within the perimeter of the shelter, must be maintained.
- Placement of clear floor space should not impede the use of a bench by other transit users.
- The shelter must be connected by an accessible route to the bus stop boarding and alighting area.
- Bus stop shelters cannot obstruct the boarding and alighting area.
- Minimum clear width and maneuvering requirements must be followed around the shelter and between the shelter and other street furniture. A minimum clearance of 36 inches must be maintained around the shelter and an adjacent connecting sidewalk (more is preferred).

ACCESSIBLE PATHS

At minimum, an accessible path should accommodate the following:

- A minimum clear width of 36 inches. The U.S. Access Board's Public Rights-of-Way Accessibility Guidelines (PROWAG) recommend a minimum clear passage width of 48 inches. This is especially important next to a curb drop-off.
- A corresponding accessible route from the bus stop to the pedestrian route used by the general public.
- A maximum cross slope of 1:48 (2.08%).
- A maximum running slope of 1:20 (5%).
- Stable, firm and slip-resistant ground and floor surfaces.
- No change in vertical elevation greater than ¼ inch (or up to ½ inch if beveled on a slope no greater than 1:2.
- Openings in floor or ground surfaces (i.e., gratings) shall not allow passage of a sphere more than ½ inch in diameter. Elongated openings must be placed so that the long dimension is perpendicular to the dominant direction of travel.
- Objects may not protrude into an accessible route or maneuvering space. Guidelines for protruding objects are described below:
  - » Objects projecting from walls (e.g., telephones) with their leading edges between 27 inches and 80 inches above the finished floor shall protrude no more than 4 inches into the pathway.
  - » Objects mounted with their leading edges at or below 27 inches above the finished floor may protrude any amount.
  - » Free-standing objects mounted on posts or pylons, including sign panels, may overhang a maximum of 12 inches from 27 inches to 80 inches above the ground or finished floor.
  - » A minimum of 80 inches clear headroom must be provided along accessible paths. If the vertical clearance of an area adjoining an accessible route is reduced to less than 80 inches, provide a barrier to warn people who are blind or have visual impairments.
  - » DOT's ADA Standards retained language from former section 10/3.1(1), which provides that "elements such as ramps, elevators, or other circulation devices, fare vending or other ticketing areas, and fare collection areas shall be placed to minimize the distance which wheelchair users and other persons who cannot negotiate steps may have to travel compared to the general public." This requirement is intended to minimize the distance people with disabilities must travel to important facility elements.

TRANSIT SIGNS

Provide bus stop signage that meet the following requirements:

- Characters must be selected from fonts where the width of the uppercase letter "O" is 55 percent minimum and 110 percent maximum of the height of the uppercase letter "I".
- Stroke thickness of the uppercase letter "I" shall be 10 percent minimum and 30 percent maximum of the height of the character.
- Characters must be in conventional form—not italic, oblique, script, highly decorative, or other unusual form.

- Character spacing shall be measured between the two closest points of adjacent characters, excluding word spaces. Spacing between individual characters shall be 10 percent minimum and 35 percent maximum of character height.
- Line spacing between the baselines of separate lines of characters with a message shall be 135 percent minimum and 170 percent maximum of character height.
- Characters and numbers shall be sized according to the horizontal and vertical viewing distance from which they are to be read (refer to Table 703.5.5 in the ADAAG guidelines for varying character height requirements).
- Visual characters (on signs) shall be mounted 40 inches minimum above the finished floor or ground surface.
- Pictograms shall have a field height of 6 inches minimum and must be accompanied with the equivalent verbal description placed directly below.
- Characters and their background on signs and pictograms shall have a non-glare finish, with characters and symbols contrasting from their background, either light on dark or dark on light.
- Follow protruding objects requirements (refer to the Accessible Paths section).
- The following are not requirements of ADA, but best practices related to bus stop signs for all transit users:
- Provide double-sided signs for visibility from both directions and reflectorized or illuminated signs for nighttime visibility.
- Place bus stop signs at the location where people board the front door of the bus. The bus stop sign marks the area where passengers should stand while waiting for the bus and serves as a guide for the bus operator in positioning the vehicle at the stop. The bottom of the sign should be at least 7 feet above ground level and should not be located closer than 2 feet from the curb face.
- Ensure that the signs are not obstructed by trees, buildings or other signs and are located away from visual distractions.

BENCHES

Benches, if provided, should conform to the following ADA regulations:

- Clear floor or ground space for wheelchairs (complying with ADAAG Section 305).
- Seat dimensions: 20 inches minimum to 24 inches maximum in depth and 42 inches minimum in length.
- Seat height of 17 inches minimum to 19 inches maximum above the floor or ground.
- Back support of 42 inches minimum in length and extends from a point two inches maximum above the seat to a point 18 inches minimum above the seat.
- Structure supporting vertical or horizontal forces of 250 pounds applied at any point on the seat, fastener, mounting device, or supporting structure.
- When benches are exposed to weather (e.g., not within a shelter or under other structure) they must be slip resistant and designed to shed water.

Appendix D contains a comprehensive as well as a shorter "quick" bus stop accessibility checklist found in one the key resources used in the development of this section.

Recommended Resources

Toolkit for the Assessment of Bus Stop Accessibility and Safety. Easter Seals Project ACTION. www.projectaction.org

Federal Transit Administration. ADA Regulations. Part 37—Transportation Services for Individuals with Disabilities. ADA Standards for Transportation Facilities. https://www.transit.dot.gov/regulations-and-guidance/civil-rights-ada/ada-regulations

U.S. Access Board. ADA Accessibility Guidelines (ADAAG). https://federalist-e3fba26d-2806-4f02-bf0e-89c97cfba93c.app.cloud.gov/preview/atbcb/usab-uswds/ada-alternative/

U.S. Access Board. Public Rights-of-Way Accessibility Guidelines (PROWAG). https://www.access-board.gov/prowag/

Guidelines for Transit Facility Signing and Graphics. Transit Cooperative Research Program (TCRP) Report 12. 1996. http://onlinepubs.trb.org/Onlinepubs/tcrp/tcrp_rpt_12-a.pdf

Resources for accessible design. National Aging and Disability Transportation Center website. https://www.nadtc.org/

5.7 Bicycle Access and Facilities Adjacent to Bus Stops

Safely accommodating bicycle travel to, from, and through the bus stop is an important consideration in promoting a multimodal network and helping transit users complete first and last mile connections with bus stops. This section provides guidance for designing bus stops on streets with bicycle facilities. There are several resources that address this topic comprehensively and in detail, therefore, this section summarizes options for the practitioner to consider when designing bus stops adjacent to bicycle facilities. The practitioner is encouraged to refer to the recommended resources at the end of this section.

SHARED LANES

A. Shared General Traffic Lane

For bicycle routes without a separate bike lane, "Bicycle Warning" signs with a "Share the Road" plaque can be placed in advance of bus stops. Shared lane pavement markings (sharrows) should also be provided on shared lane bicycle facilities per the California Manual on Uniform Traffic Control Devices (CA MUTCD). If bus and/or bike volumes are high, or speeds exceed 35 mph, dedicated bicycle facilities and appropriate accommodations at bus stops (as described in this section) should be considered.

B. Shared Bus and Bike Lane

A dedicated lane for both buses and bikes to share is not a preferred option due to the potential for conflicts, but can be useful if lane width (13 feet or less) prevents having a separated lane for each mode but separating the two modes from general vehicular traffic is desired. This is most acceptable when:

- It is expected that bus and bicycles will not interact often, typically along a route with low to moderate bicycle traffic.
- Bus operating speeds of 20 mph or less, and bus headways of 4 minutes or longer.
- Sufficient sight distance to allow bicyclist to react to a bus pulling into or out of a bus stop or for a bus operator to observe an approaching bicyclist.

A shared bus and bike lane is depicted in **Figure 25**. BUS BIKE ONLY pavement markings should be painted in the lane, accompanied by signs that designate the lane as only for buses and bikes. Shared lane pavement markings (sharrows) should be provided for the length of the bus lane with spacing conforming the CA MUTCD standards.

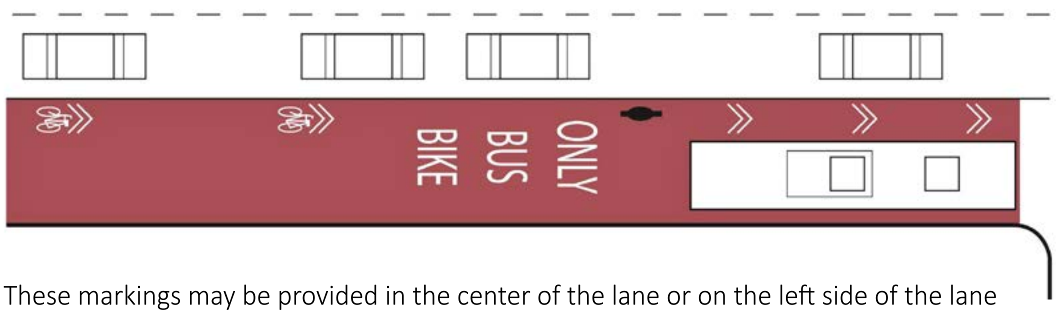


Figure 25: *Conceptual diagram of a shared bus and bicycle only lane.*

These markings may be provided in the center of the lane or on the left side of the lane indicating where bicyclists should ride. At bus stops, sharrows or chevron pavement markings should be marked on the left side of the lane spaced about 10-feet apart for the length of the bus stop.

BIKE LANES

There are several ways to accommodate bicycle facilities adjacent to various bus stop configurations depending on available space, bus frequency, type of bicycle facility, and other roadway characteristics. The following illustrates bus stops adjacent to Class II bike lanes (including buffered bike lanes) and Class IV separated bikeways.

A. Bus Stop Adjacent to a Class II or Buffered Bike Lane

1. Curbside Bus Stop in a Narrow Parking Lane Adjacent to a Bike Lane

Where available right-of-way does not allow for the 10-foot bus stop lane separate from the bike lane, a stopped bus will partially or completely block the bike lane. In this condition, a combined width of the bus stop lane and bike lane is recommended to be at least 14 feet, as shown in **Figure 26.** With this recommended width a stopped bus will partially block the bike lane, but enough space should remain for a bicycle to safely pass the bus without entering an adjacent travel lane.

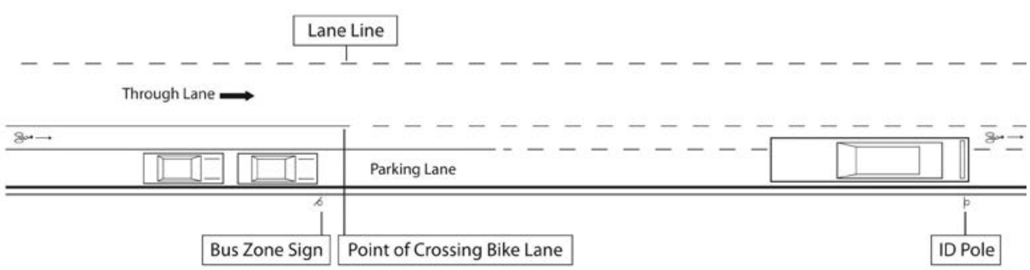


Figure 26: *Bus stop in a narrow parking lane adjacent to a bike lane.*

This condition is applicable to curbside nearside, farside, and midblock bus stops, but does not apply to curb extension bus stops.

2. **Curbside Bus Stop Adjacent to a Bike Lane**
A bus stopped at a curbside bus stop located within a standard width parking lane (7 to 8-feet in width) where the adjacent bike lane is at least 14-feet from the curb (measured from the curb face to the outer bike lane stripe) may partially block the bike lane but should provide 3.5 to 4-feet of clearance for a bicyclist to safely pass the bus and remain within the bike lane. **Figure 27** illustrates this condition which is applicable to curbside nearside, farside, and midblock bus stops, but not curb extension bus stops.

3. **Bus Turnout Adjacent to a Bike Lane**
At turnout bus stops adjacent to a Class II bike lane, a minimum width of 10 feet (preferably 12 feet) for the bus stop lane should be provided to avoid blocking the bike lane (even partially) by a stopped bus, as illustrated in **Figure 28.** Dashed bike lane markings should be used for the length of the bus stop lane area to signify that buses may cross the bike lane. This condition is applicable to open ended nearside and farside turnout stops, and midblock turnout bus stops.

Figure 27: *Curbside bus stop adjacent to a bike lane.*

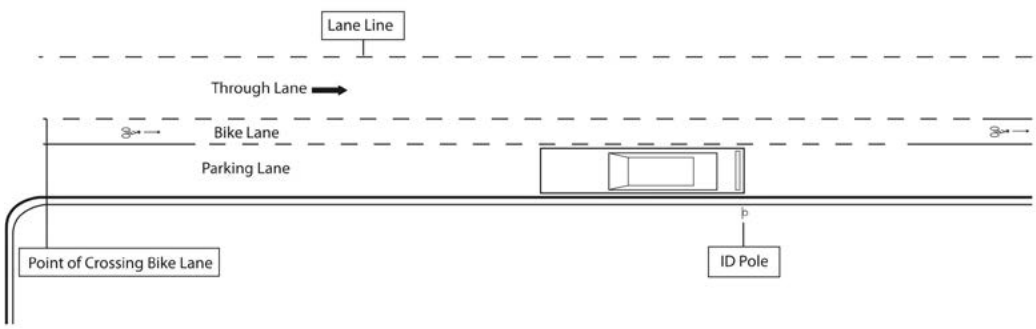
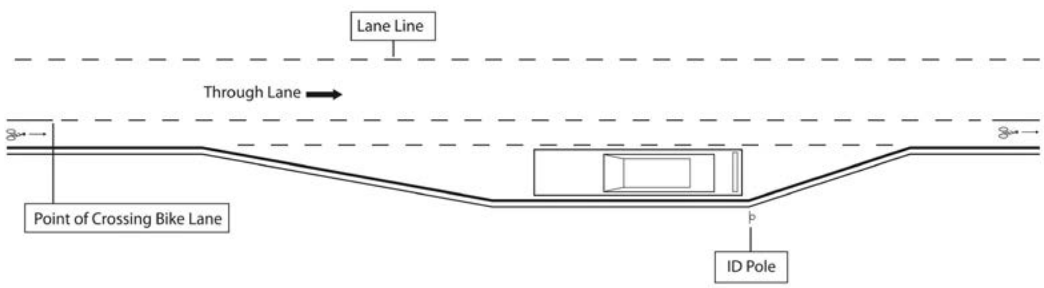


Figure 28: *Bus turnout adjacent to a bike lane.*



- If a minimum of 14 feet of combined width cannot be provided, a sign should be provided to bicyclists in the bike lane to look before passing a stopped bus.
- Care should be taken to position the seam of the concrete bus pad to ensure it is not within the bike lane.

4. **Boarding Island Bus Stop Adjacent to a Class II Bike Lane or Class IV Separated Bikeway**
A boarding island bus stop is a preferred bus stop configuration where a Class II bike lane or a Class IV separated bikeway exists between the bus stop and the sidewalk. There are several variations of boarding island bus stops, where the bicycle facility passes between the bus stop and sidewalk, as described in Section 4.1.3 on Supporting Cyclists. However, the preferred variation of a boarding island bus stop is a raised boarding island with the bike facility running between the bus stop and the sidewalk at-grade, as illustrated in **Figure 29** This configuration requires accessible pedestrian crossing and safety features, as well warning features for bicyclists using the facility.

Conditions that support the use of island bus stops include:

- Corridor where bikes and buses frequently "leapfrog" (pass or being passed).
- Moderate to high bus frequency.
- On-street parking lane.
- Speed limit of 35 mph or less.
- Passenger boardings of 20 or less an hour.
- Average bus dwell time of less than 30 seconds per stop.
- Less than 250 vehicles per peak hour in the travel lane.

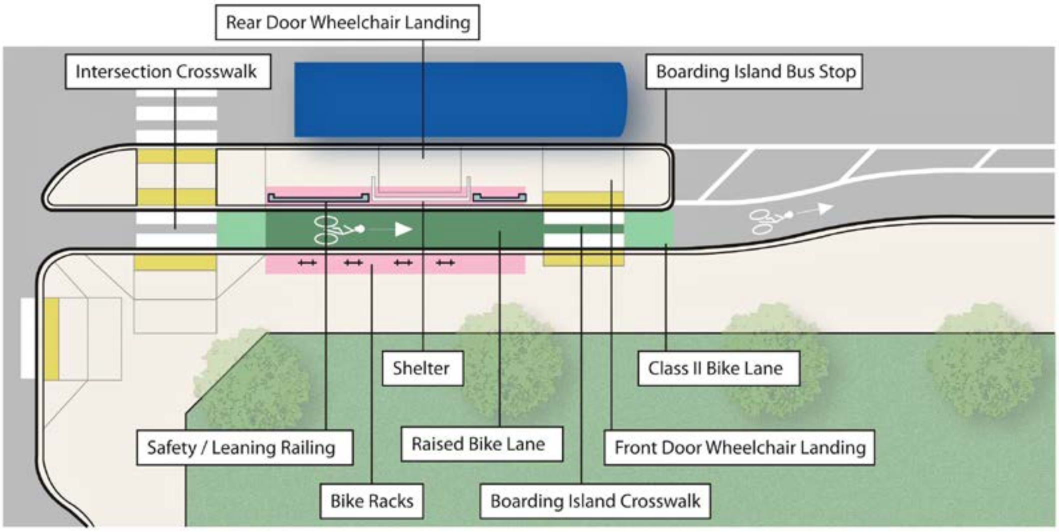


Figure 29: *Preferred configuration of a boarding island bus stop.*

5

Boarding island bus stop flush with bike lane. Image by Dylan Passmore.

The following should be considered when implementing a boarding island bus stop:

- The bike lane can be at the street or sidewalk level, but street level is preferred.
- Where the bicycle facility is at street level, a single crosswalk across the bike facility may be raised to maintain a level pedestrian crossing and avoids requiring ADA ramps on the relatively narrow boarding island.
- A sign for bicyclists to yield to crossing pedestrians should be installed in advance of the boarding island crosswalk per MUTCD standards.
- If a bus stop has a high passenger volume and there is concern regarding transit riders occupying the bike lane adjacent to the stop, green paint can be used to better designate the bike lane as a bike-only facility and railings on the boarding island can help prevent passengers from spilling over into the bike lane.

BICYCLE PARKING

See Section 5.4 on Passenger Boarding Area and Amenities for guidance on bicycle parking at bus stops.

Recommended Resources

California Manual on Uniform Traffic Control Devices (CA MUTCD). FHWA and Caltrans. 2014. https://dot.ca.gov/-/media/dot-media/programs/safety-programs/documents/ca-mutcd/rev6/camutcd2014-rev6.pdf

Transit Cooperative Research Program (TCRP) Report 183 A Guidebook on Implementing Transit-Supportive Roadway Strategies, Appendix C. Transportation Research Board. 2016. https://www.nap.edu/catalog/21929/a-guidebook-on-transit-supportive-roadway-strategies

Transit Street Design Guide. National Association of City Transportation Officials (NACTO). 2016. https://nacto.org/publication/transit-street-design-guide/

Urban Bikeway Design Guide. National Association of City Transportation Officials (NACTO). 2014. https://nacto.org/publication/urban-bikeway-design-guide/

Multimodal Corridor Guidelines. AC Transit. 2018. https://www.actransit.org/website/uploads/AC_Transit_Multimodal_Corridor_Guidelines_Final.pdf

Bus Infrastructure Design Guidelines. TransLink (Vancouver, BC area). 2018. https://www.translink.ca/-/media/translink/documents/plans-and-projects/managing-the-transit-network/bus_infrastructure_design_guidelines-sept_2018.pdf

Transit Design Guide: Standards & Best Practices. Capital MTA (Austin, TX area). 2014. https://capmetro.org//docs/default-source/plans-and-development-docs/transit-oriented-development-docs/transit-design-guide.pdf?sfvrsn=f7e538aa_2

Rhode Island Bus Stop Design Guide. Rhode Island Public Transit Authority (RIPTA). 2017 https://www.ripta.com/projects/rhode-island-bus-stop-design-guide-2017/

5.8 Lighting at Bus Stops

Lighting affects transit patron's sense of security and safety at bus stops as well as on routes to bus stops. Good lighting can deter criminal activity by improving surveillance from the street and improve the visibility of passengers for bus operators. Poor lighting can encourage unintended use of the facility by non-patrons as well as criminal activity. Illumination standards are often a policy of the local agency that installs and maintains the street lighting, but OCTA recommends lighting which provides between 2 and 5 footcandles at bus stops and encompasses all shelters and bus stop furniture.

Availability of power is a key factor in providing bus stop illumination. Direct lighting, while ideal, is often difficult to implement at remote locations. If not available, solar lighting should be considered. If installing pedestrian-scaled lighting (25 feet high or less) at bus stops, the fixtures should be vandal proof but easily maintained, and preferably LED for added cost savings. For example, avoid using exposed bulbs or elements that can be easily tampered with or destroyed. If light pollution is a concern, sensors that activate lights only when passengers are present can be used.

A cost-effective approach to providing indirect lighting is to locate bus stops near existing streetlights. When locating bus shelters and benches near existing streetlights, ensure the minimum clearances discussed elsewhere in this manual are met and that a minimum of two footcandles of light for passenger comfort reaches inside the shelter.

While street trees are highly desirable for many reasons, they can block streetlights from illuminating bus stops and even cast deep shadows on the stop. Placement of bus stops should consider light sources from existing streetlights in relation to street trees in their current state and with future growth. Local agency's annual or biannual maintenance schedules should include pruning street trees, as appropriate for the species, to improve bus stop illumination.

Street lighting should also be provided along bus stop access routes and safety lighting at intersections for traffic safety purposes and to promote a sense of security for transit patrons.

Recommend Resources

Bus Infrastructure Design Guidelines. TransLink (Vancouver, BC area). 2018. https://www.translink.ca/-/media/translink/documents/plans-and-projects/managing-the-transit-network/bus_infrastructure_design_guidelines-sept_2018.pdf

Rhode Island Bus Stop Design Guide. Rhode Island Public Transit Authority (RIPTA). 2017 https://www.ripta.com/projects/rhode-island-bus-stop-design-guide-2017/

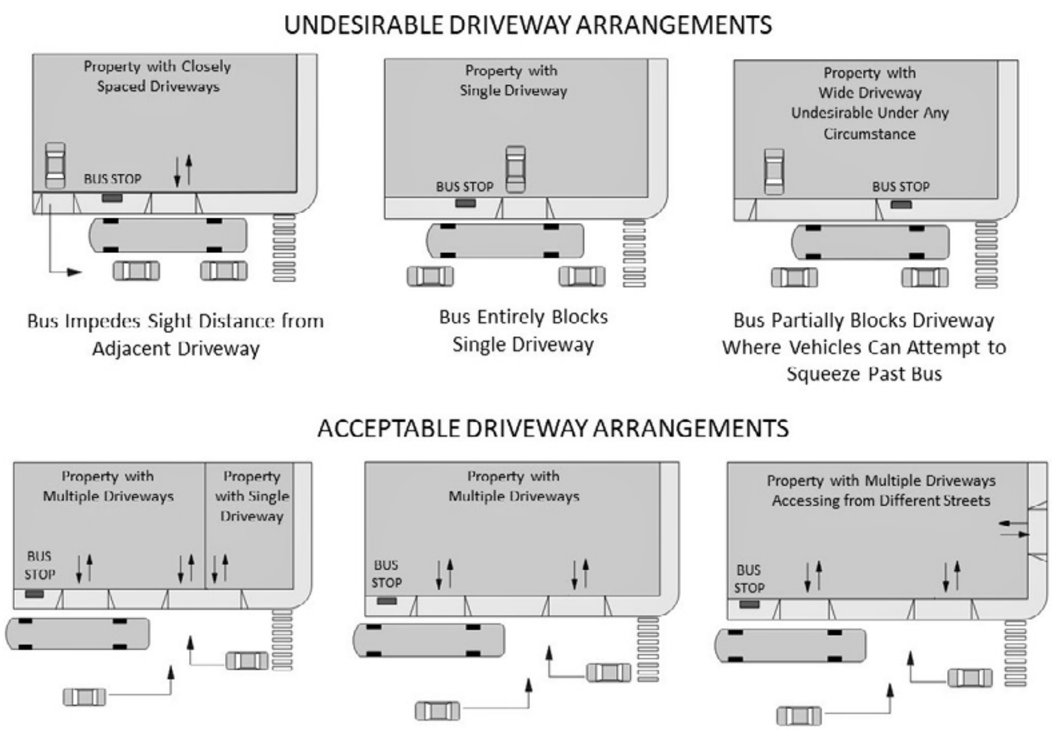
5.9 Relationship to Driveways

Whenever possible, bus stops should not be placed within the proximity of a driveway. However, if a driveway is unavoidable:

- Attempt to keep at least one exit and entrance open to vehicles accessing the property while a bus is loading or unloading passengers.
- Locate bus stops to allow sufficient 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.
- Never place a bus stop that forces passengers to wait for a bus in the middle of a driveway or where the bus stop requires passengers to enter/exit the bus on the sloped surface surrounding a driveway.
- If blocking a driveway is unavoidable, it is preferable to fully rather than partially block the driveway to prevent vehicles from attempting to squeeze by the bus in a situation with reduced sight distance.

Figure 30 depicts undesirable driveway situations where either visibility is restricted or the only drive into the property is blocked. **Figure 30** also shows acceptable driveway situations where visibility is enhanced, and access is maintained.

Figure 30: *Undesirable and acceptable driveway locations near bus stops.*



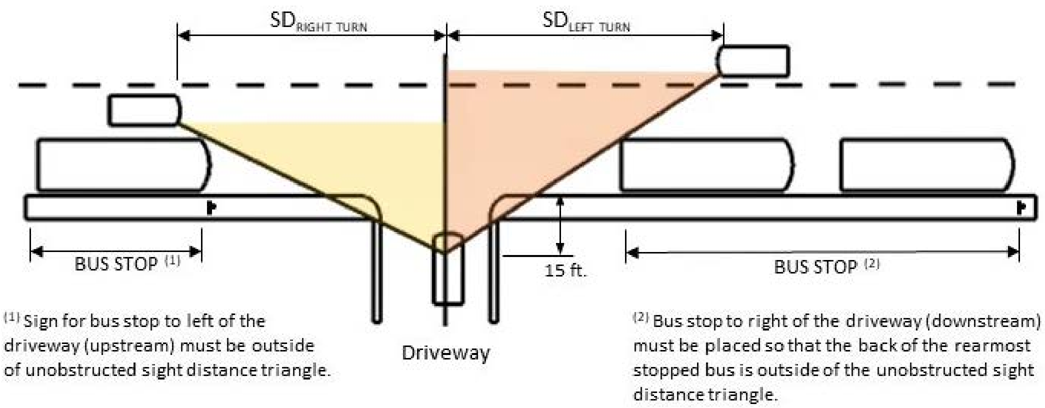
The best opportunity to eliminate driveway conflicts for passengers and buses is during early planning of development projects. New developments can arrange their access to avoid constructing driveways near existing or proposed bus stop locations if the driveway location would result in inadequate sight distance. Developers should contact OCTA regarding bus stop locations prior to starting the preliminary site plan process.

If determining whether to place a bus stop between driveways, the following should be considered:

- Peak hour traffic using the driveways.
- Projected boardings/alightings at the bus stop.
- Peak bus stop activity compared to peak use time of the driveways.
- Availability of adequate and accessible passenger waiting area.
- Queuing on the street entering the driveways that could impact the bus operator's ability to pull up to the stop.
- Availability and acceptability of alternative bus stop locations should relocation be desired.

Adequate sight distance for drivers entering and exiting the driveways and pedestrians accessing the bus stop. **Figure 31** illustrates placement of bus stops adjacent to driveways to maintain adequate stopping sight distance between vehicles traveling on the street and vehicles waiting at driveways to exit. Unobstructed sight distance triangles should be maintained as shown in the figure. This may require the placement or relocation of a bus stop further upstream or downstream of a driveway that achieves the required sight distance.

Figure 31: *Bus stop placement adjacent to driveways to maintain adequate sight distance.*



Stopping Sight Distance

Roadway Design Speed (MPH)	25	30	35	35	40	45	50	55	60
$SD_{RIGHT\ TURN}$ / $SD_{LEFT\ TURN}$ (Feet)	150	200	250	300	300	360	430	500	580

Source: Caltrans Highway Design Manual, Table 202.1 Sight Distance Standards

For details on determining clear sight distance triangles at driveway intersections the practitioner is referred to Chapter 3 of the American Association of State Highway Transportation Officials' (AASHTO) publication A Policy on Geometric Design of Highways and Streets, also referred to as the "green book".

5.9.1 Future Considerations

It can be expensive and disruptive to move a bus stop due to a conflict with a driveway. The construction of a driveway along a roadway that does not yet have transit service (or a bus stop near the driveway) but may in the future can cause future bus stops to be placed in less desired locations. Coordination should occur with OCTA and the local agency responsible for approving new driveways to provide input on locating new driveways to ensure adequate space is reserved for an existing or future bus stop.

Recommended Resources

Transit Cooperative Research Program (TCRP) Report 19 Guidelines for the Location and Design of Bus Stops. Transportation Research Board. 1996. http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_19-a.pdf

Bus Infrastructure Design Guidelines. TransLink (Vancouver, BC area). 2018. https://www.translink.ca/-/media/translink/documents/plans-and-projects/managing-the-transit-network/bus_infrastructure_design_guidelines-sept_2018.pdf

Transit Design Guide: Standards & Best Practices. Capital MTA (Austin, TX area). 2014. https://capmetro.org//docs/default-source/plans-and-development-docs/transit-oriented-development-docs/transit-design-guide.pdf?sfvrsn=f7e538aa_2

5.10 Transit Priority Measures

5.10.1 Bus Lanes

Bus lanes, or bus-only lanes, refer to lanes dedicated exclusively or primarily to the use of buses. Exclusive bus lanes help buses avoid delays caused by congestion in shared lanes and thus improve travel time and reliability. According to Los Angeles Metro, Bus lanes are considered beneficial in conditions where the average transit trip time can be reduced by at least 15%. Bus only lanes also permit buses to depart from stops quickly and safely without having to wait for gaps in traffic as with shared lanes. Exclusive bus lanes can often result in the same benefits as combinations of individual transit-supportive roadway strategies such as signal priority measures and queue-jump lanes.

TYPES OF BUS LANES

The following describe different operational and physical ways of implementing bus lanes.

A. Full-Time Versus Part-Time Bus Lanes

Like high occupancy vehicle (HOV) lanes, full-time lanes are easier to enforce and ensure travel benefits for buses. However, they can be perceived as controversial if not regularly and frequently used, especially when adjacent general-purpose travel lanes are consistently congested.

Part-time implementation of bus lanes during peak periods is usually paired with a general-purpose travel lane or parking lane used during the non-peak periods. Increased enforcement is required to ensure the lanes are used correctly during peak periods. When paired with a parking lane, this extra enforcement is especially important to ensure the lane is clear at the onset and during the peak periods by using tow truck sweeps.

The selection of full-time vs. part-time designation depends on travel patterns along the corridor, the practicality and cost to enforce part-time restrictions, and considering the trade-offs between bus travel times and restricting general traffic movements and on-street parking and curbside deliveries for several hours each day.

B. Curbside and Business Access and Transit (BAT) Bus Lanes

Curbside bus lanes are typically the simplest and least costly bus lane to implement by utilizing a wide shoulder or an existing lane such as a parking lane or general traffic lane. The curbside orientation also makes it easier to incorporate traditional bus stops. If right-turning traffic is infrequent and has other options, right-turns should be prohibited for optimal benefit—an important consideration since, according to TCRP, right turns can decrease the travel time benefit of a bus lane by fifty percent in urban settings.

However, in urban settings with short blocks and frequent cross streets it is challenging to restrict right-turning traffic. In these conditions, where curbside lanes must permit right-turning traffic to access cross streets and driveways, a business access and transit (BAT) lane may be implemented. BAT lanes allow general traffic to use the bus lane for the necessary distance to decelerate and complete a right turn or turn into the bus lane. Some BAT lanes permit traffic to turn right into the bus lane for the necessary distance to accelerate and merge into the adjacent general traffic lane.

Business and Transit (BAT) lane. Image by Oran Viriyincy.

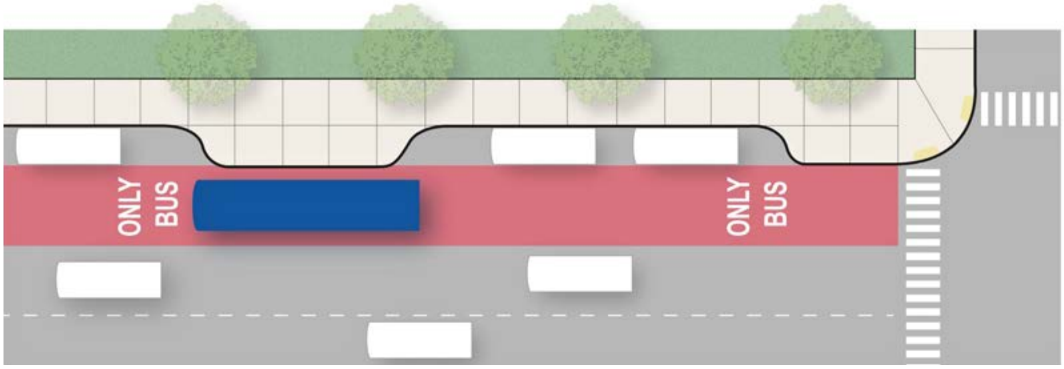
As described above, bus lanes can lose half of their travel time savings when traffic is permitted to use the bus lane to turn right. Adding to this delay, right-turning traffic frequently must yield to pedestrians further delaying buses in the bus lane while waiting for the crosswalk to clear. Regardless, many municipalities find it impractical to prohibit right turns over the entire length of a curbside bus lane. Alternative strategies to minimize right turn impediments include:

- Restricting right turns to major intersections only, particularly in dense central business districts
- Adding a right-turn lane to the right of the bus lane
- Using queue jump lanes (refer to Section 5.10.2 Queue Jump Lanes) and signal prioritization strategies instead (refer to Section 5.10.4 Traffic Signal Measures for Transit)

C. Interior Bus Lanes

Where it is impractical to prohibit right-turning traffic, on street parking, curbside deliveries, and/or passenger loading activities, an interior bus lane can be considered (also referred to as an offset or floating bus lane). An interior bus lane involves designating the outer-most through lane into a bus lane, while maintaining on-street parking and right-turn lanes. Curbside bus stops or, preferably, curb extension bus stops would effectively serve an interior bus lane, particularly if the street already uses curb extensions at intersection crosswalks. **Figure 32** illustrates an interior bus lane.

Figure 32: *Interior bus lane adjacent to street parking.*



D. Left-Side Bus Lanes

Left-side bus lanes are located on the left curbed lane on one-way streets or the median on two-way streets. They are typically used in situations where a more conventional bus lane configuration is infeasible. Conditions where a left-side bus lane configuration can be used includes bypassing traffic congestion on corridors with few, if any, bus stops such as express routes and Bus Rapid Transit (BRT) corridors, or on a route with an upcoming left turn movement. Left-side bus lanes may require prohibiting general left-turning traffic to avoid delays caused by traffic weaving across the bus lane. If stops are desired on left-side bus lanes, buses with standard right-side doors would need passenger boarding islands located to the right of the bus lane which requires additional right of way and infrastructure and may not be practical on typical urban streets.

Interior bus lane adjacent to street parking. Image by NACTO.

VISIBILITY OF BUS LANE

Painting bus lanes red can help reduce their use by unauthorized vehicles by making the restricted lanes easier to identify and enforce. According to the National Association of City Transportation Officials (NACTO), this treatment can reduce entry of unauthorized vehicles by 30-50%. Colored bus lanes can help maintain the travel time and reliability benefits that bus lanes provide. Colored bus lanes paint should only be implemented on full-time bus lanes and can be used at the beginning of the bus lane, sections of lanes that are bus-only, or for a full bus lane corridor.

WHEN TO USE BUS LANES

Bus lanes are typically used on major urban corridors that have a high volume of traffic volumes, high levels of traffic congestion, and high frequency bus service, such as multi-route, express route, and Bus Rapid Transit (BRT) corridors. Shorter sections of bus lanes can be used, though usually they are paired with other strategies, such as queue jump lanes. However, bus lanes can be paired with many of the strategies provided in this guide.

OTHER CONSIDERATIONS FOR IMPLEMENTING BUS LANES

Section 5.2.1 on Lane Widths provides guidance on the width of bus lanes.

If repurposing an existing lane, particularly a parking lane, the street crown at side streets may need to be flattened. This would help avoid shifting of the bus, which impacts rider comfort.

It is typically desirable to keep buses and bikes separated when it comes to their travel space. However, certain circumstances can lead to implementing shared bus and lanes. Section 5.7 on Bicycle Access and Facilities Adjacent to Bus Stops provides more information on this topic.

Section 5.14 Pavement Markings provides guidance on marking bus lanes. In general bus lanes should be outlined with a solid white line and have a "BUS ONLY") stencil painted in the lane. Section 5.13 covers transit signs, including for bus lanes.

Recommended Resources

Transit Cooperative Research Program (TCRP) Report 183 A Guidebook on Implementing Transit-Supportive Roadway Strategies. Transportation Research Board. 2016. https://www.nap.edu/catalog/21929/a-guidebook-on-transit-supportive-roadway-strategies

American Association of State Highway Transportation Officials (AASHTO) Guide for Geometric Design of Transit Facilities on Highways and Streets. 2014.

Transit Street Design Guide. National Association of City Transportation Officials (NACTO). 2016. https://nacto.org/publication/transit-street-design-guide/

Best Practices in Implementing Tactical Transit Lanes. UCLA Institute of Transportation Studies. 2019. https://www.its.ucla.edu/wp-content/uploads/sites/6/2019/02/Best-Practices-in-Implementing-Tactical-Transit-Lanes-1.pdf

Enhanced Transit Corridors Plan. Chapter 3. Capital and Operational Toolbox. Portland Bureau of Transportation (Oregon). 2018. https://www.portlandoregon.gov/transportation/article/686885

5.10.2 Queue Jump Lanes

Queue jump lanes provide priority treatment for buses along arterial streets by providing buses a lane to bypass traffic queued at signalized intersections. The concept of the queue jump lane is illustrated in **Figure 33**. Queue jump lanes evolved from the need to solve problems not answered by bus turnouts, which introduce significant travel time penalties to bus patrons because buses are delayed while attempting to reenter the traffic stream. Queue jump lanes provide the double benefit of removing stopped buses from the general traffic stream while prioritizing buses through congested intersections, improving travel time and service reliability.

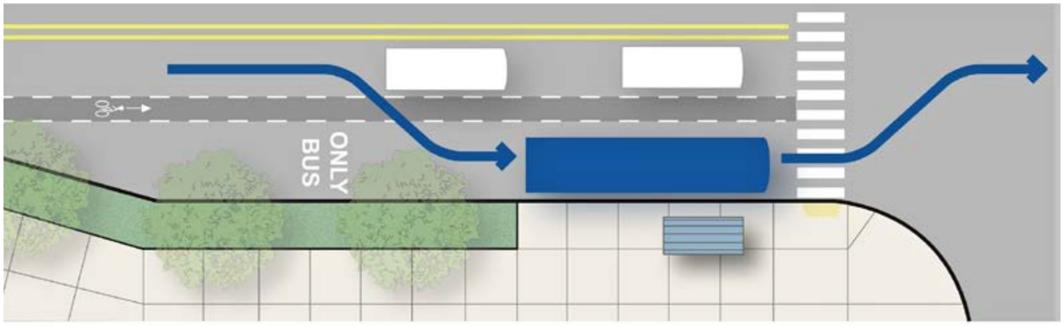


Figure 33: *Basic concept of a bus queue jump lane.*

TYPES OF QUEUE JUMP LANES

The configuration of queue jump lanes depends on whether the associated bus stop is located nearside or farside of the intersection, although they may be used in advance of distant bus stops as a means of improving bus travel time. Depending on the bus stop location, queue jump lanes can be implemented by using bus-only lanes or general-purpose right-turn lanes with an exception for buses to continue through the intersection (using a "Right Turn Only Except Buses" designation). Allowing buses to proceed straight from a right turn only lane at a signalized intersection must consider the following:

- A departure lane, sufficient merging distance, or bus stop must exist on the farside of the intersection for the bus to proceed.
- An exclusive right turn phase (right turn green arrow) cannot be used as the bus may conflict with other movements.
- Right turns on red should be prohibited from the cross street at the farside of the intersection.

Bus-only queue jump lanes require a form of signal prioritization that provides buses a few seconds of green time in advance of the general travel lanes. In all types of queue jump lanes, to be effective, lanes need to be long enough to bypass the congested vehicle queue in the adjacent general-purpose travel lane[4]. The following sections describe the most common types of bus queue jump lanes.

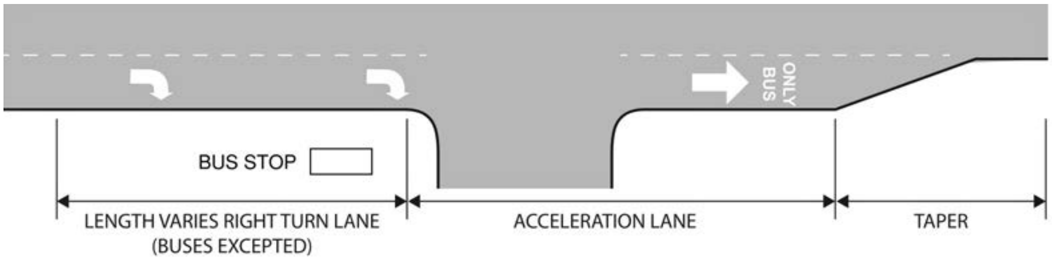
[4] *For planning purposes, 1.5 to two times the average peak-period queue length of the general-purpose lanes may be used to estimate the length of the queue jump lane, which approximate 85th and 95th-percentile queues, respectively. American Association of State Highway Transportation Officials (AASHTO). 2011.*

Bus queue jump from right turn lane with bus signal. Image by BeyondDC.

A. Queue Jump Lane with Nearside Bus Stop

This option includes a bus-only lane or nearside right turn lane (buses excepted), a nearside bus stop, and an optional acceleration lane for buses with a taper back to the general-purpose lanes (**Figure 34**). A separate signal phase is typically provided to give the bus an early green light to move through the intersection before general traffic – generally about 5-10 seconds depending on the amount of time necessary to clear right-turning traffic and for the bus to maneuver into the general-purpose lane. An optional acceleration lane may be provided if right of way is available and its impact on street parking is acceptable. The length of the acceleration lane is based on speed and should be designed to accommodate the acceleration speed of the bus. If a continuous bus-only lane is provided on the farside of the intersection, a farside bus stop is recommended (See Section B).

Figure 34: *Queue jump lane with a nearside bus stop.*



B. Queue Jump Lane with Farside Bus Stop

This option, which is sometimes referred to as a bypass lane, provides the bus stop at the farside of the intersection. This option can cost less, as no bus-only signal prioritization is required. Buses can bypass queues either using a right turn lane (buses excepted) or an exclusive bus queue jump lane as shown in **Figure 35**. Since the bus stop is located farside, a standard transition can be used for buses to re-enter the general-purpose traffic lane.

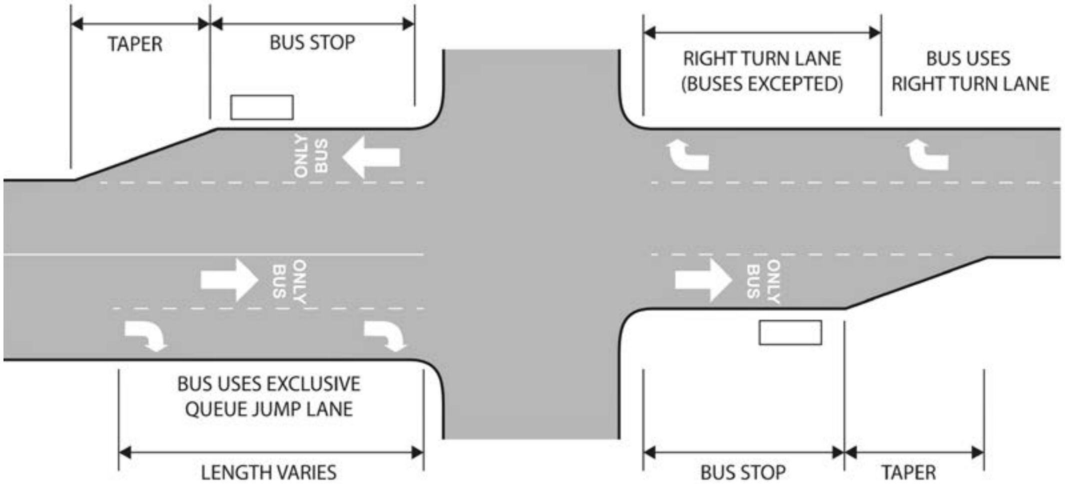


Figure 35: *Queue jump lanes options for a farside bus stop.*

This configuration can be expanded to include a continuous bus lane extending to the next block or further, depending on bus circulation patterns and available width to accommodate an extended bus-only lane as shown in   In most cases, right turns into driveways and intersections are allowable by general-purpose traffic from the bus-only lane. If nearside right-turn volumes exceed 400 vehicles per hour during the peak hour, a separate right-turn lane should be considered for general traffic and a bus-only lane provided for buses approaching the nearside of the intersection, as depicted in **Figure 36**.

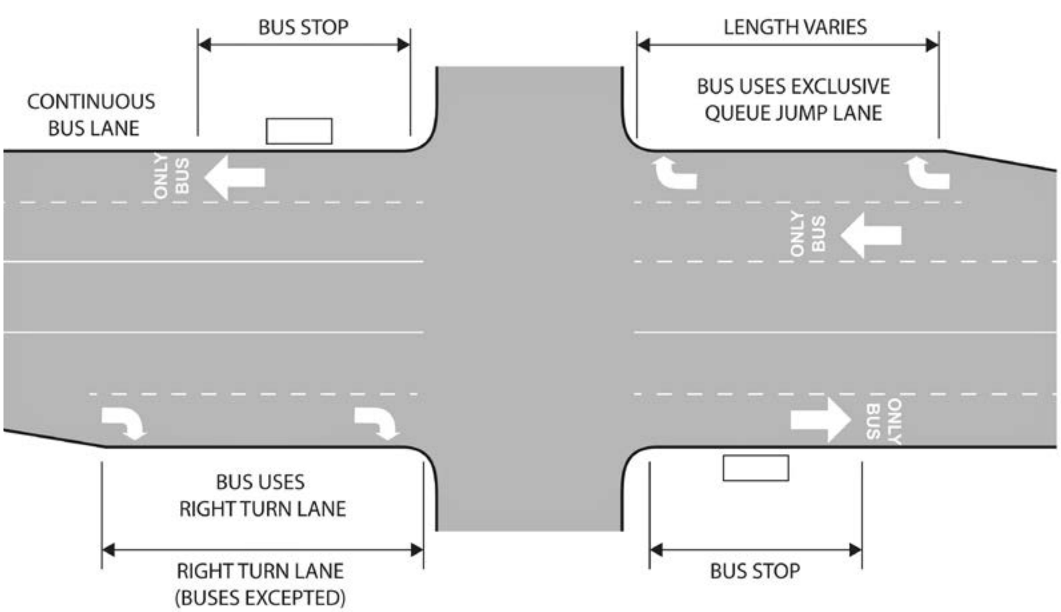


Figure 36: *Queue jump lane options with continuous bus lanes.*

C. Queue Jump Lane without a Bus Stop

Queue jump lanes can be provided at an intersection without a bus stop. Any of the queue jump lane configurations discussed in Section A for nearside bus stops can be implemented for queue jump lanes without a bus stop.

WHEN TO USE QUEUE JUMP LANES

In general, queue jump lanes at arterial street intersections should be considered where:

- Queues form at signalized intersections and operate at an unacceptable level of service (defined by local jurisdiction) that consistently impede buses and impact bus travel time.
- High-frequency bus routes have average headways of 15 minutes or less.
- A right-turn lane exists, or can be built, that extends beyond the typical peak vehicular queue in the adjacent general-purpose through lane.
- Right-turn volumes are relatively low, as high right-turn volumes can impede straight-traveling buses and defeat the purpose of the queue jump lane. Shoulders can be used if wide enough and pavement is designed to accommodate the weight of buses.
- Infrastructure costs and land acquisition are feasible; ideally where existing right-of-way, parking lane, or suitable shoulder is available to create the nearside and farside bus lanes and stops.

The use of Transit Signal Priority (TSP) for general-purpose through lanes is not available, ineffective, or otherwise undesirable from a traffic operations perspective.

When implementing a queue jump lane, a nearside bus stop configuration can provide a high level of efficiency because it can utilize the red time at a traffic signal to load and unload passengers thereby potentially reducing the number of times a bus may need to stop compared to a farside stop, where a bus may need to stop at the signal and again at the farside bus stop.

A farside configuration is best suited when there is a significant number of right turns, there are significant transfers with an intersecting transit route that has a nearside bus stop on the opposite side of the street, or the stop is used for layovers.

Further analysis should be conducted to determine peak period queuing to determine adequate queue jump lane lengths and the queue jump lane's effects on general traffic operations. The analysis should also consider travel time benefits for bus passengers given varying levels of traffic congestion. A benefit/cost analysis may be helpful to weigh the justification of acquiring right-of-way and constructing required infrastructure for this bus priority treatment.

Interactions with bicycles should also be considered. This topic is discussed in more detail in Section 5.7 on Bicycle Facilities Adjacent to Bus Stops.

The resources below provide more information on the planning and design of queue jump lanes as well as guidelines from other transit agencies.

Recommended Resources

Transit Cooperative Research Program (TCRP) Report 183 A Guidebook on Implementing Transit-Supportive Roadway Strategies. Transportation Research Board. 2016. https://www.nap.edu/catalog/21929/a-guidebook-on-transit-supportive-roadway-strategies

Transit Cooperative Research Program (TCRP) Report 19 Guidelines for the Location and Design of Bus Stops. Transportation Research Board. 1996. http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_19-a.pdf

Guide for Geometric Design of Transit Facilities on Highways and Streets. American Association of State Highway Transportation Officials (AASHTO) 2014. https://trid.trb.org/view/1320922

Best Practices in Implementing Tactical Transit Lanes. UCLA Institute of Transportation Studies. 2019. https://www.its.ucla.edu/wp-content/uploads/sites/6/2019/02/Best-Practices-in-Implementing-Tactical-Transit-Lanes-1.pdf

Enhanced Transit Corridors Plan. Chapter 3. Capital and Operational Toolbox. Portland Bureau of Transportation (Oregon). 2018. https://www.portlandoregon.gov/transportation/article/686885

Bus Stop Planning & Design Guide. Massachusetts Bay Transportation Authority (Boston, MA area). 2018. https://cdn.mbta.com/sites/default/files/engineering/001-design-standards-and-guidelines/2018-04-01-bus-stop-planning-and-design-guide.pdf

5.10.3 High Occupancy Vehicle (HOV) Lanes

High occupancy vehicle (HOV) lanes are dedicated lanes for vehicles carrying at least two or more passengers, with the exact minimum number of occupants determined by the operating agency. HOV lanes focus on moving more people rather than more vehicles to combat congestion by incentivizing carpooling, vanpooling and transit with a faster and more reliable dedicated lane, usually along freeways and major arterials.

The focus of moving more people via HOV lanes can pair well with the purpose of transit, especially when a bus-only lane is not feasible or desired, though HOV lanes are not typically implemented solely for the need of improved transit operations. They are usually justified by the occurrence of congestion, and then coordinated with transit needs to maximize their impact.

CONFIGURING HOV LANES

Like bus-only lanes described in Section 5.10.1, HOV lanes can be full-time or during peak periods only, and can be implemented in different configurations depending on several factors including:

- Available right-of-way.
- Road geometries.
- Access to side streets and driveways.

- Traffic volumes and associated congestion.
- Bus operations and stop needs.

The following list the different configuration considerations when implementing HOV lanes.

A. Separated vs. Non-Separated

When HOV lanes are implemented with a freeway, they can be provided with their own separated or buffered facility to help control access, ensuring proper use of the facility. Separated HOV lanes can be implemented as a two-way facility or reversible lane depending on whether there is a major directional travel pattern. These types of facilities often have their own entry/exit ramps to/from the local network. Separated HOV lanes often have a significant cost and usually require more right-of-way to implement.

Non-separated HOV lanes can be implemented on freeways or arterial streets with painted lines and signage. Their implementation is usually less costly, but proper use of the lanes is more difficult to enforce.

B. Inside vs. Outside Lanes

Both separated and non-separated HOV lanes can be implemented on the inside or outside of the roadway. Inside HOV lanes are typically preferred when targeting long-distance travel patterns, which would include express bus routes with infrequent stops. Outside HOV lanes are preferred when targeting shorter trip patterns; however, outside HOV lanes encounter more conflicts with general purpose traffic entering/exiting the roadway at intersections and driveways. Typically, outside HOV lanes on arterials are bus-only lanes that allow general traffic to enter when turning right onto a side street or driveway (see Business Access and Transit Lanes at the end of this section).

C. Full-Time vs. Peak Period(s)

Separated HOV lanes on freeways are full-time facilities. However, if reversible, the facility usually operates during peak periods and is closed during the non-peak periods. Arterial HOV lanes can be full-time or peak period only; however, they can become controversial if not utilized at all times of the day.

Non-separated HOV lanes, whether on freeways or arterials, are typically peak period facilities that can be used by general traffic outside of the designated times. Increased signage and enforcement are often needed to ensure the lanes are used properly during the designated peak periods.

BUS STOPS IN CONJUNCTION WITH FREEWAY HOV LANES

HOV lanes often benefit bus operations that do not require stops, such as express and regional routes, because special transit design elements require less consideration. However, bus stops can be incorporated into all HOV configurations. In California, Caltrans considers two types of transit stops associated with freeway HOV lanes: on-line transit stations and off-line transit stations. Caltrans' HOV guidelines define these two types of transit stations as follows:

- On-line transit stations are bus transfer facilities located contiguous to the HOV facility. They may serve walk-in passengers from nearby residences or park and ride lots, feeder transit lines or nearby activity centers. Transfers between other express buses operating on the HOV facility can also be accommodated.

On-Line stations may produce right of way savings, eliminate costly ramp construction that is necessary for off-line stations and provide maximum time savings. Negative aspects include added noise and air pollution to the users, long walking distances, an increase in transfers between vehicles, and expensive handicap access.

- Platform loading facilities may be in the center of the HOV lanes or on the sides. Center platforms usually require less width, provide for easy transfers, and are less expensive to construct. A major drawback occurs because buses are built to load on the right side of the vehicle. This requires that buses crossover in some manner to orientate themselves for loading. It is necessary for both types that bypass lanes be provided through the platform location to allow other HOVs to proceed without delay.
- Off-line transit stations are bus facilities, which are not contiguous to the HOV facility, but are close enough to receive direct bus service. They could be located at nearby park and ride lots, at large employment centers, or be a major transit center.

A major cost in providing service to an off-line station is the necessity of constructing either direct connector ramps or a drop-ramp facility. There could also be a considerable time penalty involved in serving this type of facility when compared to an on-line station. Many of the problems involving on-line stations such as pedestrian access, platform location, and other amenities can more easily be resolved with off-line stations.

BUSINESS ACCESS AND TRANSIT (BAT) LANES

If buses are frequent and the HOV lanes are outside running on arterial streets with frequent intersections and driveways, a business access and transit (BAT) lane can be considered. BAT lanes are a hybrid between bus-only lanes and HOV lanes. Only buses can travel in the lane continuously, but general-purpose traffic is permitted to use the lane for access to/from cross streets and driveways. BAT lanes often operate as peak period only, with general-purpose traffic permitted to use the lanes outside of peak periods. See also Section 5.2.2 on Bus-Only Lanes and Streets.

Recommended Resources

Best Practices in Implementing Tactical Transit Lanes. UCLA Institute of Transportation Studies. 2019. https://www.its.ucla.edu/wp-content/uploads/sites/6/2019/02/Best-Practices-in-Implementing-Tactical-Transit-Lanes-1.pdf

High Occupancy Vehicle Guidelines for Planning, Design and Operations. Caltrans Division of Traffic Operations. 2018. https://dot.ca.gov/-/media/dot-media/programs/traffic-operations/documents/hov_guidelines-english-edition-jan2018-a11y.pdf

Bus Infrastructure Design Guidelines. TransLink (Vancouver, BC area). 2018. https://www.translink.ca/-/media/translink/documents/plans-and-projects/managing-the-transit-network/bus_infrastructure_design_guidelines-sept_2018.pdf

5.10.4 Traffic Signal Measures for Transit

Signalized intersections can be a significant source of delay for bus operations – around 10 to 20 percent of all bus delay (PACE Transit, 2013). Several signal measures are available to help improve bus efficiency, varying in cost, effectiveness, and impact to overall intersection traffic operations. This section provides a general overview of the primary types of signal measures in common practice. Implementing transit priority signal measures can be a complex and highly technical subject and the practitioner interested in more information on this topic is encouraged to review the resources listed at the end of this section.

TYPES OF TRAFFIC SIGNAL PRIORITY (TSP) MEASURES

Transit Signal Priority (TSP) represents operational improvements that use technology to reduce delay for transit vehicles at traffic signals. The goal of TSP should be to minimize person delay, rather than just vehicle delay, to the extent practical (AASHTO, 2014). Generally, the reduction in delay is achieved by increasing a signal's green time (and/or reducing the signal's red time) on the street providing transit service. Transit priority signal measures are applied across entire transit corridors or entire transit networks as opposed to individual intersections and thus its benefits, and impacts, can be far-reaching. There are two types of TSP, passive and active.

A. Passive Transit Signal Priority

Passive TSP involves developing signal timing plans that account for expected bus operations, often programming signals to a lower speed to match average bus speeds, creating transit-focused signal progression within a corridor whether a bus is present or not, hence the term "passive". To be most effective, using passive TSP requires bus operations along the route to be consistent (timing, number of passengers, speed, etc.). The most common applications of passive traffic signal timing adjustments include:

- Signal retiming in a corridor to reduce delay to all through traffic, including buses.
- Reducing intersection cycle lengths, to reduce the amount of delay experienced by buses when they do have to stop for a red signal.

- Allocating more green time to approaches used by buses (which can potentially include minor-street approaches and left-turn lanes if used by buses).

B. Active Transit Signal Priority

Active TSP involves real-time modification of the signal timing/phasing. There are two general types of systems:

1. **Signal Preemption:**
   Depending on the program algorithm, a bus approaching a downstream traffic signal terminates normal signal operation by extending the green light or advancing the cycle to green, either through transponders or other electronic communications means, to proceed through the intersection. The bus operator determines when signal priority is needed to maintain the bus schedule.
2. **Signal Priority:**
   A bus system equipped with an Automatic Vehicle Location (AVL) system and advanced radio communications gives signal priority control to the operations center, where typically a computerized system determines bus adherence to schedule and automatically triggers timing/phasing adjustments to traffic signals when needed. Pairing with real-time traffic detection systems, referred to as adaptive signal priority, provides additional efficient control of traffic and transit flow. Signal priority can adjust signal timing/phasing in the following ways:
   - Extending the green time to allow an approaching bus to pass through without stopping
   - Triggering an early green to reduce red time for an approaching bus
   - Inserting a new phase into the normal sequence of phases to prioritize an approaching bus
   - Skipping a phase to serve a bus more quickly
   - Adjusting the normal order of signal phases to allow for an approaching bus to proceed

According to the FTA (Transit Signal Priority Planning and Implementation Handbook, 2005), the distinction between transit signal priority and signal pre-emption is an important one because: "signal priority modifies the normal signal operation process to better accommodate transit vehicles, while pre-emption interrupts the normal process for special events such as an approaching transit vehicle.

WHEN TO USE TRANSIT PRIORITY SIGNAL MEASURES

TSP can help make farside bus stops more efficient, both with and without queue jump lanes, by reducing delay associated with waiting at the signal prior to stopping at the farside stop. However, care needs to be taken to ensure the intersection will operate at an acceptable level to allow the bus to take advantage of the prioritization. According to TCRP Report 138, the following intersection characteristics suit TSP best:

- Peak hour volume-to-capacity ratios between 0.6 and 0.9
- Transit ridership is already high or is likely to increase because of implementing TSP.

- Enough buses travel the corridor to justify the need (typically at least 4 buses per hour per direction), but not so many as to trigger the TSP every cycle (if 10+ buses per hour or combined headways are less than 6 minutes, consider passive TSP).

Table 9 compares passive and active TSP applications and considerations.

Table 9: *Comparison of Passive and Active TSP Applications and Considerations*

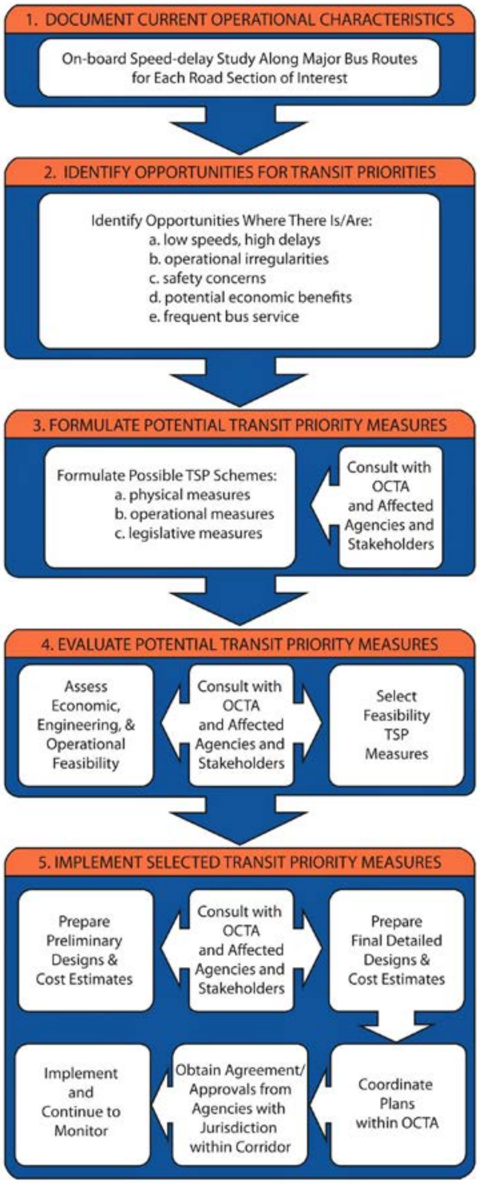
	Passive TSP	Active TSP
Definition	Optimizing traffic signal timing and phasing and corridorwide synchronization to transit speeds.	Modifying traffic signal timing or phasing when transit vehicles are present, using vehicle-to-signal communication.
Applications	• Corridors with high volume of transit vehicles (10 transit vehicles/hour or combined headways less than 6 minutes) • Corridors with short signal cycles or short distances between signals • Corridors with high pedestrian activity • One-way streets • Corridors with alternating farside and nearside bus stops	• Where signals are a major source of delay • Corridors with long signal cycles of long distances between signals • Routes with moderate to long headways • Farside bus stops
Considerations	• Traffic volumes and intersection capacity • Traffic signal spacing • Traffic signal cycle length • Effect on cross street traffic • Where delay at bus stops (such as layovers) is not a factor	• Type and location of bus stop • Where dedicated transit lanes and/or queue jump lanes exist or can be implemented • Traffic volumes and intersection capacity • Traffic signal spacing • Traffic signal cycle length • Effect on cross street traffic
Source: Adapted from Transit Street Design Guide. National Association of City Transportation Officials (NACTO). 2016.		

Both active TSP (signal preemption and signal priority) require advanced signal timing capabilities and additional equipment onboard buses, both of which can be costly to implement and maintain. Passive TSP requires little to no additional capital investment to implement, though more regular retiming may be required to ensure the timing remains effective. Additionally, general traffic can experience unexpected delays and frustrate motorists because the signals are timed for transit.

Using any of the signal measures presented requires coordination with the signal's controlling jurisdiction, as well as with emergency response services to ensure emergency vehicles will still be prioritized over buses. A traffic analysis should be conducted to identify impacts to traffic operations.

Figure 37 presents a conceptual process flowchart for planning, designing, and implementing Transit Signal Priority projects.

Figure 37: *Conceptual process flowchart for planning, designing, and implementing TSP measures. Adapted from Guide for Geometric Design of Transit Facilities on Highways and Streets (AASHTO, 2014).*



Recommended Resources

Transit Cooperative Research Program (TCRP) Report 183 A Guidebook on Implementing Transit-Supportive Roadway Strategies. Transportation Research Board. 2016. https://www.nap.edu/catalog/21929/a-guidebook-on-transit-supportive-roadway-strategies

Guide for Geometric Design of Transit Facilities on Highways and Streets. American Association of State Highway Transportation Officials (AASHTO) 2014. https://trid.trb.org/view/1320922

Transit Signal Priority (TSP): A Planning and Implementation Handbook. ITS America. 2005. https://nacto.org/wp-content/uploads/2015/04/transit_signal_priority_handbook_smith.pdf

Transit Street Design Guide. National Association of City Transportation Officials (NACTO). 2016. https://nacto.org/publication/transit-street-design-guide/

Bus Infrastructure Design Guidelines. TransLink (Vancouver, BC area). 2018. https://www.translink.ca/-/media/translink/documents/plans-and-projects/managing-the-transit-network/bus_infrastructure_design_guidelines-sept_2018.pdf

Enhanced Transit Corridors Plan. Chapter 3. Capital and Operational Toolbox. Portland Bureau of Transportation (Oregon). 2018. https://www.portlandoregon.gov/transportation/article/686885

5.11 Transit Centers

Transit centers are major bus facilities that are designed to accommodate a variety of transit functions, including passenger loading, unloading, and transfers from other bus routes and at train stations. In addition, transit centers can serve as park-and-ride lots (see Section 5.12 on Park-and-Ride Facilities for specific considerations for this type of transit center).

5.11.1 Placement and Design Considerations

Transit centers are appropriate for train stations, large scale developments such as shopping centers, planned communities and major office or commercial developments. The design of transit centers is based on two variables: The individual characteristics of a location and operation needs. Since transit needs and functions vary from location to location, no universal criteria can be developed. It is recommended, however, that transit centers be located as close as possible to the core of activity centers.

A typical transit center layout is shown on **Figure 38**. Depending on the level of service and demand, transit centers could include enclosed buildings and a variety of amenities such as shelters, benches, bus bays, telephones, restrooms, food services, bicycle parking or bike stations, and trash receptacles. Some transit centers may be combined with retail and service establishments and provide shared parking facilities.

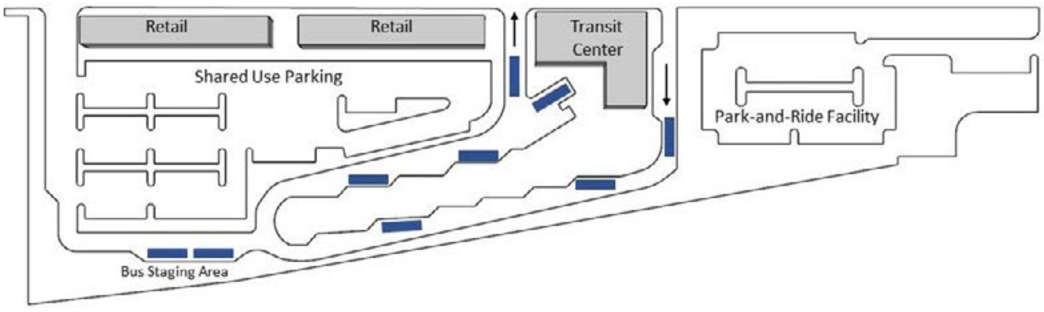


Figure 38: *Conceptual transit center layout with adjacent park and ride facility and shared use parking in adjacent development.*

When planning and designing transit centers there are several key questions the practitioner should consider:

- Location – Where are the buses going to stop within the activity center?
- Identity – How will the transit center location be communicated and how will transit patrons be directed to it?
- Function – What kinds of service will be provided? Will the center serve only destination-oriented services, or will the center be a hub for transfers and express services? Will other modes of public transportation use the center (e.g. Metrolink, taxis, shuttles, other agency vehicles)?
- Size – How may and what kind of buses will the center serve, and will bus layovers or staging be required?

- Pedestrian connections – How will passengers access the center on safe and accessible routes? It is desirable to discourage pedestrians from crossing a center's bus circulating roadways, but usually this is impractical to implement. Will stairs, escalators, and/or elevators be needed? Where, how many, and what types of at-grade crossings and traffic control should be provided?
- Vehicle access – How will buses, and automobiles if the center is also a park-and-ride facility, access the center? Since it is preferable to separate bus and automobile traffic, how will this separation be achieved? Will vehicle access conflict with pedestrians?
- Passenger amenities – What passenger amenities will be provided? What level of seating and/or shelter capacity will be required? Where will bicycle storage be located and at what capacity? Are there local zoning code standards for the placement and capacity of bicycle parking?

Authority staff is available to discuss a site's suitability for a transit center and to assist in addressing the planning and design issues described above.

5.11.2 Typical Transit Center Layouts

The following are common layouts for transit centers. Since sites being considered for a transit center often differ significantly with respect to size and shape, grades, and access to streets, these common types of layouts demonstrate various methods of internal bus circulation, bus capacities, and pedestrian access and waiting areas. The first two types of transit center layouts are representative of off-street facilities, followed by on-street transit centers layouts and a hybrid between the two. In all cases, the bus stop layouts can be directly curbside or in a sawtooth configuration.

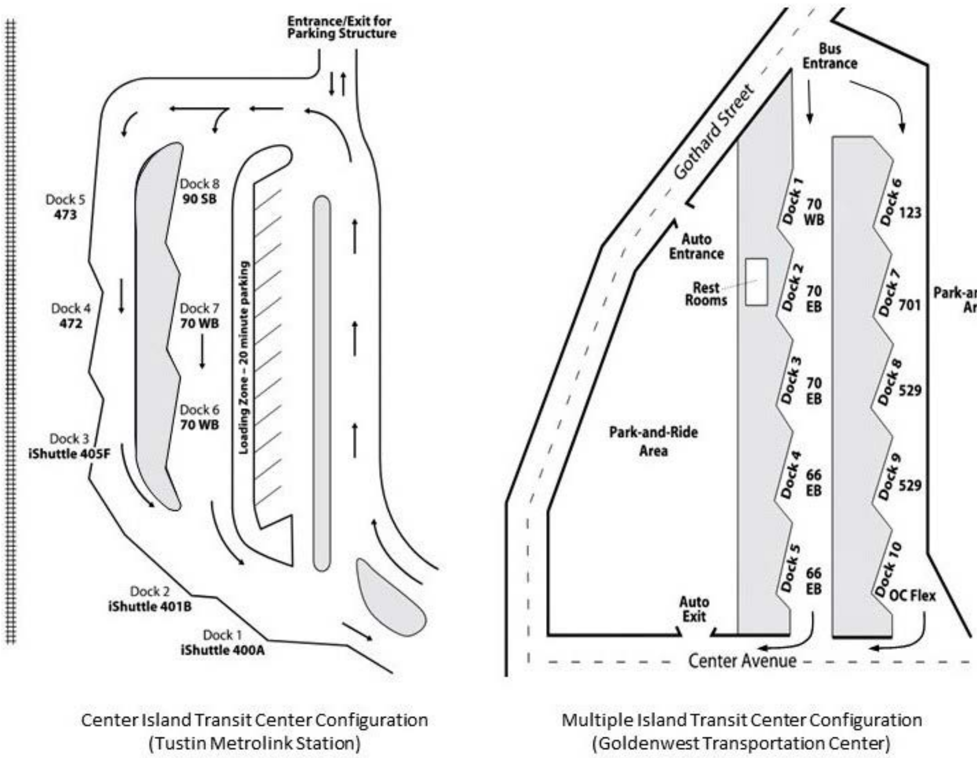
Off-street facilities require more space for buses to turn to/from the facility and are most often used when bus layovers are needed. On-street facilities are often used in physically constrained areas such as downtown settings or adjacent to a train station or major event center.

OCTA transit center at the Anaheim Regional Transportation Intermodal Center (ARTIC).

A. Center Island(s)

Center island layouts involve a clockwise loop around an island at which buses park at designated berths for passenger boarding and alighting. This type of layout is best used when there is a high number of transferring passengers, as they do not need to cross the circulating roadway to complete their transfer. However, pedestrian crossings are needed for those not transferring and should be along the most direct routes pedestrians want to go to avoid jaywalking across the bus circulating roadway. A benefit to this design is space for amenities, especially shelters, which can be accommodated on both sides of the island. A transit center can also consist of multiple center islands used on more compact sites or on sites with one-way circulation. **Figure 39** shows Orange County examples of transit centers configured with a center island and multiple islands.

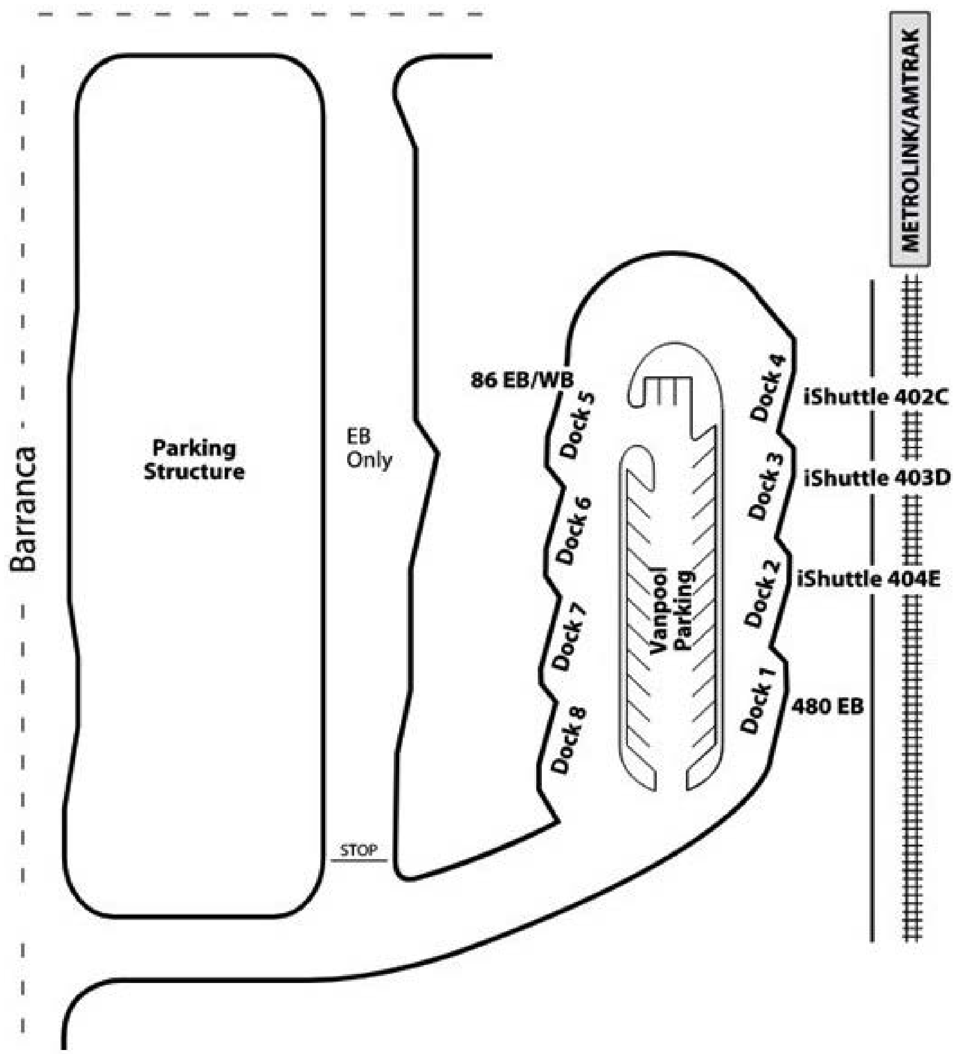
Figure 39: *Examples of center island and multiple island transit center configurations.*



B. Perimeter

The perimeter layout provides bus berths along one or more curbs of a transit drive. A one-way and one-side example is shown in **Figure 40**. Depending on the application, this type of layout can minimize pedestrian crossings of the bus drive, and passenger amenities can be consolidated in one area.

Figure 40: *Example of a perimeter transit center configuration.*



Perimeter Transit Center Configuration
(Irvine Station)

C. On-Street

On-street transit centers (or transfer centers) provide multiple successive bus berths along a dedicated curbside bus lane. This type of layout is often used when there are several routes crossing at an intersection or in front of a major event center, as depicted in the photograph below.

Additional considerations for using the on-street transit center layout include:

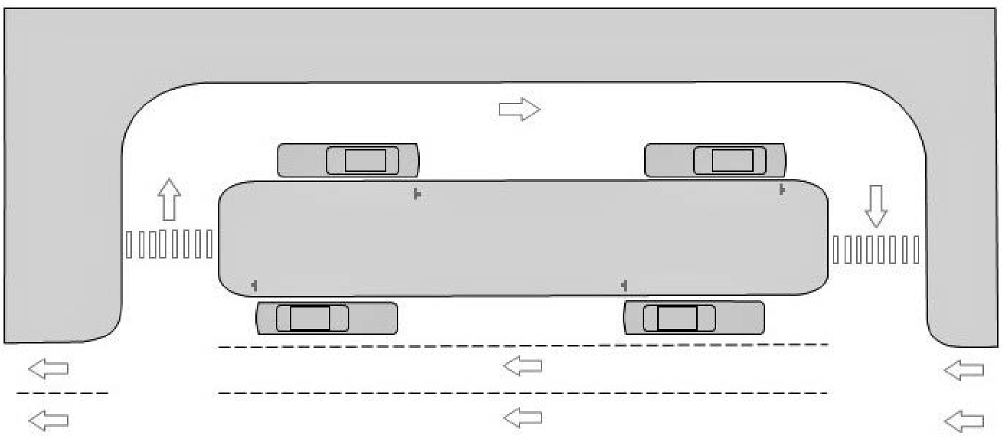
- Providing enough sidewalk space to accommodate both transit passengers and through pedestrians.
- Design elements to discourage jaywalking.
- Coordination with adjacent property owners to address concerns related to frequent bus operations in front of their property including noise, fumes, crowds, and refuse.

D. Hybrid

Off-street configurations and be combined with on-street configurations to form transit centers. These hybrid transit centers are often considered where additional bus stop capacity is needed, such as at older and smaller transit centers or sites with limited off-street space.

For example, a transit center with center islands can have wide enough circulation loops to facilitate bus berths along the perimeter of the transit center's circulating roadway. Another combination is to pair an off-street layout with a row of on-street bus berths. This hybrid if often used when the transit center is adjacent to high frequency and high volume transit routes, with the direction passing directly along the transit center using the on-street berths and the counter direction turning into the adjacent off-street facility, as shown in **Figure 41**.

Figure 41: *Example hybrid transit center configuration.*



Hybrid Transit Center Configuration

BUS BERTH CONFIGURATIONS

There are two general styles of bus berths – areas designed to accommodate multiple transit vehicles – that can be used at transit centers. These styles can be deployed in various ways as part of the layouts explored above. The most common berth styles, parallel curbside and sawtooth, are described in Section 5.3.1 on Bus Stop Configuration Types. **Appendix C** provides technical specifications and drawings for bus stops accommodating multiple vehicles.

Recommended Resources

Bus Infrastructure Design Guidelines. TransLink (Vancouver, BC area). 2018. https://www.translink.ca/-/media/translink/documents/plans-and-projects/managing-the-transit-network/bus_infrastructure_design_guidelines-sept_2018.pdf

Transit Design Guidelines. WeGo Public Transit (Nashville, TN area). 2019. https://www.nashvillemta.org/PDF/WeGoGuidelines021919.pdf

5.12 Park-and-Ride Facilities

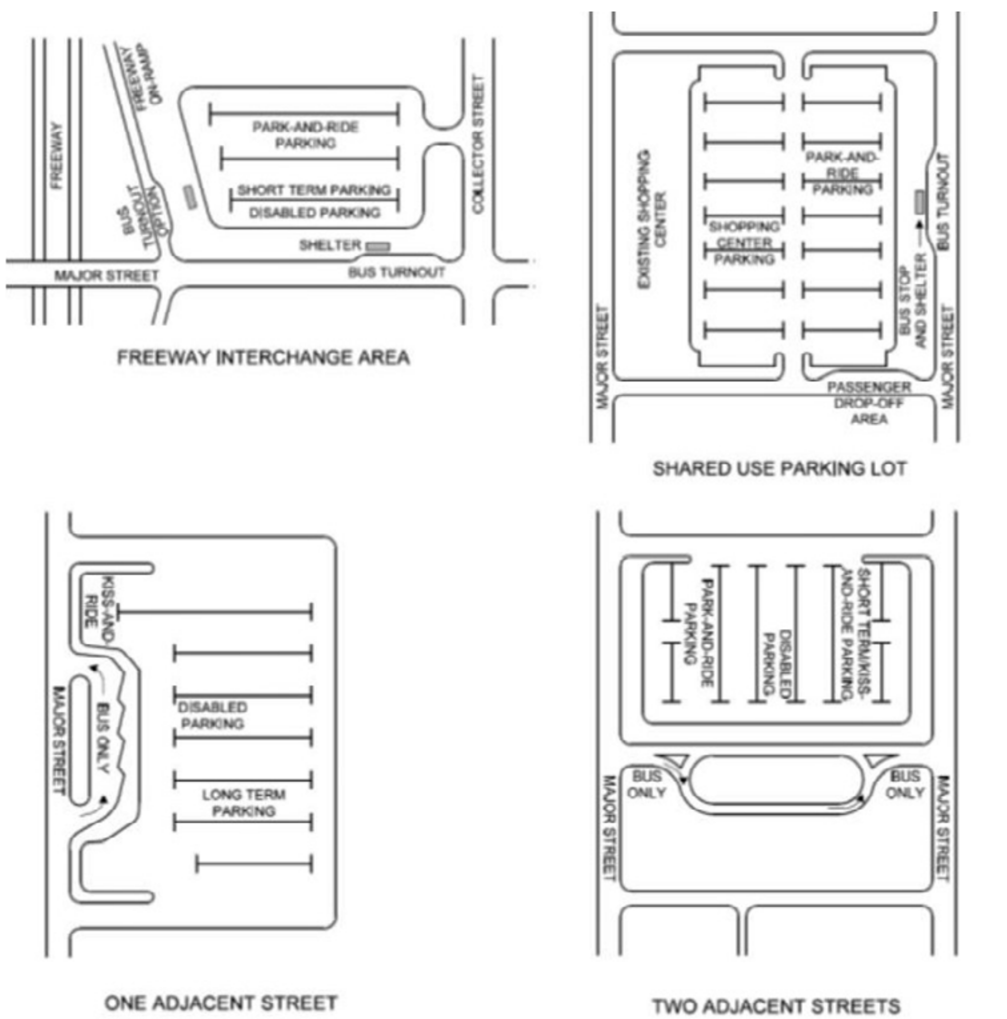
Park-and-ride facilities help facilitate access to transit services for those not within walking or bicycling distance of the service. They pair parking with a transit center (see Section 5.11 on Transit Centers) and are often associated with the end or start of a route, though this is not mandatory.

5.12.1 Design and Placement Criteria for Park-and-Ride Facilities

Park-and-ride lots should be designed according to standard parking lot criteria, including ADA. If combined with a transit center, covered passenger waiting areas or shelters, benches, bicycle storage facilities, restrooms, and pay phones are not necessary at park-and-ride lots. But these amenities may be considered at park-and-ride lots if they are served by a single bus stop. Adequate lighting should always be provided to enhance safety.

The actual design of a shared park-and-ride lot / transit center facility varies due to site and operational constraints. Common shared-use park-and-ride applications are shown on **Figure 42**.

Figure 42: *Conceptual park-and-ride applications.*



General guidelines for placement of park-and-ride lots include:

- Accessible, and as close as possible, to freeways and arterials, especially those with poor vehicular levels of service.
- Proximity to existing or future major traffic generators.
- Near other transportation facilities such as train stations, transportation centers, or mobility hubs.
- Upstream of any consistent sources of traffic delay.

ESTIMATING PARK-AND-RIDE PARKING CAPACITIES

Aside from costs and available land, a sketch-planning process can be used to determine the number of general parking spaces needed (adapted from the Florida Department of Transportation):

1. Estimate the number of motorists that will use the facility.
2. Convert the number of motorists to the number of parked vehicles using either parking demand rates, or data from similar facilities.
3. Adjust the number of parked vehicles to account for fluctuations in demand created by seasonal factors.
4. Compute the maximum accumulation of shared-ride vehicles.
5. Compute the number of accessible spaces required.
6. Convert the total estimated number of spaces to an area measure.
7. Calculate additional space needs for bus facilities, turning radii, and other vehicle circulation design criteria.
8. Develop space allowances for landscaping, setbacks, drainage, and other site design criteria.

For planning purposes, roughly 90-100 spaces can be constructed on an acre of land.

OTHER GUIDANCE

Other guidance for the design of park-and-ride lots include:

- Provide at least 25 parking spaces.
- Where possible, locate the farthest parking stall no further than ¼ mile from the bus stop or transit center boarding areas.
- Ensure clear sight lines between all areas of the park-and-ride facility and the bus stop or transit center boarding areas.
- Consider pedestrian walkways that have a direct pathway, with minimal roadway crossings, to reduce pedestrian/vehicular conflicts.
- Provide long-term bicycle parking in the form of bike racks and storage lockers. At very busy locations, consider providing a bicycle station.
- As much as possible, separate bus and other vehicle flows from each other to maximize efficiency and safety.

More general information on pedestrian and bicycle access at transit facilities is available in Section 5.5 on Pedestrian Access and Section 5.7 Bicycle Access and Facilities Adjacent to Bus Stops.

Occasionally, it makes sense to provide automobile drop-off/pick-up areas at the lot. These areas should, as much as possible, be:

- Located in the passenger vehicle area of the lot.
- One-way circulation.
- Adjacent to the bus stop passenger waiting area.

These areas can also be utilized for facilitating taxi, ride share services, and private shuttle buses. Larger park-and-ride facilities may require dedicated space for queuing of these services, which can be designated with markings and signs to help manage congestion within the parking facility.

In addition to ADA parking spaces, other dedicated parking spaces can be considered as well, including:

- Electric vehicle parking with charging stations
- Van/carpool
- Car share

5.12.2 Park-and-Ride Programs

Two types of park-and-ride programs exist in Orange County: 1) Shared use lot; 2) Permanent lot programs. The following is a brief description of each type of park-and-ride program. For more information on these park-and-ride programs, please contact OCTA at (714) 636-RIDE or (800) 636-RIDE if you are in South Orange County. For more information regarding the shared-use park-and-ride program, call Caltrans at (714) 724-2240.

A. Shared Use Park-and-Ride Program

The shared-use program is administered by the California Department of Transportation (Caltrans). The Authority works closely with Caltrans to recruit new participants. Shared-use lots are portions of other parking lots where space has been dedicated for use by commuters.

Caltrans offers a $3 million liability policy to protect property owners who make a portion of their parking lots available for shared-use park-and-ride facilities. In addition, Caltrans posts signs with the name of the program participants to guide commuters to the lots. Caltrans also makes minor improvements to the park-and-ride section of the lot when necessary.

Considering the growing demand for park-and-ride lots and the limited amount of space for constructing new ones, it is recommended that shared-use lots be provided at sites such as shopping centers and employment centers. These parking lots, which are intended for use by residents of the immediate community, help mitigate the traffic impacts of the development and conserve energy resources.

B. Permanent Park-and-Ride Facility Program

The permanent park-and-ride program is administered by OCTA. The Authority identifies areas where the demand for park-and-ride lots is on the rise and seeks to have new facilities built or dedicated. Often the construction of permanent park-and-ride lots is a cooperative effort involving OCTA, Caltrans, local agencies, and developers.

Recommended Resources

State Park-and-Ride Guide. Florida Department of Transportation, Office of Freight, Logistics and Passenger Operations, Transit Office. 2012. https://www.fdot.gov/docs/default-source/transit/pages/finalparkandrideguide20120601.pdf

Transit Design Guide: Standards & Best Practices. Capital MTA (Austin, TX area). 2014. https://capmetro.org//docs/default-source/plans-and-development-docs/transit-oriented-development-docs/transit-design-guide.pdf?sfvrsn=f7e538aa_2

5.13 Mobility Hubs

As described in OC Transit Vision's Transit-Supportive Design and Policy Handbook, mobility hubs are places where multiple modes of transportation come together, providing seamless connections to the transit system and between modes. The emerging best practice is to provide fully featured "mobility hubs" at transit centers including elements such as "bike stations" with secure bike parking, repair, and rental facilities (and extensive rider amenities, such as showers); bikeshare docks (if a local system exists); carshare vehicles; a staffed or unstaffed traveler information kiosk with integrated information on all modes serving the transit center; retail spaces such as a café; public restrooms; and placemaking features such as plazas, art, and landscaping (**Figure 43**).

Together with other access elements including stops for connecting transit, park-and-ride lots, and pedestrian and bicycle routes through the site, mobility hubs can ensure that transit riders have access to a wide range of options for first/last mile connectivity, greatly increasing the range and utility of transit routes serving the transit center.

Figure 43: *Elements of a Mobility Hub. Source: SANDAG.*

5.14 Signs and Pavement Markings

5.14.1 5.5.A – Regulatory Transit Signs

Regulatory signs for transit provide information on required or prohibited movements, lane or signal phase dedication, and exemptions for buses. They help with the enforcement of several of the transit priority measures provided in this document. Regulatory transit signs denote whether a condition is always active or is active only during certain hours and can be accompanied by flashing beacons or be activated blank-out signs to help increase awareness and understanding. The signs are to be mounted on sign poles, signal mast arms, and/or overhead and are often complemented with pavement markings (see Section 5.14 Pavement Markings).

The California Manual on Uniform Traffic Control Device (CA MUTCD) is the State's standard on the selection, placement and use of regulatory signs. Some signs presented in this section are recommended by national design guides such as the NACTO Transit Street Design Guide and, therefore, may not be applicable as a regulatory sign in California. However, many transit-related signs used nationally can usually be adapted for use in California or at least used experimentally with permission of the Federal Highway Administration and/or the California Transportation Commission. The resources listed at the end of this section should be consulted for detailed use requirements. The following provides an overview of commonly used regulatory signs and their general application.

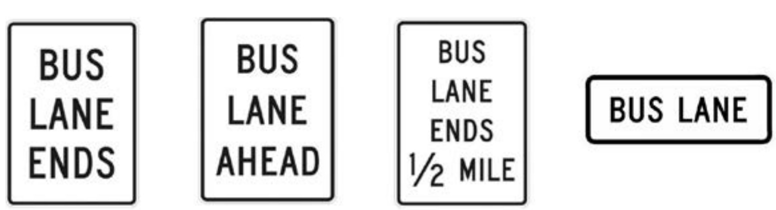
SIGN TYPES

Transit signs have been grouped into the following categories based on their source and characteristics.

A. Standard MUTCD Transit Signs

The national version of the MUTCD provides several standard signs for designating dedicated bus lanes. These signs are classified as "Preferential Lane" signs and may be applicable to other vehicles legally allowed in a restricted lane including taxis and bikes. Signs in **Figure 44** are to alert drivers to the beginning or end of a bus lane, whether that lane is transitioning to/from a general-purpose lane or is ending, and traffic must merge. **Figure 44** also shows a "BUS LANE" plaque, used when a lane regulation applies to the bus lane, such as requiring the bus lane to turn right. The plaque is typically placed above or under the regulation sign to state that the regulation only applies to the bus lane.

Figure 44: *Bus lane alert signs-pole/signal mast arm mounted (MUTCD).*



R3-12f R3-12g R3-12h R3-5gP

Figure 45 shows both pole/signal-mast (R3-11b) and overhead mounted (R3-14c) examples of signs for part-time bus lanes, which denote the active period(s) of the lane designation. The overhead version demonstrates how a lane can have several preferential assignments. This sign can be used for buses only and for shared bus-bike lanes.

The national MUTCD and the California MUTCD provide sign variations to mark the location of the bus stop/pad and prevent other vehicles from parking or stopping in the designated area (**Figure 46**).

B. Additional MUTCD Transit Signs

The CA MUTCD provides several more specialized bus lane signs (SR60 series) specifically for when the right lane of a street is reserved as bus lanes or shared bus and taxi lane either full-tome or part-time, as shown in **Figure 47** The CA MUTCD also provides signs that give buses (and HOV) an exemption from left-turn restrictions during specific hours or at ramp meters as shown in **Figure 48**.

Figure 45: *Part-time bus lane alert signs (CA MUTCD).*

R3-11b R3-14c

Figure 46: *No parking / stopping signs to delineate bus stop zones (CA MUTCD).*

R7-7 R7-107 R28C (CA)

Figure 47: *Other specialized bus lane signs (CA MUTCD).*

SR60-8 (CA) SR60-3 (CA) SR60-5 (CA) SR60-1 (CA) SR60-2 (CA)

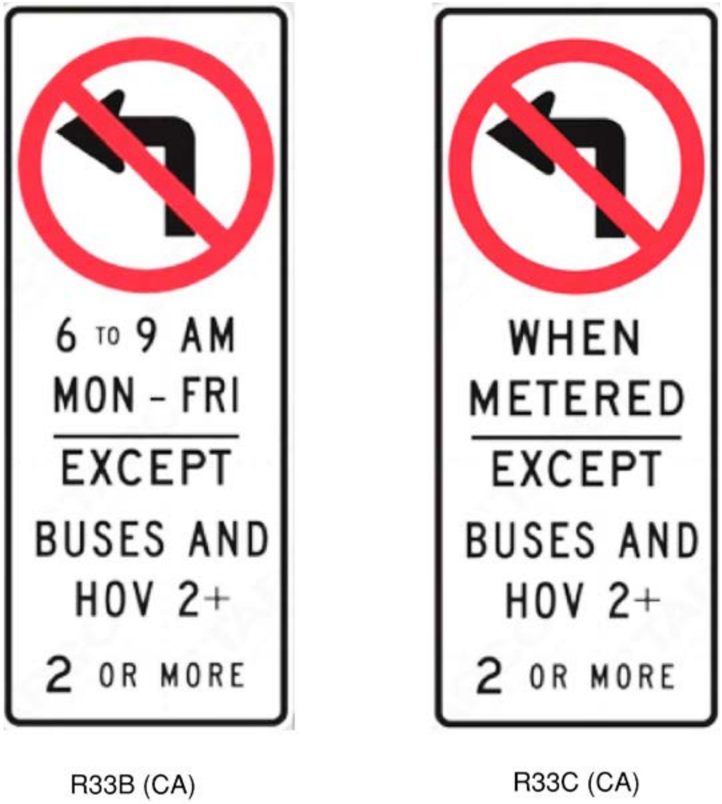


Figure 48: *Signs exempting buses from turn restrictions (CA MUTCD).*

C. Other Sign Options

TRCP 183 and NACTO recommend that if bus signal heads are provided at an intersection, such as when controlling bus-only lane or a queue jump lane, a sign to denote what this signal is should be provided to avoid confusion by unfamiliar motorists. In addition, NACTO states that signing should indicate when a turn is restricted but buses are exempt from the restriction, whether the restriction is full-time or part-time. Examples of this condition include when a right-only turn lane is shared as a queue jump lane for buses accessing a farside bus stop or when left turns are prohibited during rush hours except for buses. These situations involve placing an “EXCEPT BUS” or “BUSES EXEMPT” plaque below the restriction sign. The California MUTCD does not include these signs, so in California these signs are typically customized and implemented by local agencies.

Recommended Resources

California Manual on Uniform Traffic Control Devices (CA MUTCD), Chapter 2G. Preferential and Managed Lane Signs. FHWA and Caltrans. 2014. https://dot.ca.gov/-/media/dot-media/programs/safety-programs/documents/ca-mutcd/rev6/camutcd2014-rev6.pdf

Transit Street Design Guide. National Association of City Transportation Officials (NACTO). 2016. https://nacto.org/publication/transit-street-design-guide/

5.15 Bus Stop Pavement Markings

The California Manual on Uniform Traffic Control Devices (MUTCD) instructs and provides guidance on the use of pavement markings for preferential lanes and managed lanes, but it does not provide standard pavement markings specifically for bus stops. The following provides information on unique transit situations where words and symbols marked on the pavement should be used in travel lanes and at bus stops. The MUTCD requires that these markings be white and laterally in the center of the lane unless otherwise noted. Information on striping lanes can be found in Section 3D.02 of the California MUTCD.

5.15.1 Bus Lanes

When lanes are dedicated to buses full-time or part-time, applying the "BUS ONLY" pavement marking is an effective way to communicate and enforce the restriction and should be used. Circumstances occasionally arise where it makes sense to have bikes share a bus-only lane. More information on how to stripe this type of shared lane, and other bicycle-related markings, is provided in Section 5.7 on Bicycle Access and Facilities Adjacent to Bus Stops. In terms of denoting a shared bus-bike lane, the marking text should read "BUS BIKE ONLY".

The spacing for providing these markings is left to engineering judgement with supporting markings spaced as close as 80 feet apart on city streets. The MUTCD states that the following be considered when making this determination:

- Prevailing speed.
- Block lengths.
- Distance from intersections.

Additionally, the MUTCD recommends markings be placed where decision points or other locations where "factors that affect clear communication to the road user" exist.

Red paint can also be used to complement the above pavement markings to make the bus-only nature of the lane more visible. Red painted bus lanes are not addressed in the current version of the California MUTCD but are in use in larger cities across the United States. More information on this treatment is provided in Section 5.10.1 Bus Lanes.

Red painted bus lanes. Image by BeyondDC.

5.15.2 Bus Stop Pavement Markings

Since the California MUTCD does not address pavement markings for bus stops, it is the responsibility of OCTA and the local agency to identify the bus stop with pavement markings, if so desired. At a minimum a bus stop signpost, “No Stopping Any Time” signs, and/or red painted curbs should be used to delineate bus stops and their associated deceleration and acceleration zones.

Marking the location of bus stops with lateral striping and “BUS” text markings can help keep them clear of intrusions such as parked passenger vehicles. However, bus stop edge lines and adjacent bike lane markings (if needed) should conform with California MUTCD standards. Providing bus stop striping should be considered when:

- Stop bay is entirely outside of the travel lane.
- On-street parking (both long and short term) is permitted adjacent to the stop.
- When the bus stop is located at the nearside of an intersection and is frequently used by right turning vehicles.
- Locations that are prone to or could likely be obstructed by non-transit vehicles, including those in areas with complex parking/loading restrictions and/or curb designations that can confuse drivers.
- The stop is likely to remain in the location long-term.

Figure 49 illustrates typical pavement markings used to identify a bus stop.

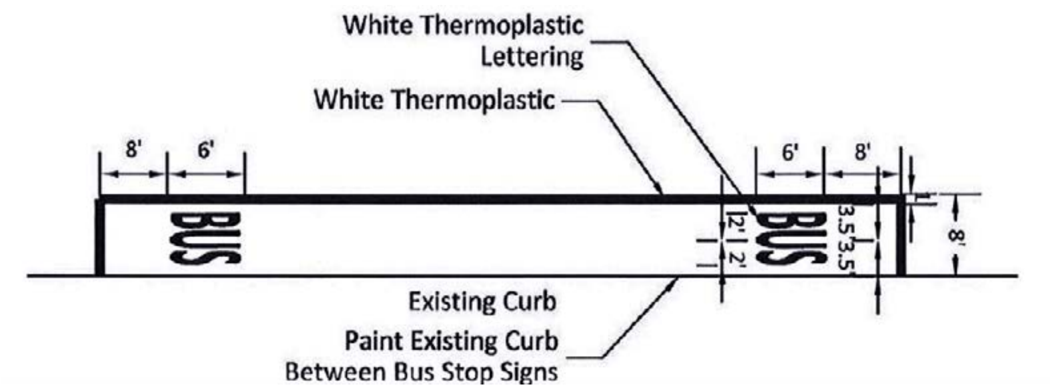


Figure 49: *Typical bus stop pavement markings.*

NACTO suggests that, in addition to no parking signs and red curbing, deceleration and acceleration zones can be denoted with diagonal striping to keep clear zones for buses to enter/exit a bus stop.

Recommended Resources

California Manual on Uniform Traffic Control Devices (CA MUTCD), Chapter 2G. Preferential and Managed Lane Signs. FHWA and Caltrans. 2014. https://dot.ca.gov/-/media/dot-media/programs/safety-programs/documents/ca-mutcd/rev6/camutcd2014-rev6.pdf

Transit Street Design Guide. National Association of City Transportation Officials (NACTO). 2016. https://nacto.org/publication/transit-street-design-guide/

5.16 Passenger Information Signs

Many of the signs at a bus stop are for passengers; however, most are related to identifying routes, bus stop schedules or wayfinding. Section 5.17 on Wayfinding Information provides more information on this type of passenger information. This section provides information on non-wayfinding signs such as real-time arrival/departure information and passenger warning signs.

5.16.1 Real-Time Arrival/Departure Signs

The addition of websites and smartphone apps that provide real-time tracking of buses is made possible by GPS-enabled buses. This same information can be relayed to passengers at larger bus stops such as transit centers and park-and-rides, or at high-frequency stops, via real-time arrival/departure signs. Such signs provide passengers with increased confidence of their travel plans. OCTA is currently conducting a pilot program for several real-time mobile apps.

The signs are provided in the form of monitors and/or displays. Displays at bus stops or at bus berths in transit centers on on-street transfer centers and usually list the next arrival of the routes serving the stop or berth. These real-time information signs are commercially available systems and can be designed into the bus stop or bus berth shelter or mounted on walls, columns, or posts.

At transit centers or park-and-ride facilities in centrally located areas, monitors often provide arrival/departure information for all routes in the system. Some transit agencies also provide kiosks that distribute this information along with digital copies of wayfinding information such as system maps and timetables, and trip planning tools. Kiosks enable those without smartphones to access these new planning tools.

To the extent possible, real-time kiosks should provide a means to access any internet-based real-time information such as a real-time tracking website or app. This can be done by displaying URLs and/or QR codes that can take a user to the website or app store location.

5.16.2 Other Passenger Information Signs

Some bus stops, particularly transit centers and park-and-rides, may require warning signs for passenger safety and/or facility security. Such signs can include warnings such as:

- Watching for moving buses or crossing bus circulation roadways.
- Prohibiting activities such as skateboarding on a stop platform.
- Phone information for reporting suspicious activity (911) or maintenance needs.
- Areas restricted for transit authority staff or law enforcement only such as parking spaces close to transit centers.

Recommended Resources

Transit Street Design Guide. National Association of City Transportation Officials (NACTO). 2016. https://nacto.org/publication/transit-street-design-guide/

Transit Design Guide: Standards & Best Practices. Capital MTA (Austin, TX area). 2014. https://capmetro.org//docs/default-source/plans-and-development-docs/transit-oriented-development-docs/transit-design-guide.pdf?sfvrsn=f7e538aa_2

Bus Stop Planning & Design Guide. Massachusetts Bay Transportation Authority (Boston, MA area). 2018. https://cdn.mbta.com/sites/default/files/engineering/001-design-standards-and-guidelines/2018-04-01-bus-stop-planning-and-design-guide.pdf

Transit-Supportive Guidelines. Ontario Ministry of Transportation (Canada). 2012. http://www.mto.gov.on.ca/english/transit/pdfs/transit-supportive-guidelines.pdf

5.17 Guide and Wayfinding Information

Wayfinding signs guide users to transit facilities and direct them once they are in the facility, specifically to the correct stop or berth. This section addresses the following:

- Guide signs on roadways directing transit users to park-and-ride facilities but also transit centers and train stations.
- Transit system information that provides riders with route system, individual routes, and schedule information.
- Transit facility wayfinding information to direct riders to the correct bus stop or berth.

Points of interest wayfinding directing people to nearby places is mentioned in this section, but the topic is outside of the scope of these guidelines. Practitioners interested in general wayfinding should consult the references provided at the end of this section.

5.17.1 Bus Facility Wayfinding

Figure 50: *Park and ride and bus facility wayfinding guide signs (CA MUTCD).*

The following signs are available for providing wayfinding to bus facilities.

A. Standard California MUTCD Bus and Park-and-Ride Guide Signs

The California MUTCD provides two standard transit-specific guide signs for bus facility wayfinding: a park-and-ride directional sign (D4-2) and a bus symbol sign (I-6), which is usually paired with another sign (such as an overhead freeway sign) to associate the bus facility with other guide signs. These signs are shown in **Figure 50**.

B. Additional CA MUTCD Bus Wayfinding Guide Signs

The CA MUTCD provides additional bus facility related signs (**Figure 51**) such as park-and-ride signs for overhead mounting.

5.17.2 Bus Stop and Transit Facility Wayfinding

Standard OCTA bus stop signs (as covered in Section 5.15. Passenger Information Signs) provide stop and route information. However, larger bus stops with more than one route – particularly transit centers and park-and-ride lots – can benefit passengers by providing additional system and route information, directions to bus stops, and guidance to relevant points of interest nearby. These signs help orient passengers who may not be familiar with the stop or the transit system. The following describes different types of bus stop wayfinding information. Note that no matter the type of information presented, signs should maintain a similar style and branding to make them easily identifiable.

Figure 51: *Additional park and ride and bus facility wayfinding guide signs (CA MUTCD).*

A. Transit System Wayfinding

Despite most of this information being available online and accessible via smartphones, having physical signs providing information on the transit system ensures all passengers, regardless of their technological access, can have access to current information.

These signs can consist of:

- Strip maps of single routes.
- Fixed schedules and/or frequencies.
- Full system maps.
- Transit facility layouts.
- Transfer maps/schedules.

The following guidance is provided for these types of signs:

- Sign information should be designed to be consistent with other ways to access the same information, such as on the Authority's website or pamphlets obtained on transit vehicles.
- Maps/layouts should be oriented in the direction corresponding to the location and orientation of the passenger.
- To the extent possible, maps/layouts should note where the passenger is currently in relation to the rest of the map, taking care not to clutter the map.
- Protect signs from the weather and vandalization, and in such a manner that the content can easily be replaced with current information.

B. Bus Stop Wayfinding

At larger stops such as transit centers, park-and-ride lots and train stations, the arrangement of stops can be spread out and complex, especially to an unfamiliar user. The following guidance is provided for bus stop related wayfinding signs:

- Wayfinding signs should be provided when the opposite direction stop is at another location, such as the opposite one-way street of a couplet.
- Multi-stop facilities, especially those where stops/berths are shared by more than one route, should have letter or number designations clearly shown to help in guiding passengers to the correct stop/berth.
- Temporary signs, such as route/schedule changes, should be protected from weather conditions and securely mounted to permanent or temporary signposts.

C. Points of Interest Wayfinding

Some bus stops serve significant points of interest such as museums, healthcare, parks, event centers, government services, major education, and employment campuses, as examples. Providing wayfinding with distance and/or estimated travel time can help passengers make more informed travel decisions. These signs also can act as gateways to the surrounding area. Providing similar signs to other transportation services also helps passengers with their travel decisions. These can include wayfinding to nearby services such as:

- Bike share of bicycle station facilities.
- Taxi and ride-share services.
- Other transit system stops or modes such as private shuttles.

Recommended Resources

California Manual on Uniform Traffic Control Devices (CA MUTCD). FHWA and Caltrans. 2014. https://dot.ca.gov/-/media/dot-media/programs/safety-programs/documents/ca-mutcd/rev6/camutcd2014-rev6.pdf

Transit Street Design Guide. National Association of City Transportation Officials (NACTO). 2016. https://nacto.org/publication/transit-street-design-guide/

Appendices

OCTA
Orange County Transportation Authority
5753
CNG
OCbus.com
CA 43438

Appendix A
OCTA Revenue Fleet Specifications

OCTA FLEET BOOKLET

DRAWINGS AND TECHNICAL DATA

REVENUE FLEET

NEW FLYER, EL DORADO

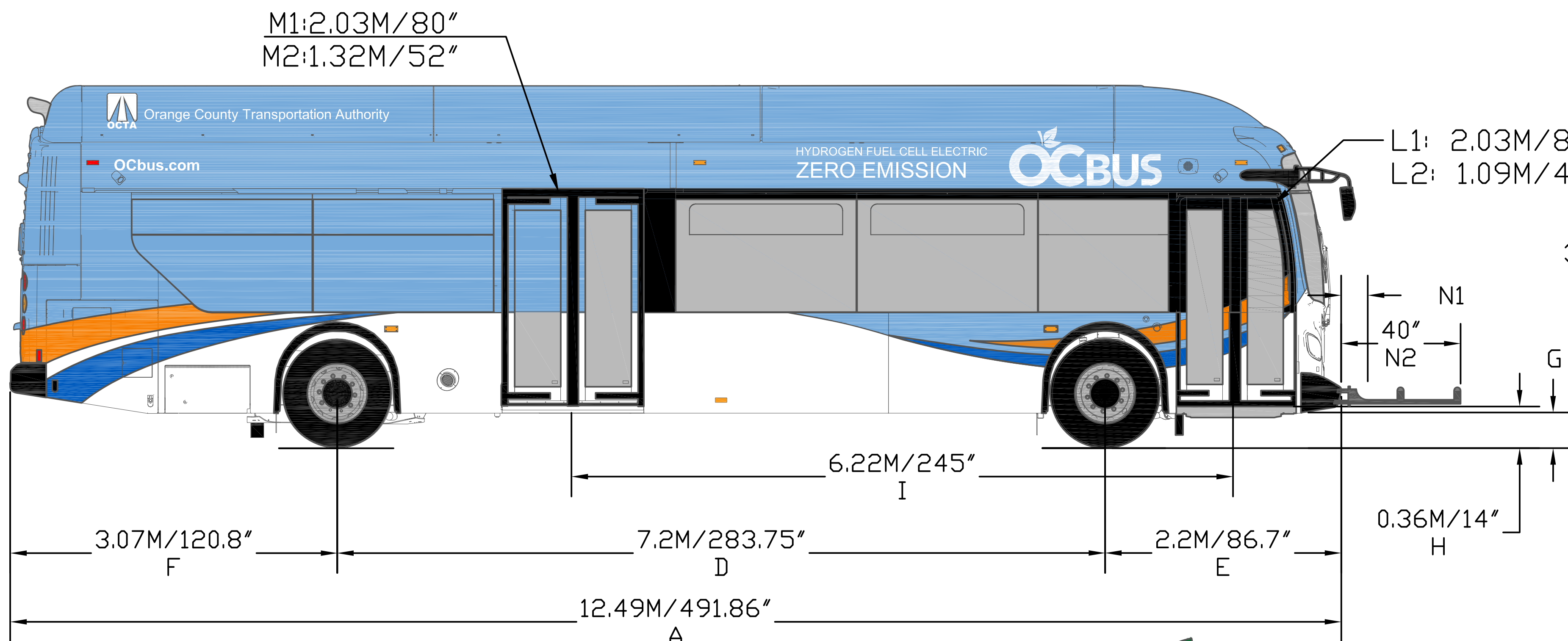
1997 - 2019

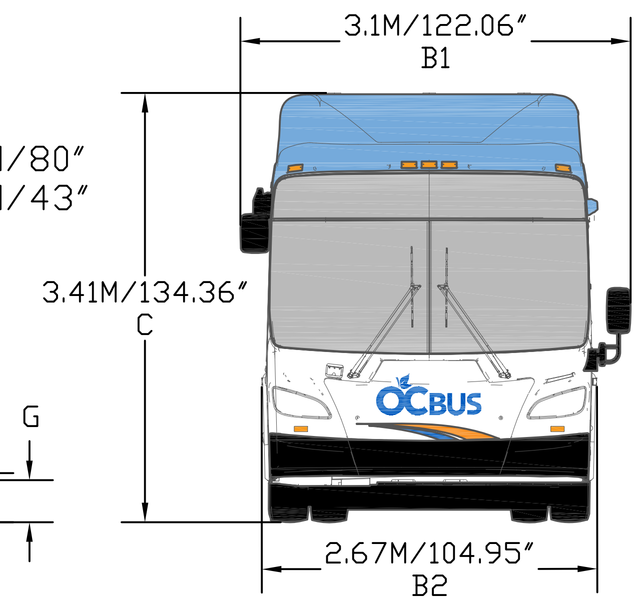
REVISION JUNE 2019

TABLE OF CONTENTS

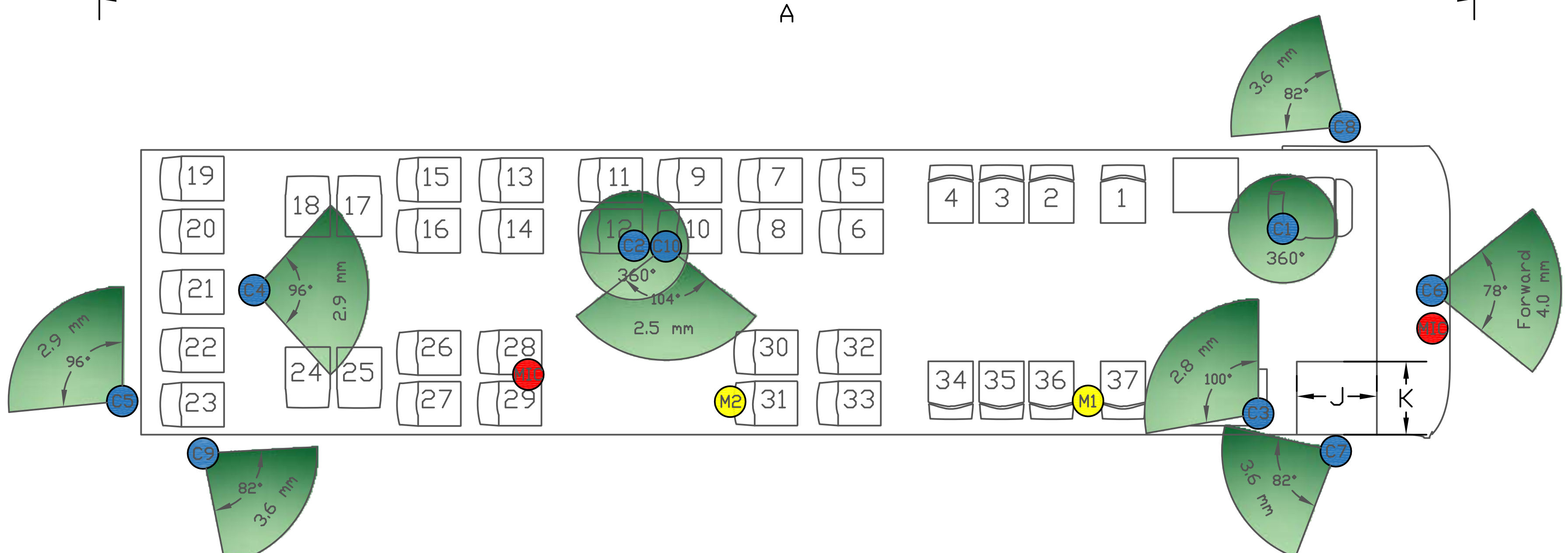
2018 NEW FLYER HYDROGEN FUEL CELL

FUEL / CAP.	FUEL CELL	SERIES	QTY	REV.
H2 / 37.5 kg	Ballard FC Velocity - HD V.7	1111-1120	10	JUNE 2019





ANGLES
APPROACH: 9°
BREAKOVER: 9°
DEPARTURE: 9°



A LETTER/LETTERS MAY BE MISSING IN THE DRAWING	
A	OVERALL LENGTH
B1	OVERALL WIDTH (WITH MIRROR)
B2	OVERALL WIDTH (WITHOUT MIRROR)
C	OVERALL HEIGHT
D	WHEEL BASE LENGTH
E	FRONT OVERHANG
F	REAR OVERHANG
G	FRONT BUMPER DISTANCE TO GROUND
H	FIRST STEP DISTANCE TO GROUND
I	CENTER LINE FRONT DOOR TO REAR DOOR
J	WHEEL CHAIR LIFT WIDTH
K	WHEEL CHAIR LIFT EXTENSION
L1	ENTRANCE DOOR HEIGHT (CLEARANCE)
L2	ENTRANCE DOOR WIDTH (CLEARANCE)
M1	EXIT DOOR HEIGHT (CLEARANCE)
M2	EXIT DOOR WIDTH (CLEARANCE)
N1	BIKE RACK STOWED LENGTH
N2	BIKE RACK DEPLOYED LENGTH

TOTAL # OF SEATS: 37 PASSENGERS
TOTAL # OF STANDEES: 43 PASSENGERS

CAMERAS · MICROPHONES · MOTION SENSORS · INRA-RED

OCTA

Tolerances
For all dimensions in inches ±1″

DRAFTING STANDARD ASME Y14.5

2018 NEW FLYER HYDROGEN FUEL CELL

DRAWN ARIANA CURRIM

REVISION 6/14/2019

SIZE 11" X 17"

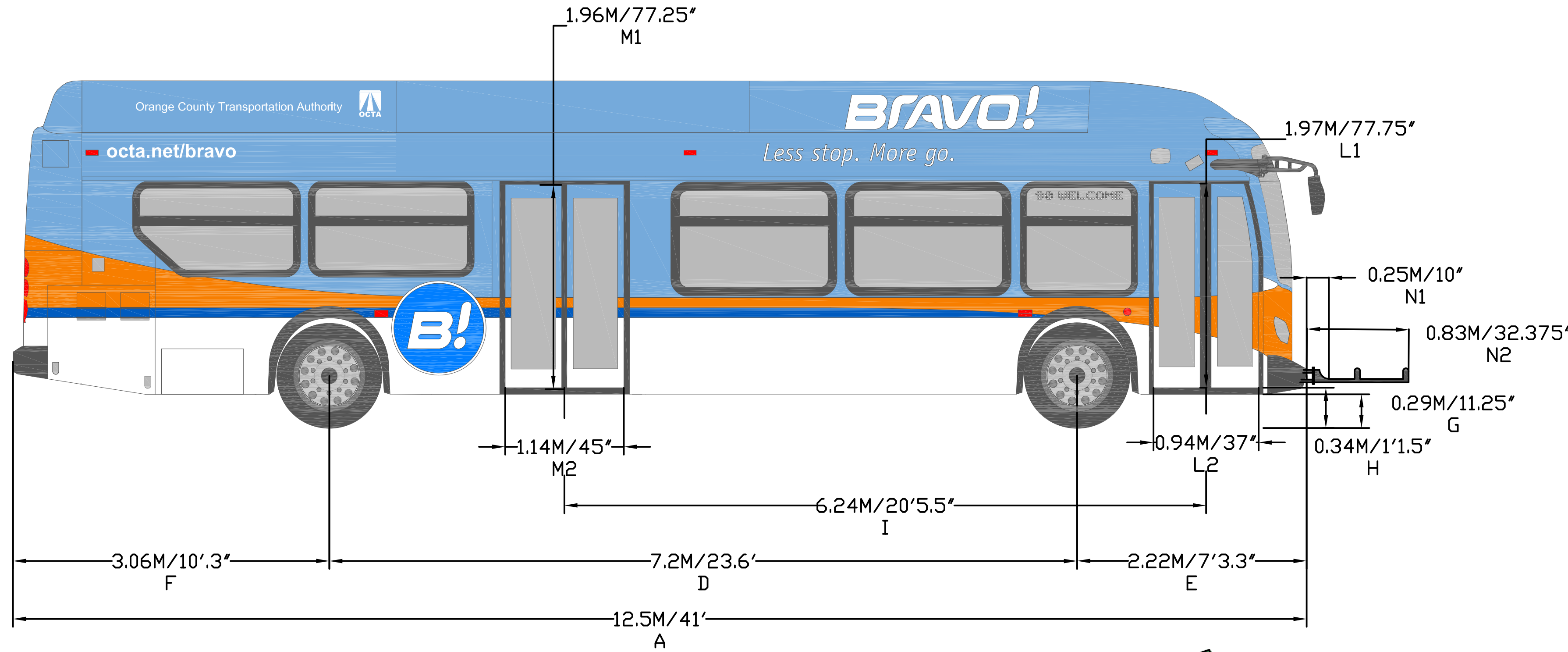
DWG NO.

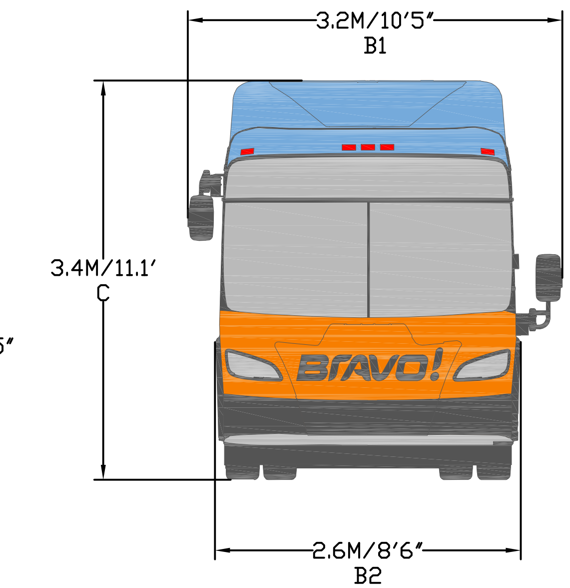
SCALE DO NOT SCALE

SHEET 1 OF 19

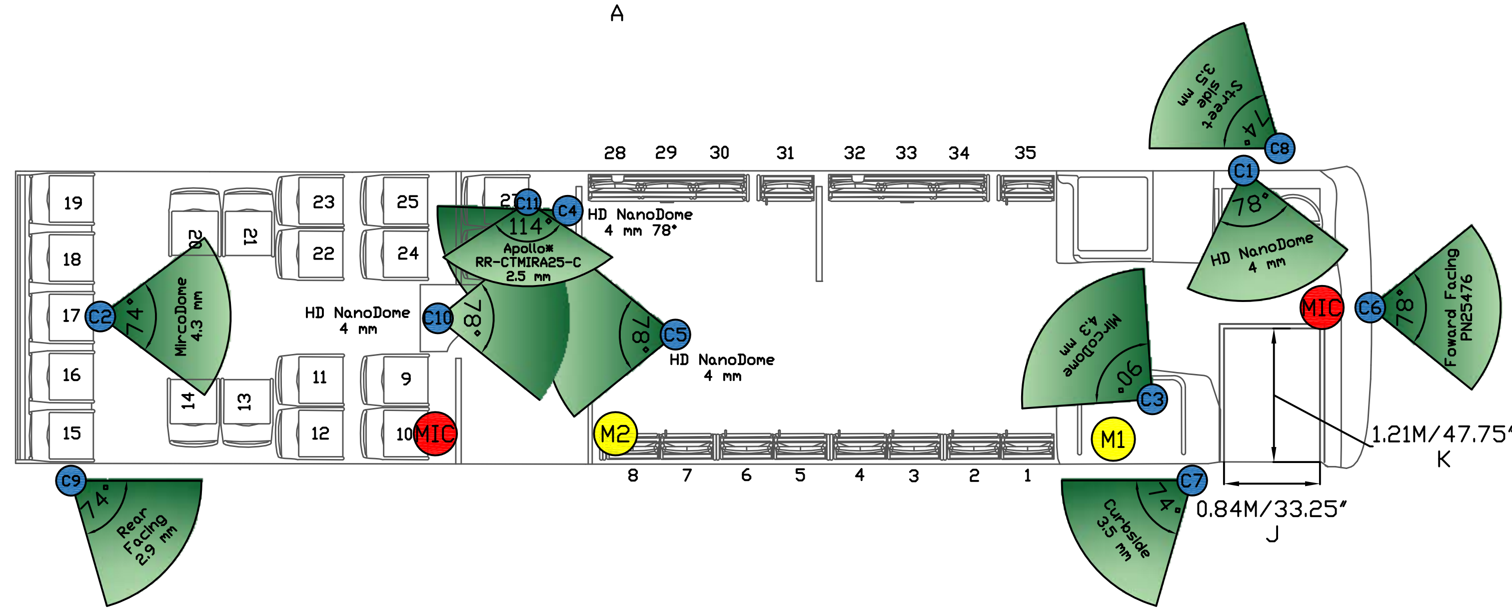
2016-2018 NEW FLYER XCELSIOR BRAVO

FUEL / CAP.	ENGINE	SERIES	QTY	REV.
CNG / 19,770 SCF	ISL-G 8.9L - L9N 8.9L -	5801-5814 5861-5866	20	JUNE 2019





ANGLES
APPROACH: 9°
BREAKOVER: 9°
DEPARTURE: 9°



A LETTER/LETTERS MAY BE MISSING IN THE DRAWING	
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B1	OVERALL WIDTH (WITH MIRROR)
B2	OVERALL WIDTH (WITHOUT MIRROR)
C	OVERALL HEIGHT
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M1	EXIT DOOR HEIGHT (CLEARANCE)
M2	EXIT DOOR WIDTH (CLEARANCE)
N1	BIKE RACK STOWED LENGTH
N2	BIKE RACK DEPLOYED LENGTH

TOTAL # OF SEATS: 35 PASSENGERS
TOTAL # OF STANDEES: 33 PASSENGERS

CAMERAS (green) MICROPHONES (red) MOTION SENSORS (yellow) INRA-RED (blue)

*Apollo Camera Installed On:
5801-5814

OCTA	Tolerances For all dimensions in inches: ±1″	DRAFTING STANDARD ASME Y14.5	2016 NEW FLYER XCELSIOR BRAVO	
	DRAWN ARIANA CURRIM		SIZE 11" X 17"	DWG NO.
	REVISION 6/14/2019		SCALE DO NOT SCALE	SHEET 2 of 19

2016 NEW FLYER XCELSIOR

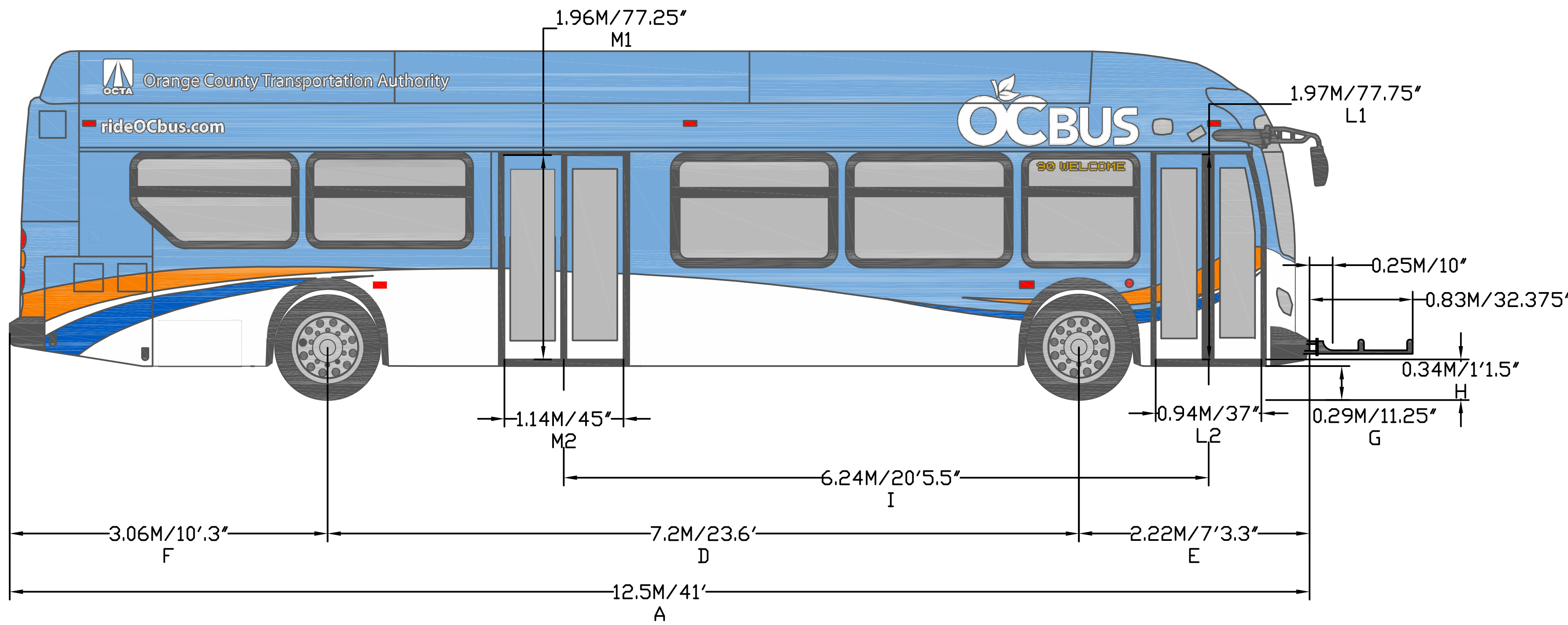
FUEL / CAP.
CNG / 19,770 SCF

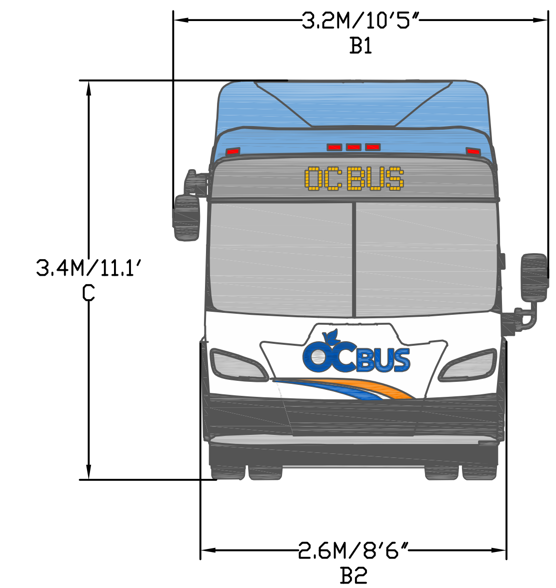
ENGINE
ISL-G 8.9L

SERIES
5701*-5799
5815-5858
*5701 is SR1917

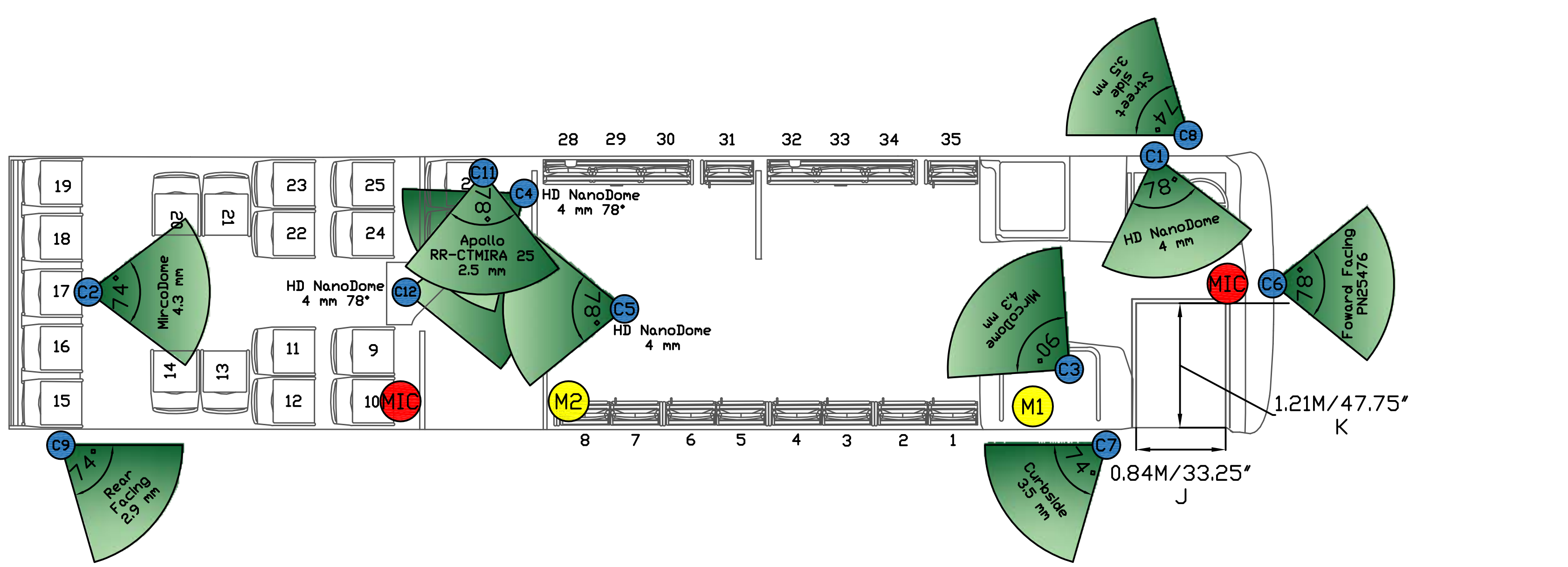
QTY
143

REV.
JUNE 2019





ANGLES
APPROACH: 9°
BREAKOVER: 9°
DEPARTURE: 9°



A LETTER/LETTERS MAY BE MISSING IN THE DRAWING	
A	OVERALL LENGTH
B1	OVERALL WIDTH (WITH MIRROR)
B2	OVERALL WIDTH (WITHOUT MIRROR)
C	OVERALL HEIGHT
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H	FIRST STEP DISTANCE TO GROUND
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L2	ENTRANCE DOOR WIDTH (CLEARANCE)
M1	EXIT DOOR HEIGHT (CLEARANCE)
M2	EXIT DOOR WIDTH (CLEARANCE)
N1	BIKE RACK STOWED LENGTH
N2	BIKE RACK DEPLOYED LENGTH

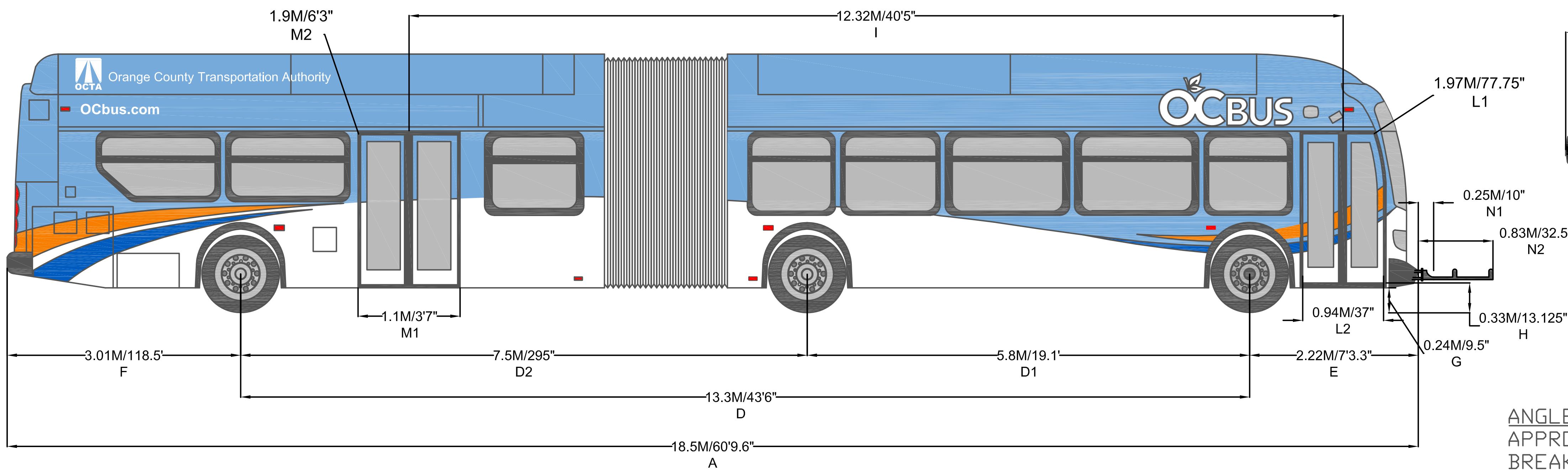
TOTAL # OF SEATS: 35 PASSENGERS
TOTAL # OF STANDEES: 33 PASSENGERS

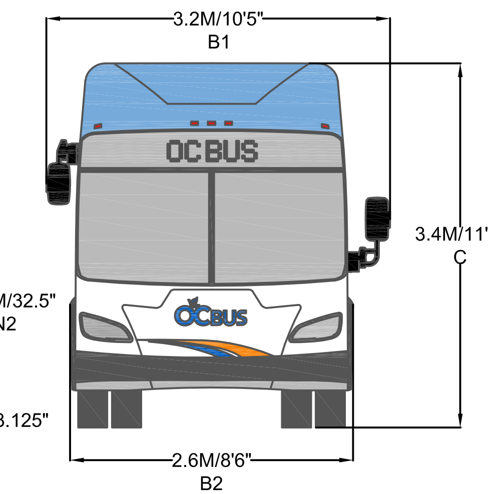
CAMERAS | MICROPHONES | MOTION SENSORS | INRA-RED

OCTA	Tolerances For all dimensions in inches: ±1"	DRAFTING STANDARD ASME Y14.5	2016 NEW FLYER XCELSIOR
	DRAWN ARIANA CURRIM		SIZE 11" X 17" / DWG NO.
	REVISION 6/14/2019		SCALE DO NOT SCALE / SHEET 3 of 19

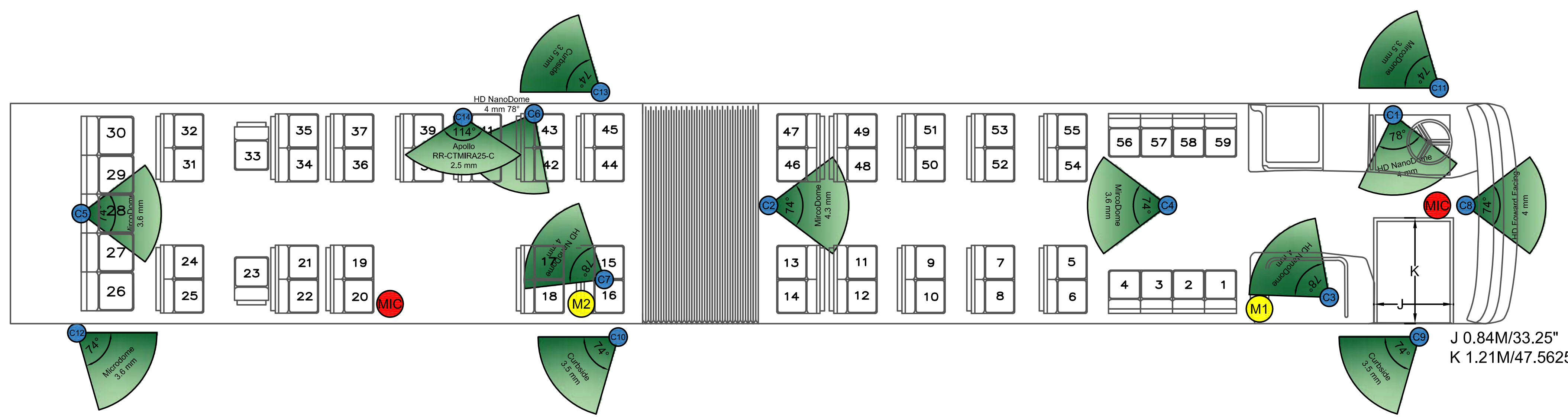
2015 NEW FLYER XCELSIOR ARTICULATED

FUEL / CAP.	ENGINE	SERIES	QTY	REV.
CNG / 26,360 SCF	ISL-G 8.9L	7621-7636	16	JUNE 2019





ANGLES
APPROACH: 9°
BREAKOVER:
- FRONT: 12°
- REAR: 9°
DEPARTURE: 9°



A LETTER/LETTERS MAY BE MISSING IN THE DRAWING	
A	OVERALL LENGTH
B1	OVERALL WIDTH (WITH MIRROR)
B2	OVERALL WIDTH (WITHOUT MIRROR)
C	OVERALL HEIGHT
D	WHEEL BASE LENGTH
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M2	EXIT DOOR WIDTH (CLEARANCE)
N1	BIKE RACK STOWED LENGTH
N2	BIKE RACK DEPLOYED LENGTH

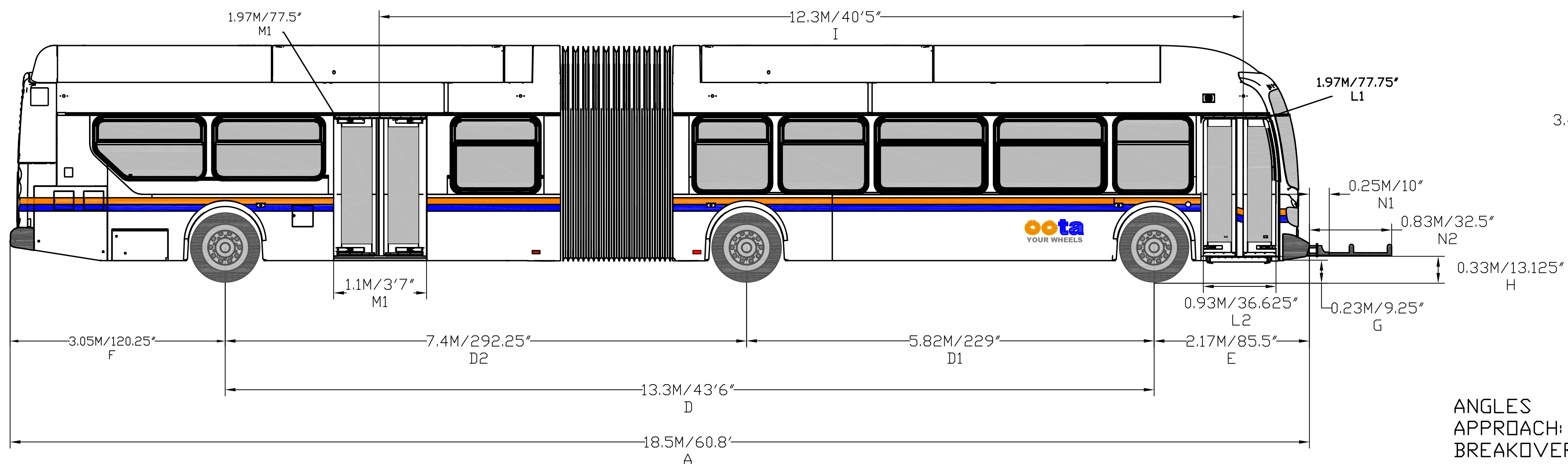
TOTAL # OF SEATS: 59 PASSENGERS
TOTAL # OF STANDEES: 57 PASSENGERS

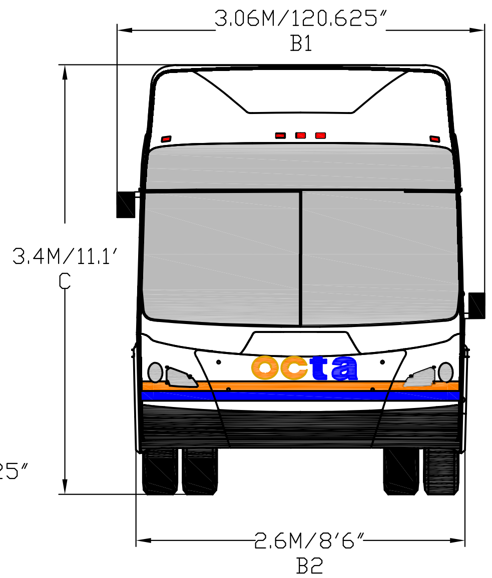
CAMERAS | MICROPHONES | MOTION SENSORS | INRA-RED

Tolerances For all dimensions in inches: ±1"	DRAFTING STANDARD ASME Y14.5	2015 NEW FLYER XCELSIOR ARTICULATED	
DRAWN ARIANA CURRIM		SIZE 11" X 17"	DWG NO.
REVISION 6/14/2019		SCALE DO NOT SCALE	SHEET 4 of 19

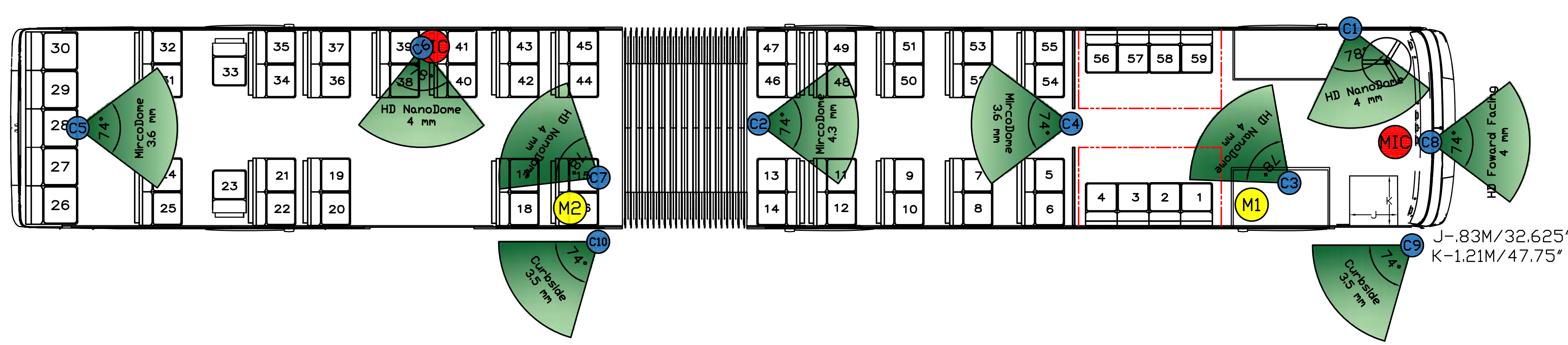
2013 NEW FLYER ARTICULATED

FUEL / CAP.	ENGINE	SERIES	QTY	REV.
CNG / 26,360 SCF	ISL-G 8.9L	7601-7620	20	JUNE 2019





ANGLES
APPROACH: 9°
BREAKOVER:
- FRONT: 12°
- REAR: 9°
DEPARTURE: 9°



A LETTER/LETTERS MAY BE MISSING IN THE DRAWING	
A	OVERALL LENGTH
B1	OVERALL WIDTH (WITH MIRROR)
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N2	BIKE RACK DEPLOYED LENGTH

TOTAL # OF SEATS: 59 PASSENGERS
TOTAL # OF STANDEES: 57 PASSENGERS

CAMERAS | MICROPHONES | MOTION SENSORS | INRA-RED

OCTA

Tolerances
For all dimensions in inches: ±1"

DRAWN: ARIANA CURRIM
REVISION: 6/14/2019

DRAFTING STANDARD: ASME Y14.5

2013 NEW FLYER ARTICULATED

SIZE: 11" X 17"
DWG NO.:
SCALE: DO NOT SCALE
SHEET: 6 OF 19

2008 NEW FLYER 5121 SERIES

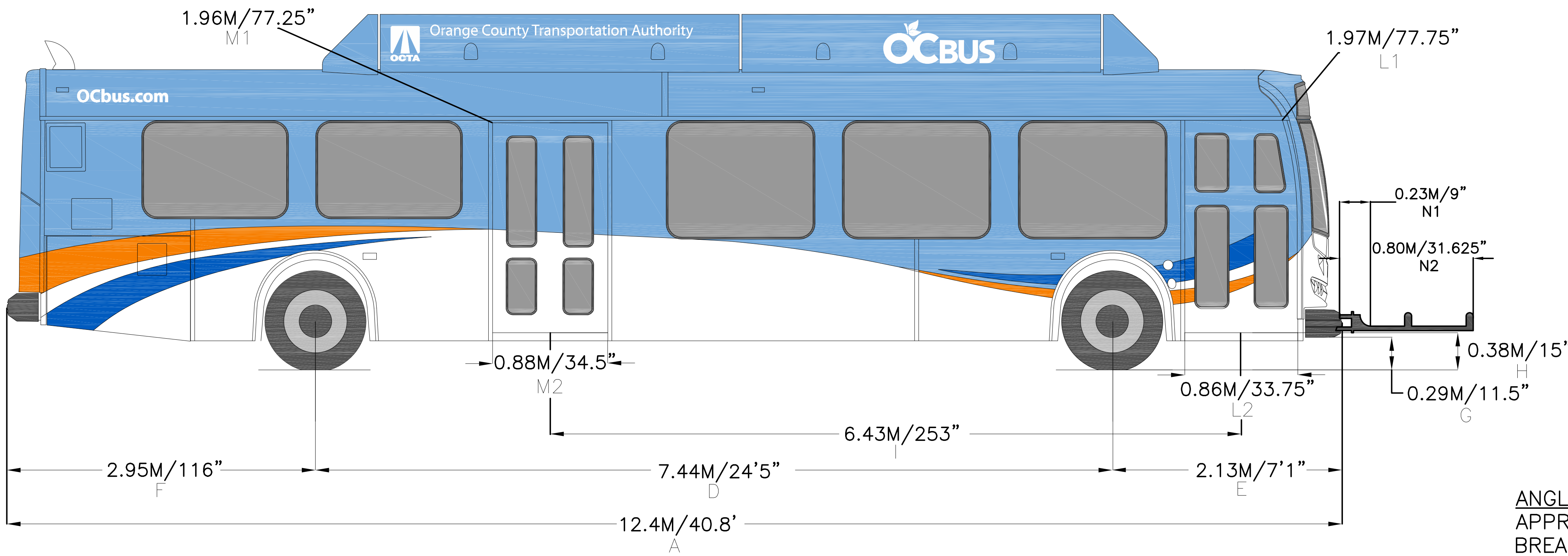
FUEL / CAP.
CNG / 23,065 SCF

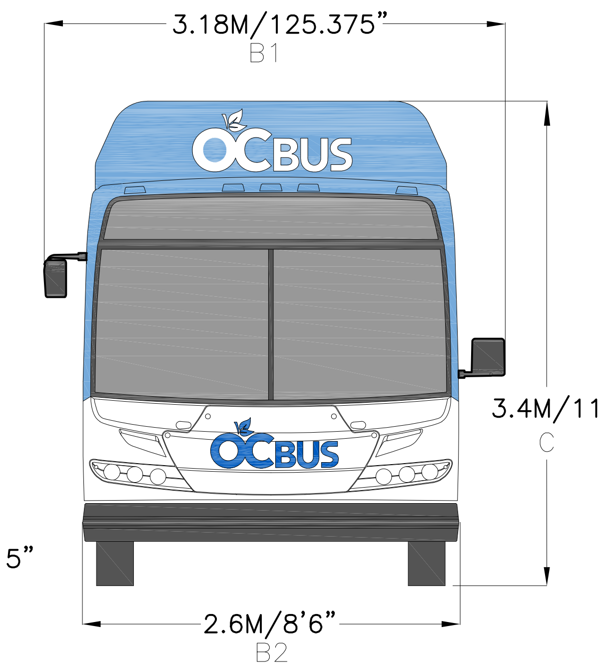
ENGINE
NEAR ZERO
ISL-G 8.9L

SERIES
5121-5150

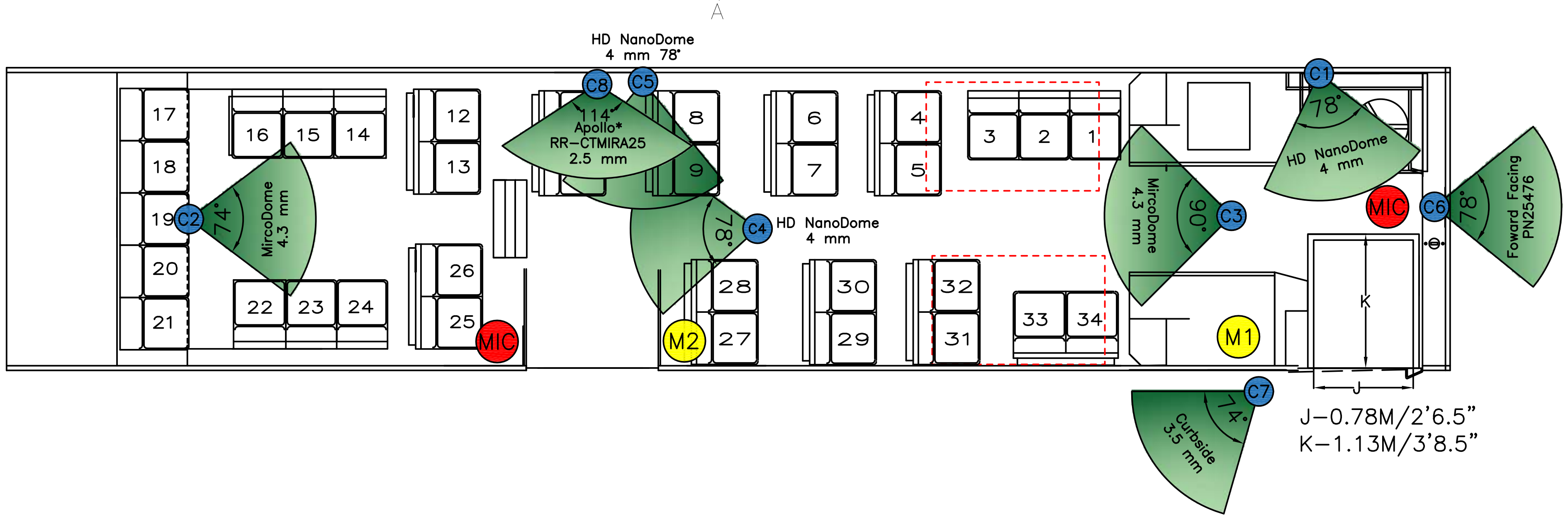
QTY
30

REV.
JUNE 2019





ANGLES
APPROACH: 9°
BREAKOVER: 9.4°
DEPARTURE: 8.8°



J–0.78M/2'6.5"
K–1.13M/3'8.5"

*Apollo Camera Installed On:
5121–5127

A LETTER/LETTERS MAY BE MISSING IN THE DRAWING	
A	OVERALL LENGTH
B1	OVERALL WIDTH (WITH MIRROR)
B2	OVERALL WIDTH (WITHOUT MIRROR)
C	OVERALL HEIGHT
D	WHEEL BASE LENGTH
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M2	EXIT DOOR WIDTH (CLEARANCE)
N1	BIKE RACK STOWED LENGTH
N2	BIKE RACK DEPLOYED LENGTH

TOTAL # OF SEATS: 34 PASSENGERS
TOTAL # OF STANDEES: 40 PASSENGERS

CAMERAS | MICROPHONES | MOTION SENSORS | INRA-RED

OCTA

Unless Otherwise Specified:
Dimensions are in Inches
Tolerances
Decimals .XX ± .05 .XXX ± .010
Degrees ± .5° ± .5°

DRAFTING STANDARD: ASME Y14.5

2008 NEW FLYER 5121 SERIES

DRAWN: ARIANA CURRIM

REVISION: 6/14/2019

SIZE: 11" X 17"

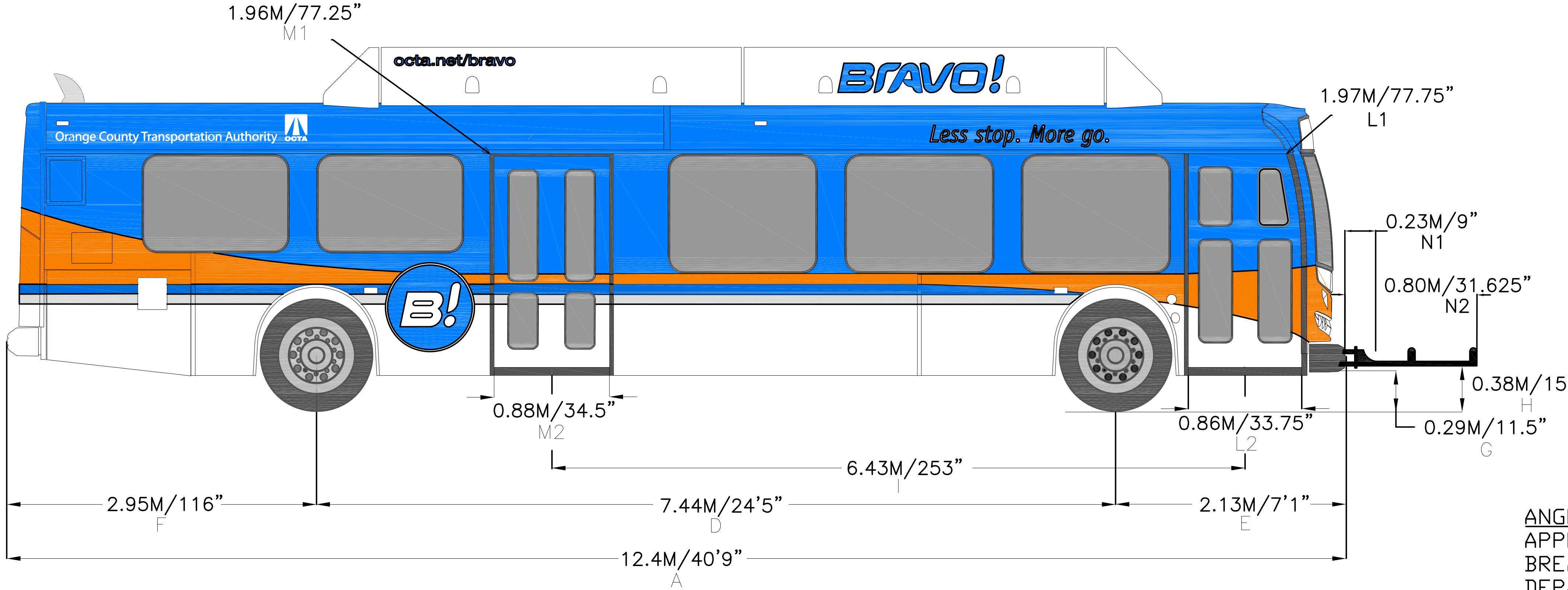
DWG NO.

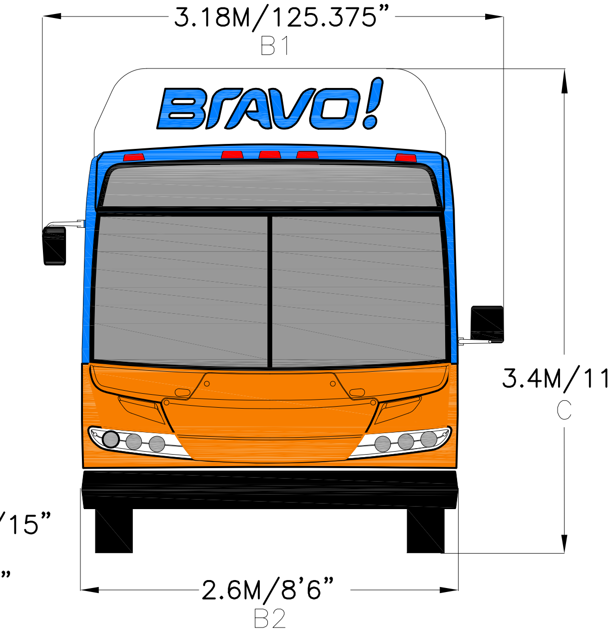
SCALE: DO NOT SCALE

SHEET: 7 OF 19

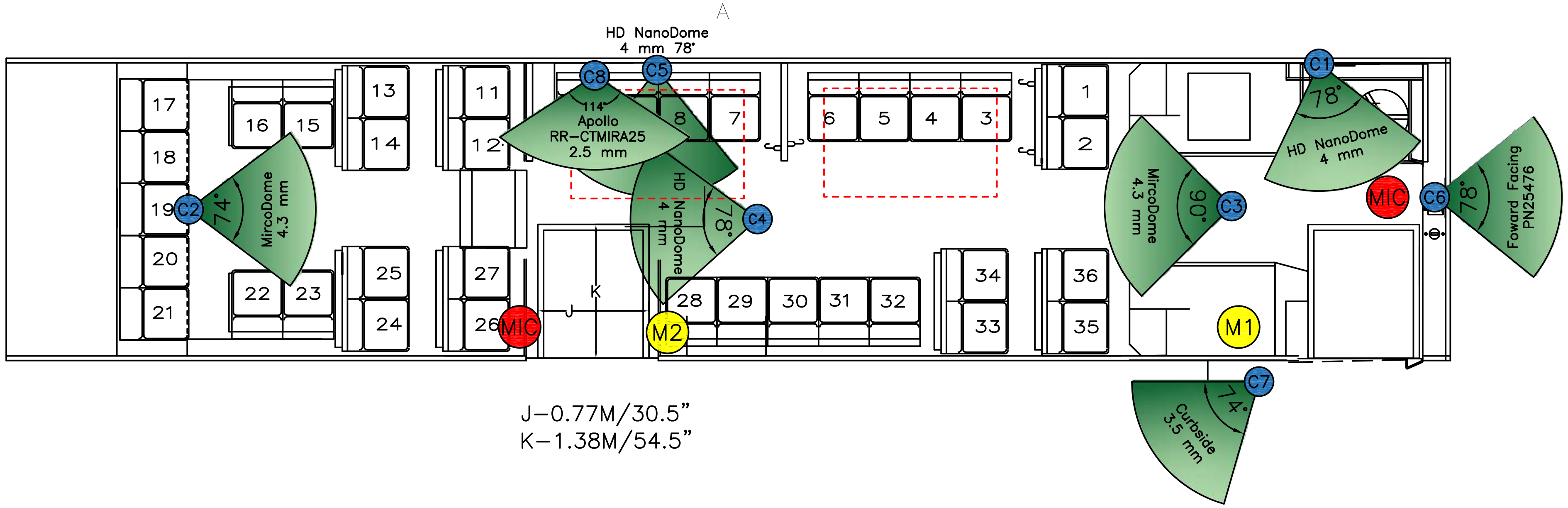
2008 NEW FLYER BRAVO

FUEL / CAP.	ENGINE	SERIES	QTY	REV.
CNG / 23,065 SCF	ISL-G 8.9L Near Zero	7575-7588	14	JUNE 2019





ANGLES
APPROACH: 9°
BREAKOVER: 9.4°
DEPARTURE: 8.8°



J–0.77M/30.5"
K–1.38M/54.5"

A LETTER/LETTERS MAY BE MISSING IN THE DRAWING

A	OVERALL LENGTH
B1	OVERALL WIDTH (WITH MIRROR)
B2	OVERALL WIDTH (WITHOUT MIRROR)
C	OVERALL HEIGHT
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N1	BIKE RACK STOWED LENGTH
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TOTAL # OF SEATS: 36 PASSENGERS
TOTAL # OF STANDEES: 40 PASSENGERS

CAMERAS | MICROPHONES | MOTION SENSORS | INRA-RED

OCTA

Tolerances For all dimensions in inches: ±1"	DRAFTING STANDARD ASME Y14.5	2008 NEW FLYER BRAVO	
DRAWN ARIANA CURRIM		SIZE 11" X 17"	DWG NO.
REVISION 6/14/2019		SCALE DO NOT SCALE	SHEET 8 OF 19

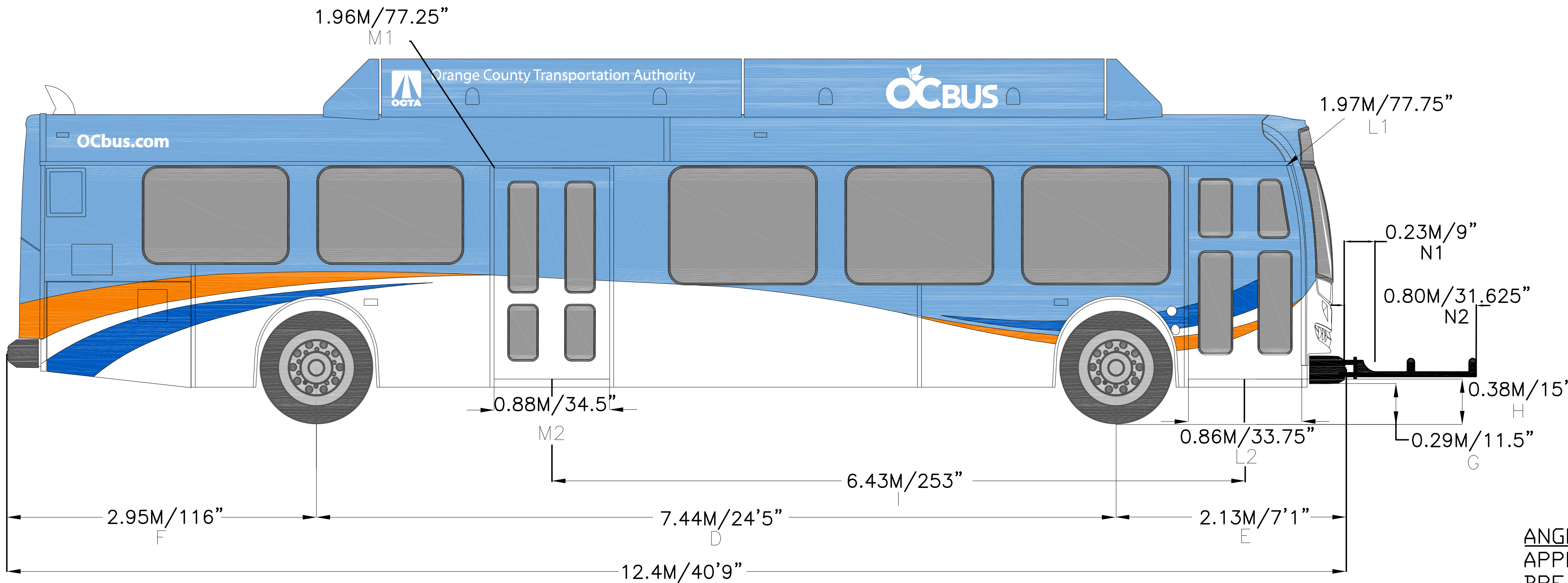
2006-2008 NEW FLYER

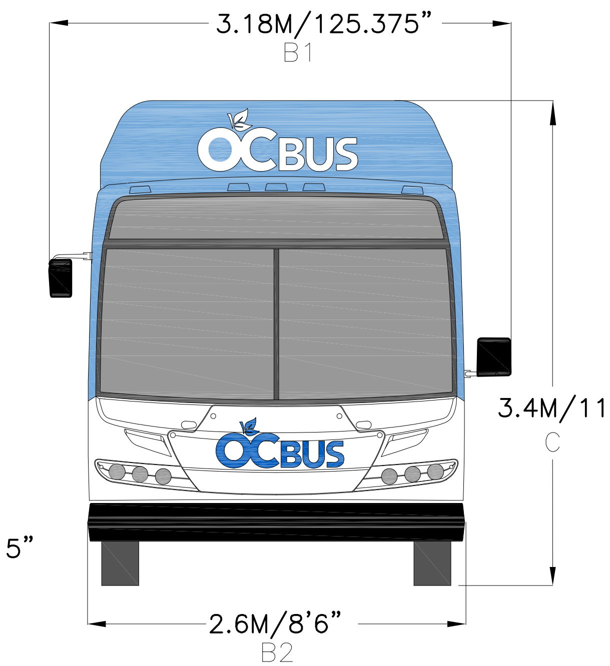
FUEL / CAP.
CNG / 23,065 SCF

ENGINE : SERIES
ISL-G 8.9L : 5501-5599, 5601-5674, 7501-7528
ISL-G Near Zero : 5675-5678, 7529-7574, 7589-7592

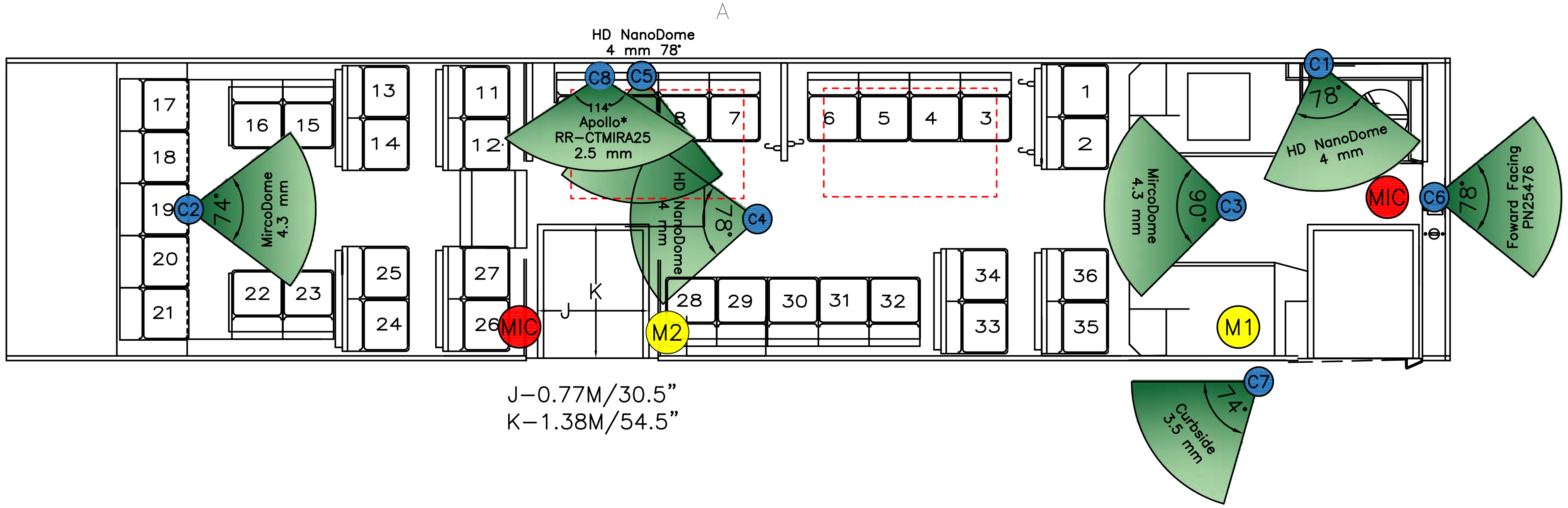
QTY
201
54

REV.
JUNE 2019





ANGLES
APPROACH: 9°
BREAKOVER: 9.4°
DEPARTURE: 8.8°



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A LETTER/LETTERS MAY BE MISSING IN THE DRAWING	
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N2	BIKE RACK DEPLOYED LENGTH

TOTAL # OF SEATS: 36 PASSENGERS
TOTAL # OF STANDEES: 40 PASSENGERS

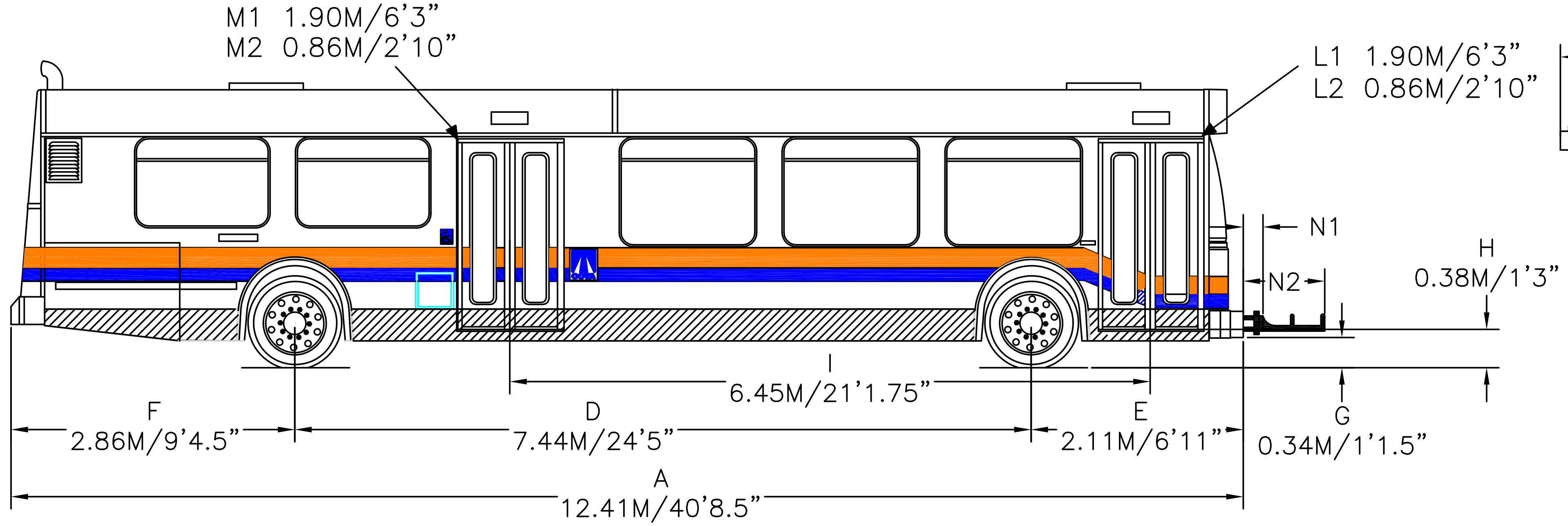
CAMERAS | MICROPHONES | MOTION SENSORS | INRA-RED

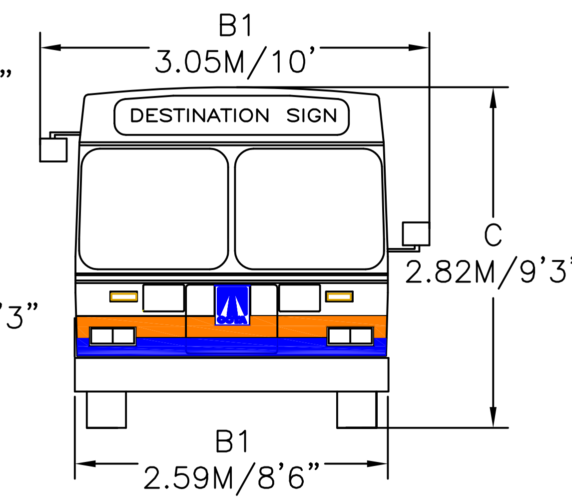
*Apollo Camera Installed On:
5501–5532, 5536, 5537, 5539–5542,
5544–5549, 5551, 5553–5555, 5558–5561,
5565–5571, 5573–5593, 5596–5599,
5601–5609, 5612, 5614, 5615, 5617, 5618,
5621–5629, 5631–5635, 5637–5652, 7574, 7592

OCTA	Tolerances For all dimensions in inches: ±1"	DRAFTING STANDARD ASME Y14.5	2006-2008 NEW FLYER	
	DRAWN ARIANA CURRIM		SIZE 11" X 17"	DWG NO.
	REVISION 6/14/2019		SCALE DO NOT SCALE	SHEET 9 OF 19

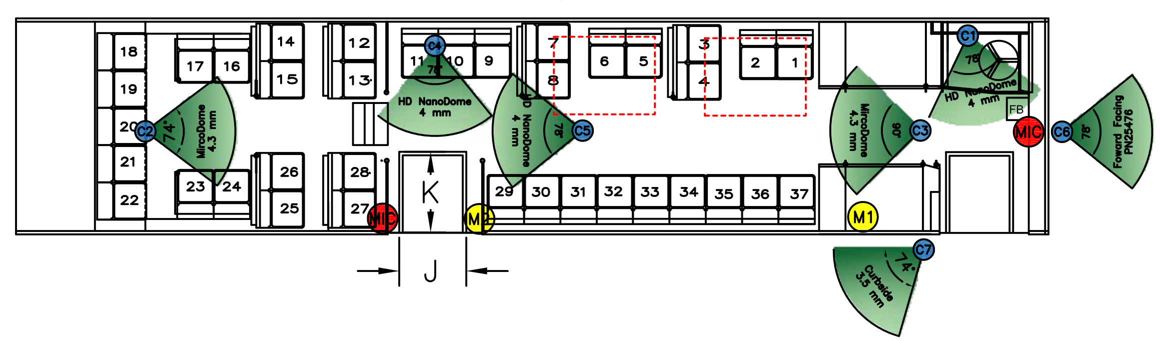
1997-1998 NEW FLYER CONTINGENCY FLEET

FUEL / CAP.	ENGINE	SERIES	QTY	REV.
DIESEL / 120 GAL	ISC 8.3L	5300: 02, 06, 31, 35, 42, 53, 54, 62, 76, 87, 88	11	JUNE 2019
		5400: 01, 03, 06, 08-12, 16	9	



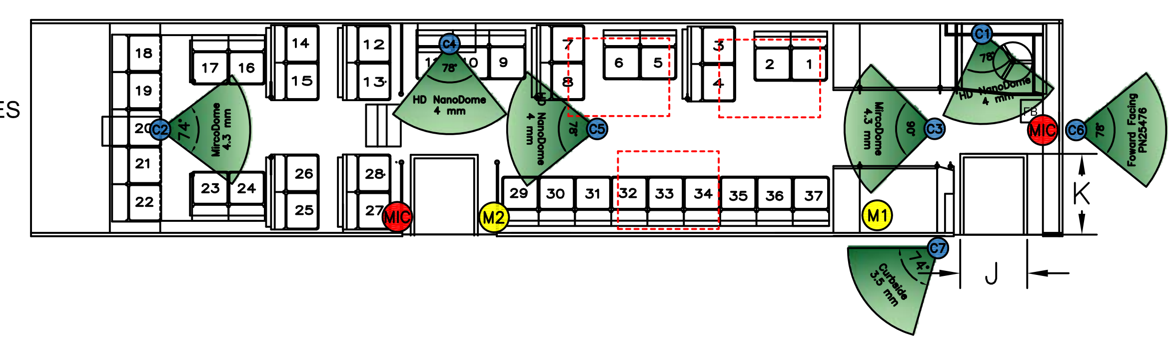


SR467 5300 SERIES
REAR WHEELCHAIR



WHEELCHAIR DIMENSIONS ARE THE SAME FOR BOTH SERIES
J 0.78M/2'6.5"
K 1.13M/3'8.5"

SR466/SR481 5400 SERIES
FRONT WHEELCHAIR



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H	FIRST STEP DISTANCE TO GROUND
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TOTAL # OF SEATS: 37 PASSENGERS
TOTAL # OF STANDEES: 40 PASSENGERS

CAMERAS | MICROPHONES | MOTION SENSORS | INRA-RED

OCTA

Unless Otherwise Specified: Dimensions are in Inches
Tolerances
Decimals .XX ± .05 .XXX ± .010
Degrees ± .5° ± .5°

DRAFTING STANDARD: ASME Y14.5

1997-1998 NEW FLYER CONTINGENCY FLEET

SIZE: 11" X 17"
DWG NO.

DRAWN: ARIANA CURRIM
REVISION: 6/14/2019
SCALE: DO NOT SCALE
SHEET: 10 OF 19

VEHICLE		FUEL						ENGINE							TRANSMISSION		
Bus Series	Quantity	Type	Number of Tanks	Manufacturer	Part Number	Period of Certification	Tank Capacity	Engine Year	Engine Model	Oil Type	Cap.	Max. RPM	Power hp (kw) @ rpm	Torque lb-ft (N-M) @ RPM	Transmission	Fluid	Capacity
2018 NEW FLYER HYDROGEN FUEL CELL 1111-1120	10	H2	5	Hexagon Lincoln		Anually or 100,000 miles	37.5 kg	2018	Siemens PEM 1DB2022	N/A	N/A	3500	268 (200) @ 1500	2803 (3800) @ 600A	N/A		
2015 NEW FLYER ARTICULATED 7621-7636	16	CNG	8	Lincoln Composites	RH36A16-12003	Anually or 100,000 miles	746 SCM 26,360 SCF	2015	ISL-G 8.9L	15W40 Low Ash	26.5 L 7 Gal	2,200	320 (239) @ 2200	1000 (1356) @ 1300	Allison B500R 4000 Series 5th Gen	Transynd	48.3 L 12.75 Gal
2016-2018 NEW FLYER XCELSIOR BRAVO 5801-5814, 5861-5866	20	CNG	6	Lincoln Composites	RH36A16-12003	Anually or 100,000 miles	559.82 SCM 19,770 SCF	2013	ISL G 8.9L	15W40 Low Ash	26.5 L 7 Gal	2,200	280 (209) @ 2000	900 (1220) @ 1300	Allison B400R 3000 Series 5th Gen	Transynd	29.3 L 7.75 Gal
2015 -2016 NEW FLYER XCELSIOR 5701-5799, 5815-5858	143	CNG	6	Lincoln Composites	RH36A16-12003	Anually or 100,000 miles	559.82 SCM 19,770 SCF	2013	ISL G 8.9L	15W40 Low Ash	26.5 L 7 Gal	2,200	280 (209) @ 2000	900 (1220) @ 1300	Allison B400R 3000 Series 5th Gen	Transynd	29.3 L 7.75 Gal
2013 NEW FLYER ARTICULATED 7601-7620	20	CNG	8	Lincoln Composites	RH36A16-12003	Anually or 100,000 miles	746 SCM 26,360 SCF	2010	ISL-G 8.9L	15W40 Low Ash	26.5 L 7 Gal	2,200	320 (239) @ 2200	1000 (1356) @ 1300	Allison B500R 4000 Series 5th Gen	Transynd	48.3 L 12.75 Gal
2008 NEW FLYER NEAR ZERO 5121-5150	30	CNG	7	Lincoln Composites	R240040-012	Anually or 100,000 miles	653 SCM 23,065 SCF	2017/2018	ISL-G 8.9L Near Zero	15W40 Low Ash	27.6 L 7.3 Gal	2,200	280 (209) @ 2000	900 (1220) @ 1300	Allison B400R 3000 Series 4th Gen	Transynd	21.0 L 5.5 Gal
2008 NEW FLYER BRAVO NEAR ZERO 7575-7588	14	CNG	7	Lincoln Composites	R240040-012	Anually or 100,000 miles	653 SCM 23,065 SCF	2017/2018	ISL-G 8.9L Near Zero	15W40 Low Ash	27.6 L 7.3 Gal	2,200	280 (209) @ 2000	900 (1220) @ 1300	Allison B400R 3000 Series 4th Gen	Transynd	21.0 L 5.5 Gal
2006-2008 NEW FLYER NEAR ZERO 5675-5678, 7529-7574, 7589-7592	54	CNG	7	Lincoln Composites	R240040-012	Anually or 100,000 miles	653 SCM 23,065 SCF	2017/2018	ISL-G 8.9L Near Zero	15W40 Low Ash	27.6 L 7.3 Gal	2,200	280 (209) @ 2000	900 (1220) @ 1300	Allison B400R 3000 Series 4th Gen	Transynd	21.0 L 5.5 Gal
2006-2008 NEW FLYER 5501-5599, 5601-5674, 7501-7528	201	CNG	7	Lincoln Composites	R240040-012	Anually or 100,000 miles	653 SCM 23,065 SCF	2010	ISL-G 8.9L	15W40 Low Ash	26.5 L 7 Gal	2,200	280 (209) @ 2000	900 (1220) @ 1300	Allison B400R 3000 Series 4th Gen	Transynd	21.0 L 5.5 Gal
1998 NEW FLYER CONTINGENCY 5401, 5403, 5406, 5408-5412, 5416	9	Diesel	1	N / A	103719 NF	Anually or 100,000 miles	454 L 120 Gal	2001	ISC 8.3L	15W40 Low Ash	19.8 L 5.25 Gal	2,200	289 (216) @ 2000	900 (1220) @1300	Allison B400R (6speed)	Transynd	18 L 4.75 Gal
1997 NEW FLYER CONTINGENCY 5302, 5306, 5331, 5335, 5342, 5353, 5354, 5362, 5376, 5387, 5388	11	Diesel	1	N / A	103719 NF	Anually or 100,000 miles	454 L 120 Gal	2001	ISC 8.3L	15W40 Low Ash	19.8 L 5.25 Gal	2,200	289 (216) @ 2000	900 (1220) @1300	Allison B400R (6speed)	Transynd	18 L 4.75 Gal

Fuel, Engine, Transmission

VEHICLE		POWER STEERING		WHEELCHAIR			DIFFERENTIAL AND HUBS				ENGINE COOLANT	
Bus Series	**Quantity**	**Fluid**	**Capacity**	**Wheelchair Ramp**	**Oil Type**	**Cap.**	**Gear Ratio**	**Differential Oil**	**Cap.**	**Front Wheel Hub**	**Coolant Type**	**Capacity**
2018 NEW FLYER HYDROGEN FUEL CELL 1111-1120	10	Transynd	8.7 L 2.3 Gal	NF RAMPS	Transynd	0.94 L 0.25 Gal	5.67:1	SAE 75W-89	14.5 l 3.83 Gal	Multi Purpose Lithium Grease	Cummins ES Compleat DI-WEG (Fuel Cell)	
2015 NEW FLYER ARTICULATED 7621-7636	16	Transynd	24.6 L 6.5 Gal	NF RAMPS	Transynd	0.94 L 0.25 Gal	4.56:1	SAE 75W-90	14.5 L 3.83 Gal	Multi Purpose Lithium Grease	Cummins ES Compleat	12.4L 3.28Gal
2016-2018 NEW FLYER XCELSIOR BRAVO 5801-5814, 5861-5866	20	Transynd	41.6 L 7.75 Gal	NF RAMPS	Transynd	0.94 L 0.25 Gal	4.56:1	SAE 75W-90	14.5 L 3.83 Gal	Multi Purpose Lithium Grease	Cummins ES Compleat	12.4L 3.28 Gal
2015 -2016 NEW FLYER XCELSIOR 5701-5799, 5815-5858	143	Transynd	41.6 L 7.75 Gal	NF RAMPS	Transynd	0.94 L 0.25 Gal	4.56:1	SAE 75W-90	14.5 L 3.83 Gal	Multi Purpose Lithium Grease	Cummins ES Compleat	12.4L 3.28 Gal
2013 NEW FLYER ARTICULATED 7601-7620	20	Transynd	24.6 L 6.5 Gal	NF RAMPS	Transynd	0.94 L 0.25 Gal	4.56:1	SAE 75W-90	14.5 l 3.83 Gal	Multi Purpose Lithium Grease	Cummins ES Compleat	12.4L 3.28Gal
2008 NEW FLYER NEAR ZERO 5121-5150	30	Transynd	22.0 L 5.8 Gal	NF RAMPS	Transynd	0.94 L 0.25 Gal	5.44:1	SAE 75W-90	16.8 L 4.4 GAL	Multi Purpose Lithium Grease	Cummins ES Compleat	12.4L 3.28 Gal
2008 NEW FLYER BRAVO NEAR ZERO 7575-7588	14	Transynd	22.0 L 5.8Gal	NF RAMPS	Transynd	0.94 L 0.25 Gal	5.44:1	SAE 75W-90	16.8 L 4.4 GAL	Multi Purpose Lithium Grease	Cummins ES Compleat	12.4L 3.28 Gal
2006-2008 NEW FLYER NEAR ZERO 5675-5678, 7529-7574, 7589-7592	54	Transynd	22.0 L 5.8Gal	NF RAMPS	Transynd	0.94 L 0.25 Gal	5.44:1	SAE 75W-90	16.8 L 4.4 GAL	Multi Purpose Lithium Grease	Cummins ES Compleat	12.4L 3.28 Gal
2006-2008 NEW FLYER 5501-5599, 5601-5674, 7501-7528	201	Transynd	22.0 L 5.8Gal	NF RAMPS	Transynd	0.94 L 0.25 Gal	5.44:1	SAE 75W-90	16.8 L 4.4 GAL	Multi Purpose Lithium Grease	Cummins ES Compleat	12.4L 3.28Gal
1998 NEW FLYER CONTINGENCY 5401, 5403, 5406, 5408-5412, 5416	9	DEXRON I	24.6 L 6.5 Gal	NF RAMPS	DEXRON II	0.94 L 0.25 Gal	5.22:1	GL-5 80W90	18.5 L 4.1 GAL	Multi Purpose Lithium Grease	Cummins ES Compleat	23 L 6 GAL
1997 NEW FLYER CONTINGENCY 5302, 5306, 5331, 5335, 5342, 5353, 5354, 5362, 5376, 5387, 5388	11	DEXRON I	24.6 L 6.5 Gal	NF RAMPS	DEXRON II	0.94 L 0.25 Gal	5.22:1	GL-5 80W90	18.5 L 4.1 GAL	Multi Purpose Lithium Grease	Cummins ES Compleat	23 L 6 GAL

VEHICLE		DIMENSIONS ± 1"																						Wheel Chair Lift					SEATING	
Bus Series	Quantity	Overall Length	Width w/ Mirror	Width w/o Mirror	Height	Wheel Base Length			Front Overhang	Rear Overhang	Front Bumper to Ground	Front Step to Ground	Center Line Front to Rear Door	Entrance Door		Exit Door		Bike Rack		Turning Radius	Angles			Type	Width	Extension	Location	Cap.	Seated	Standee
						Front to Rear	Front to Center	Center to Rear						Height	Width	Height	Width	Stowed	Deployed		Approach	Breakover	Departure							
2018 NEW FLYER HYDROGEN FUEL CELL	10	12.49 M	3.1 M	2.67 M	3.41 M	7.2 M	N/A	N/A	2.2 M	3.07 M	0.29 M	0.356 M	6.22 M	2.03 M	1.09 M	2.03 M	1.32 M		1.02 M	13.4 M	9 deg	9 deg.	9 deg	NF RAMPS	0.84 M	1.21 M	Front	2	35	43
1111-1120		491.86"	122.06"	104.95"	134.36"	283.75"			86.7"	120.8"	11.5"	14"	20' 5"	6' 8"	43"	6' 8"	52"		40"	44'					33.25"	47.75"				
2015 NEW FLYER ARTICULATED	16	18.5 M	3.2 M	2.6 M	3.4 M	13.3 M	5.8 M	7.5 M	2.22 M	3.01 M	0.24 M	0.33 M	12.32 M	1.97 M	0.94 M	1.9 M	1.1 M	0.25 M	0.83 M	13.4 M	9 deg.	Front: 12 deg.	9 deg.	NF RAMPS	0.84 M	1.21 M	Front	2	59	57
7621-7636		60.8'	10'5"	8'6"	11.1'	43.5'	19.1'	295"	7'3.3"	118.5"	9.5"	13.125"	40' 5"	77.75"	37"	6' 3"	3' 7"	10"	32.5"	44'		Rear: 9 deg.			33.25"	47.5625"				
2016-2018 NEW FLYER XCELSIOR BRAVO	20	12.5 M	3.2M	2.6 M	3.4 M	7.2 M	N/A	N/A	2.22 M	3.06 M	0.29 M	0.34 M	6.24 M	1.97 M	0.94 M	1.96 M	1.14 M	0.25 M	0.83 M	13.3 M	9 deg.	9 deg.	9 deg	NF RAMPS	0.84 M	1.21 M	Front	2	35	33
5801-5814, 5861-5866		41'	10'5"	8' 6"	11.1'	23.6'			7' 3.3"	10'.3"	11.25"	1'1.5"	20' 5.5"	77.75"	37"	77.25"	45"	10"	32.375"	43.5'					33.25"	47.75"				
2015- 2016 NEW FLYER XCELSIOR	143	12.5 M	3.2M	2.6 M	3.4 M	7.2 M	N/A	N/A	2.22 M	3.06 M	0.29 M	0.34 M	6.24 M	1.97 M	0.94 M	1.96 M	1.14 M	0.25 M	0.83 M	13.3 M	9 deg.	9 deg.	9 deg	NF RAMPS	0.84 M	1.21 M	Front	2	35	33
5701-5799, 5815-5858		41'	10'5"	8' 6"	11.1'	23.6'			7' 3.3"	10'.3"	11.25"	1'1.5"	20' 5.5"	77.75"	37"	77.25"	45"	10"	32.375"	43.5'					33.25"	47.75"				
2013 NEW FLYER ARTICULATED	20	18.5 M	3.06 M	2.6 M	3.4 M	13.3 M	5.82 M	7.4 M	2.17 M	3.05 M	0.23 M	0.33	12.32 M	1.97 M	0.93 M	1.97 M	1.1 M	0.25 M	0.83 M	13.4 M	9 deg.	Front: 12 deg.	9 deg.	NF RAMPS	0.83 M	1.21 M	Front	2	59	57
7601-7620		60.8'	120.625"	8.5'	11.1'	43.5'	229"	292.25"	85.5"	120.25"	9.25"	13.125"	40' 5"	77.75"	36.625"	77.5"	3' 7"	10"	32.5"	44'		Rear: 9 deg.			32.625"	47.75"				
2008 NEW FLYER NEAR ZERO	30	12.4	3.18 M	2.6 M	3.4 M	7.4 M	N/A	N/A	2.13 M	2.95 M	0.29 M	0.38 M	6.43 M	1.97 M	0.86 M	1.96 M	0.88 M	0.23 M	0.8 M	13.4 M	9 deg.	9.4 deg.	8.8 deg	NF RAMPS	0.77 M	1.38 M	Front	2	34	40
5121-5150		40.8'	125.375"	8' 6"	11'	24.4'			7' 1"	116"	11.5"	15"	253"	77.75"	33.75"	77.25"	34.5"	9"	31.625"	44'					30.5"	54.5 "				
2008 NEW FLYER BRAVO NEAR ZERO	14	12.4	3.18 M	2.6 M	3.4 M	7.4 M	N/A	N/A	2.13 M	2.95 M	0.29 M	0.38 M	6.43 M	1.97 M	0.86 M	1.96 M	0.88 M	0.23 M	0.8 M	13.4 M	9 deg.	9.4 deg.	8.8 deg	NF RAMPS	0.77 M	1.38 M	Rear	2	36	40
7575-7588		40.8'	125.375"	8' 6"	11'	24.4'			7' 1"	116"	11.5"	15"	253"	77.75"	33.75"	77.25"	34.5"	9"	31.625"	44"					30.5"	54.5 "				
2006-2008 NEW FLYER NEAR ZERO	54	12.4	3.18 M	2.6 M	3.4 M	7.4 M	N/A	N/A	2.13 M	2.95 M	0.29 M	0.38 M	6.43 M	1.97 M	0.86 M	1.96 M	0.88 M	0.23 M	0.8 M	13.4 M	9 deg.	9.4 deg.	8.8 deg	NF RAMPS	0.77 M	1.38 M	Rear	2	36	40
5675-5678, 7529-7574, 7589-7592		40.8'	125.375"	8' 6"	11'	24.4'			7' 1"	116"	11.5"	15"	253"	77.75"	33.75"	77.25"	34.5"	9"	31.625"	44"					30.5"	54.5 "				
2006-2008 NEW FLYER	201	12.4	3.18 M	2.6 M	3.4 M	7.4 M	N/A	N/A	2.13 M	2.95 M	0.29 M	0.38 M	6.43 M	1.97 M	0.86 M	1.96 M	0.88 M	0.23 M	0.8 M	13.4 M	9 deg.	9.4 deg.	8.8 deg	NF RAMPS	0.77 M	1.38 M	Rear	2	36	40
5501-5599, 5601-5674, 7501-7528		40.8'	125.375"	8' 6"	11'	24.4'			7' 1"	116"	11.5"	15"	253"	77.75"	33.75"	77.25"	34.5"	9"	31.625"	44"					30.5"	54.5 "				
1998 NEW FLYER CONTINGENCY	9	12.4 M	3.05M	2.57 M	2.8 M	7.44 M	N/A	N/A	2.11 M	2.86 M	0.38 M	0.34 M	6.45 M	1.97 M	0.86 M	1.96 M	0.88 M	0.23 M	0.8 M	13.5 M	9 deg.	8.2 deg.	9 deg.	NF RAMPS	0.78 M	1.13 M	Front	3	37	40
5401, 5403, 5406, 5408-5412, 5416		40.8'	10'0"	8'6"	9.2'	24.4'			6' 11"	9' 4.5"	1' 3"	1' 1.5"	21' 1.75"	77.75"	33.75"	77.25"	34.5"	9"	31.625"	44'					2' 6.5"	3' 8.5"				
1997 NEW FLYER CONTINGENCY 5302, 5306, 5331,	11	12.4 M	3.05M	2.57 M	2.8 M	7.44 M	N/A	N/A	2.11 M	2.86 M	0.38 M	0.34 M	6.45 M	1.97 M	0.86 M	1.96 M	0.88 M	0.23 M	0.8 M	13.5 M	9 deg.	8.2 deg.	9 deg.	NF RAMPS	0.78 M	1.13 M	Rear	2	37	40
5335, 5342, 5353, 5354, 5362, 5376, 5387, 5388		40.8'	10'0"	8'6"	9.2'	24.4'			6' 11"	9' 4.5"	1' 3"	1' 1.5"	21' 1.75"	77.75"	33.75"	77.25"	34.5"	9"	31.625"	44'					2' 6.5"	3' 8.5"				

VEHICLE		ACCELERATION TESTS								WEIGHT				
Bus Series	**Quantity**	**0-10 MPH**	**0-20 MPH**	**0-30 MPH**	**0-40 MPH**	**0-50 MPH**	**0-60 MPH**	**Max. Vehicle Speed**	**Range**	**CURB Vehicle wright**	**Gross Vehicle Weight Rating (GVWR)**	**Front Axle Capacity**	**Center Axle Capacity**	**Rear Axle Capacity**
2018 NEW FLYER HYDROGEN FUEL CELL 1111-1120	10	2.81 sec	7.9 sec	15 sec	21.42 sec	30.31 sec	43.08 sec	107.8 KPH	300 Recorded	15195 kg	20,200 kg	7,200 kg	N/A	13,000 kg
								67 MPH	350 Stated	33,500 lb	44,533 lb	15,873 lb		28,660 lb
2015 NEW FLYER ARTICULATED 7621-7636	16	4.43 sec	11.32 sec	20.09 sec	34.71 sec	56.21 sec	92.94 sec	105 KPH	350-400 miles	20,620 kg	30,790 kg	6,700 kg	11,500 kg	12,590 kg
								65 MPH		45,460 lb	67,890 lb	14,780 lb	25,350 lb	27,760 lb
2016-2018 NEW FLYER XCELSIOR BRAVO 5801-5814, 5861-5866	20	3.2575 sec	7.6425 sec	13.67 sec	23.1075 sec	36.9625 sec	57.29 sec	105 KPH	350-400 miles	13,608 kg	19,290 kg	6,700 kg	N/A	12,590 kg
								65 MPH		30,000 lb	42,540 lb	14,780 lb		27,760 lb
2015 -2016 NEW FLYER XCELSIOR 5701-5799, 5815-5858	143	3.2575 sec	7.6425 sec	13.67 sec	23.1075 sec	36.9625 sec	57.29 sec	105 KPH	350-400 miles	13,608 kg	19,290 kg	6,700 kg	N/A	12,590 kg
								65 MPH		30,000 lb	42,540 lb	14,780 lb		27,760 lb
2013 NEW FLYER ARTICULATED 7601-7620	20	6.02 sec	12.31 sec	21.69 sec	36.84 sec	56.21 sec	92.94 sec	105 KPH	350-400 miles	20348 kg	30,290 kg	6,700 kg	11,000 kg	12,590 kg
								65 MPH		44,860 lb	66,790 lb	14,780 lb	24,250 lb	27,760 lb
2008 NEW FLYER NEAR ZERO 5121-5150	30	3.66 sec	8.86 sec	15.91 sec	27.13 sec	44.66 sec	79.55 sec	110.1KPH	350 miles	14,560 kg	19,290 kg	6,700 kg	N/A	12,590 kg
								68.4 MPH		32,100 lb	42,540 lb	14,780 lb		27,760 lb
2008 NEW FLYER BRAVO NEAR ZERO 7575-7588	14	3.66 sec	8.86 sec	15.91 sec	27.13 sec	44.66 sec	79.55 sec	110.1KPH	350 miles	14,624 kg	19,290 kg	6,700 kg	N/A	12,590 kg
								68.4 MPH		32,240 lb	42,540 lb	14,780 lb		27,760 lb
2006-2008 NEW FLYER NEAR ZERO 5675-5678, 7529-7574, 7589-7592	54	3.66 sec	8.86 sec	15.91 sec	27.13 sec	44.66 sec	79.55 sec	110.1KPH	350 miles	14,624 kg	19,290 kg	6,700 kg	N/A	12,590 kg
								68.4 MPH		32,240 lb	42,540 lb	14,780 lb		27,760 lb
2006-2008 NEW FLYER 5501-5599, 5601-5674, 7501-7528	201	3.66 sec	8.86 sec	15.91 sec	27.13 sec	44.66 sec	79.55 sec	110.1KPH	350 miles	14,624 kg	19,296 kg	6,704 kg	N/A	12,592 kg
								68.4 MPH		32,240 lb	42,540 lb	14,780 lb		27,760 lb
1998 NEW FLYER CONTINGENCY 5401, 5403, 5406, 5408-5412, 5416	9	4.1 sec	6.9 sec	10.8 sec	16.4 sec	26.4 sec	40.0 sec	104.6 KPH	N/A	15,241 kg	17,204 kg	6,000 kg	N/A	11,204 kg
								65.0 MPH		33,600 lb	37,930 lb	13, 230 lb		24,700 lb
1997 NEW FLYER CONTINGENCY 5302, 5306, 5331, 5335, 5342, 5353, 5354, 5362, 5376, 5387, 5388	11	4.1 sec	6.9 sec	10.8 sec	16.4 sec	26.4 sec	40.0 sec	104.6 KPH	N/A	15,241 kg	17,204 kg	6,000 kg	N/A	11,204 kg
								65.0 MPH		33,600 lb	37,930 lb	13, 230 lb		24,700 lb

VEHICLE		TIRES				WHEELS						FILTERS				
Bus Series	Quantity	Tire Size	Pressure			Alcoa (Mfg)	Wheel	Bolt	Bolt Hole	Hub Piloted	Hub	Fuel	Water	Transmission	Power Steering	Air
			Front	Middle	Rear	Part #	Size	Pattern	Diameter	Mounting	Bore	2, 4, 6, 8		3, 5, 7		
2018 NEW FLYER HYDROGEN FUEL CELL 1111-1120	10	305/70R22.5	825 Kpa 120 psi	N/A N/A	825 Kpa 120 psi	886513DB	22.5 x 8.25	14 Degree DC 10 Hole	1.04 in. 26.4 mm	335mm Bolt Circle	8.670 in	N/A	N/A	N/A	N/A	2039
2015 NEW FLYER ARTICULATED 7621-7636	16	305/70R22.5	825 Kpa 120 psi	825 Kpa 120 psi	825 Kpa 120 psi	886513DB	22.5 x 8.25	15 Degree DC 10 Hole	1.219 in. 32.811 mm	335mm Bolt Circle	8.670 in	18633/2147	23568	2270	47753	2039
2016-2018 NEW FLYER XCELSIOR BRAVO 5801-5814, 5861-5866	20	305/70R22.5	825 Kpa 120 psi	N/A	825 Kpa 120 psi	886513DB	22.5 x 8.25	14 Degree DC 10 Hole	1.04 in. 26.4 mm	335mm Bolt Circle	8.670 in	18633/2147	N/A	2270	47753	2039
2015 -2016 NEW FLYER XCELSIOR 5701-5799, 5815-5858	143	305/70R22.5	825 Kpa 120 psi	N/A	825 Kpa 120 psi	886513DB	22.5 x 8.25	14 Degree DC 10 Hole	1.04 in. 26.4 mm	335mm Bolt Circle	8.670 in	18633/2147	N/A	2270	47753	2039
2013 NEW FLYER ARTICULATED 7601-7620	20	305/70R22.5	827 Kpa 120 psi	N/A	827 Kpa 120 psi	886513DB	22.5 x 8.25	15 Degree DC 10 Hole	1.219 in. 32.811 mm	335mm Bolt Circle	8.670 in	18633/2147	23568	2270	47753	2039
2008 NEW FLYER NEAR ZERO 5121-5150	30	305/70R22.5	825 Kpa 120 psi	N/A	825 Kpa 120 psi	886513DB	22.5 x 8.25	15 Degree DC 10 Hole	1.219 in. 32.811 mm	335mm Bolt Circle	8.670 in	18633/2147	23568	2270	1602	2039
2008 NEW FLYER BRAVO NEAR ZERO 7575-7588	14	305/70R22.5	825 Kpa 120 psi	N/A	825 Kpa 120 psi	886513DB	22.5 x 8.25	15 Degree DC 10 Hole	1.219 in. 32.811 mm	335mm Bolt Circle	8.670 in	18633/2147	23568	2270	1602	2039
2006-2008 NEW FLYER NEAR ZERO 5675-5678, 7529-7574, 7589-7592	54	305/70R22.5	825 Kpa 120 psi	N/A	825 Kpa 120 psi	886513DB	22.5 x 8.25	15 Degree DC 10 Hole	1.219 in. 32.811 mm	335mm Bolt Circle	8.670 in	18633/2147	23568	2270	1602	2039
2006-2008 NEW FLYER 5501-5599, 5601-5674, 7501-7528	201	305/70R22.5	825 Kpa 120 psi	N/A	825 Kpa 120 psi	886513DB	22.5 x 8.25	15 Degree DC 10 Hole	1.219 in. 32.811 mm	335mm Bolt Circle	8.670 in	18633/2147	23568	2270	1602	2039
1998 NEW FLYER CONTINGENCY 5401, 5403, 5406, 5408-5412, 5416	9	275/70R22.5	758 Kpa 110 psi		724 Kpa 105 psi	886513DB	22.5 x 8.25	15 Degree DC 10 Hole	1.219 in. 32.811 mm	335 mm Bolt Circle	281.2 mm	17197	23568	2270	14046	2039
1997 NEW FLYER CONTINGENCY 5302, 5306, 5331, 5335, 5342, 5353, 5354, 5362, 5376, 5387, 5388	11	275/70R22.5	758 Kpa 110 psi		724 Kpa 105 psi	886513DB	22.5 x 8.25	15 Degree DC 10 Hole	1.219 in. 32.811 mm	335 mm Bolt Circle	281.2 mm	17197	23568	2270	14046	2039

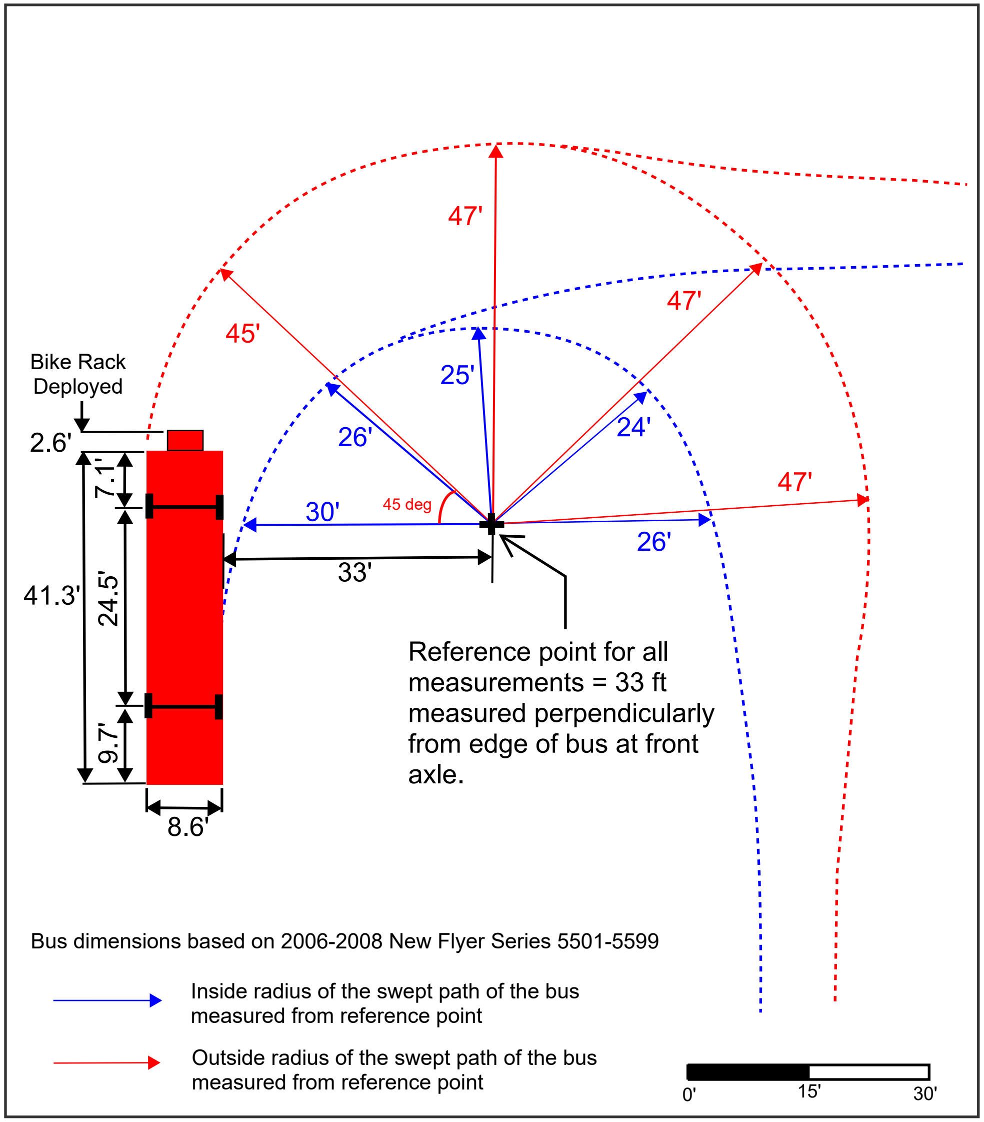
VEHICLE		AIR CONDITIONING SYSTEM							
Bus Series	**Quantity**	**Manufacturer**	**Model**	**Compressor Type**	**Refrigerant Type**	**Charge**	**Oil Charge**	**Funcitonality**	**Unit Mount Location**
2018 NEW FLYER HYDROGEN FUEL CELL 1111-1120	10	Thermo King	TE-15 M3	S616	R-407c	7.7 kg 17 lbs	2.22L 75 fl oz	Heat / AC	Rear
2015 NEW FLYER ARTICULATED 7621-7636	16	Thermo King	Front: RLFHP1MV-M4 Rear: T15E - M6	S616	R-407c	7.7Kg 17.0 lb	2.2L 75oz fl	Heat / AC	Front Roof Rear
2016-2018 NEW FLYER XCELSIOR BRAVO 5801-5814, 5861-5866	20	Thermo King	T15-M11	S391	R-407c	7.7Kg 17.0 lb	2.2L 75oz fl	Heat / AC	Rear
2015 -2016 NEW FLYER XCELSIOR 5701-5799, 5815-5858	143	Thermo King	T15-M11	S391	R-407c	7.7Kg 17.0 lb	2.2L 75oz fl	Heat / AC	Rear
2013 NEW FLYER ARTICULATED 7601-7620	20	Thermo King	Front: RLFHP1 - M4 Rear: T15E - M3	S616	R-407c	7.7Kg 17.0 lb	2.2L 75oz fl	Heat / AC	Front Roof Rear
2008 NEW FLYER NEAR ZERO 5121-5150	30	Thermo King	T-11	S391	R-407c	7.7Kg 17.0 lb	2.2L 75oz fl	Heat / AC	Rear
2008 NEW FLYER BRAVO NEAR ZERO 7575-7588	14	Thermo King	T-11	S391	R-407c	7.7Kg 17.0 lb	2.2L 75oz fl	Heat / AC	Rear
2006-2008 NEW FLYER NEAR ZERO 5675-5678, 7529-7574, 7589-7592	54	Thermo King	T-11	S391	R-407c	7.7 kg 17 lbs	2.22 L 75 fl oz	Heat / AC	Rear
2006-2008 NEW FLYER 5501-5599, 5601-5674, 7501-7528	201	Thermo King	T-11	S391	R-407c	7.7Kg 17.0 lb	2.2L 75oz fl	Heat / AC	Rear
1998 NEW FLYER CONTINGENCY 5401, 5403, 5406, 5408-5412, 5416	9	Thermo King	T11	X426	R-22	7.7 Kg 17.0 lb	3.96 L 134ozfl	Heat / AC	Rear
1997 NEW FLYER CONTINGENCY 5302, 5306, 5331, 5335, 5342, 5353, 5354, 5362, 5376, 5387, 5388	11	Thermo King	T11	X426	R-22	7.7 Kg 17.0 lb	3.96 L 134ozfl	Heat / AC	Rear

VEHICLE		CAMERAS							DESTINATION SIGNS			AUTOMATIC STOP ANNOUNCEMENT						FARE COLLECTION SYSTEM			
Bus Series	**Quantity**	**Manufacturer**	**Model**	**No. of Cameras**	**No. Audio Inputs**	**Special Equip.**	**Drivecam**	**Motion Detectors**	**Manufacturer**	**Model**	**Includes**	**Manufacturer**	**Model**	**ITMS**	**Interior Scrolling Signs**	**Antenna Requirements**	**Automatic Passenger Counter**	**Manufacturer**	**Model**	**Size**	**Power Requirement**
2018 NEW FLYER HYDROGEN FUEL CELL 1111-1120	10	March Networks	GT 12	10	2	Night/Day	1	2	Luminator	Horizon Gen IV	Front, side	ACS	SmartMDT-IVU	Intergrated	Yes	GPS	Yes	GFI	Odessy	36.25"	24V DC
2015 NEW FLYER ARTICULATED 7621-7636	16	March Networks	5412	13	2	Night/Day	1	2	Luminator	Horizon Gen IV	Front, side	ACS	SmartMDT-IVU	Intergrated	Yes	GPS	Yes	GFI	Odessy	36.25"	24V DC
2016-2018 NEW FLYER XCELSIOR BRAVO 5801-5814, 5861-5866	20	March Networks	GT 12	10	2	Night/Day	1	2	Luminator	Horizon Gen IV	Front, side	ACS	SmartMDT-IVU	Intergrated	Yes	GPS	Yes	GFI	Odessy	36.25"	24V DC
2015 -2016 NEW FLYER XCELSIOR 5701-5799, 5815-5858	143	March Networks	GT 12	10	2	Night/Day	1	2	Luminator	Horizon Gen IV	Front, side	ACS	SmartMDT-IVU	Intergrated	Yes	GPS	Yes	GFI	Odessy	36.25"	24V DC
2013 NEW FLYER ARTICULATED 7601-7620	20	March Networks	5412	10	2	Night/Day	1	2	Luminator	Horizon Gen IV	Front, side and rear	ACS	SmartMDT-IVU	Intergrated	Yes	GPS	Yes	GFI	Odessy	36.25"	24V DC
2008 NEW FLYER NEAR ZERO 5121-5150	30	March Networks	5308	7	2	Night/Day	1	2	Luminator	GEN IV	Front, side	ACS	SmartMDT-IVU	Intergrated	Yes	GPS	Yes	GFI	Odessy	36.25"	24V DC
2008 NEW FLYER BRAVO NEAR ZERO 7575-7588	14	March Networks	5308	7	2	Night/Day	1	2	Luminator	GEN IV	Front, side	ACS	SmartMDT-IVU	Intergrated	Yes	GPS	Yes	GFI	Odessy	36.25"	24V DC
2006-2008 NEW FLYER NEAR ZERO 5675-5678, 7529-7574, 7589-7592	54	March Networks	5308	7	2	Night/Day	1	2	Luminator	GEN IV	Front, side	ACS	SmartMDT-IVU	Intergrated	Yes	GPS	Yes	GFI	Odessy	36.25"	24V DC
2006-2008 NEW FLYER 5501-5599, 5601-5674, 7501-7528	201	March Networks	5308	7	2	Night/Day	1	2	Luminator	GEN IV	Front, side	ACS	SmartMDT-IVU	Intergrated	Yes	GPS	Yes	GFI	Odessy	36.25"	24V DC
1998 NEW FLYER CONTINGENCY 5401, 5403, 5406, 5408-5412, 5416	9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Luminator	GTI	Front, side	N/A	N/A	N/A	N/A	N/A	No	GFI	Odessy	36.25"	24V DC
1997 NEW FLYER CONTINGENCY 5302, 5306, 5331, 5335, 5342, 5353, 5354, 5362, 5376, 5387, 5388	11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Luminator	GTI	Front, side	N/A	N/A	N/A	N/A	N/A	No	GFI	Odessy	36.25"	24V DC

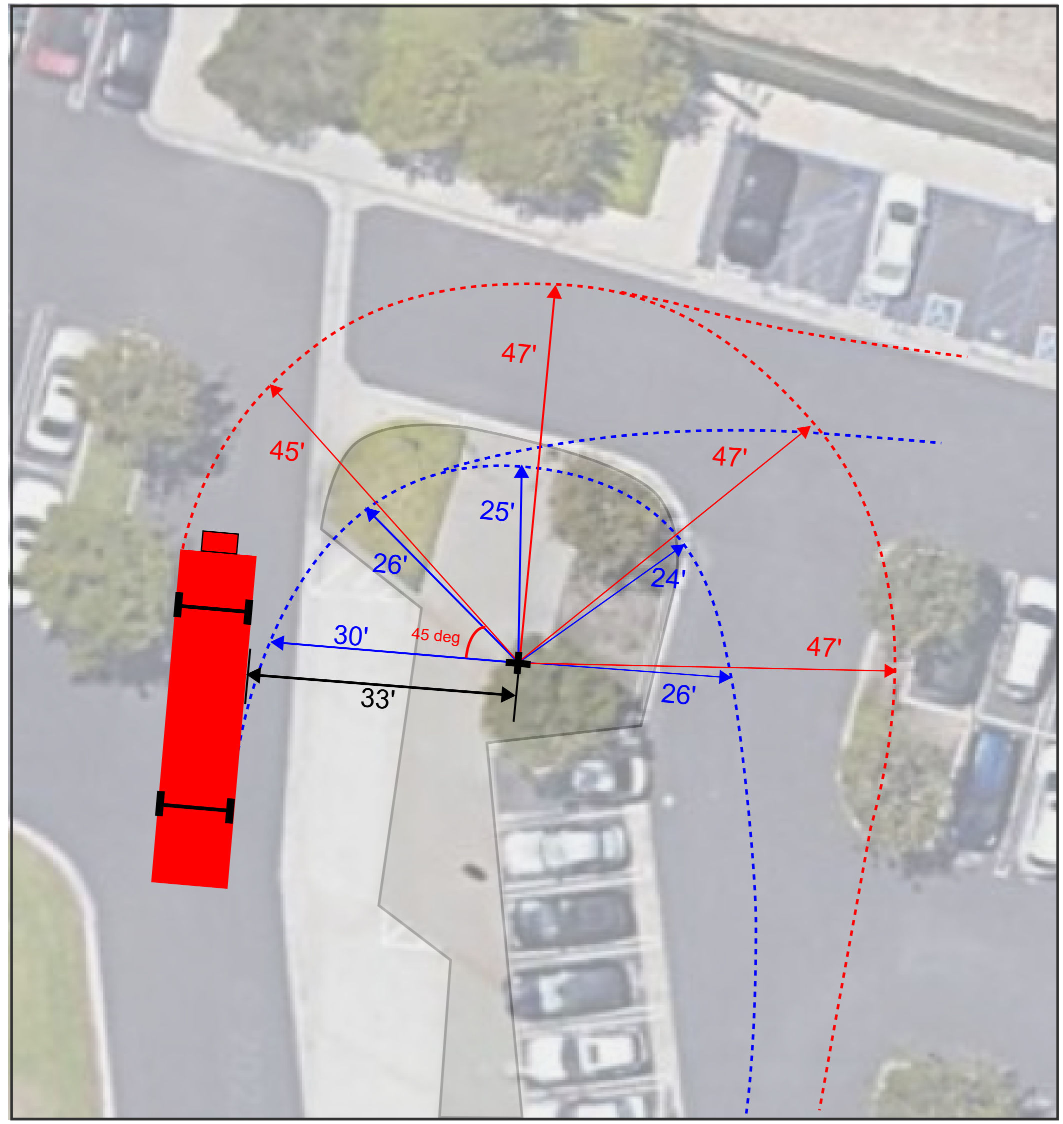
VEHICLE		VEHICLE BATTERY SYSTEM					BATTERY EQUALIZER		MULTIPLEX SYSTEM		VEHICLE COMMUNICATION PLATFORM	RADIO SYSTEM			MOBILE DATA TERMINAL				Fleetwatch	
Bus Series	Quantity	12/24V	Alternator Type	Dual Alternator	Voltage Regulator	Battery System	Type	Over Voltage Protection Equip	Manufacturer	Model		Radio Freq	Radio Mfg	Antenna Requirements	Manufacturer	Model	Integration	Wireless Ability	Type (VIT/CANCEIVER)	CLASS System
2018 NEW FLYER HYDROGEN FUEL CELL 1111-1120	10	12/24V	N/A	N/A	N/A	GRP31/AGM	Vanner	Yes	Parker-Vansco	VMM 1615	J1939 CAN	800 MHz	Harris	RF	Xerox ACS	OrbStar 8400-4	ASAS	Yes	JX55	Yes
2015 NEW FLYER ARTICULATED 7621-7636	16	12/24V	EMP 535	No	Transtech REG24C	GRP31/AGM	Vanner 70-100	Yes	Parker-Vansco	VMM 1615	J1939 CAN	800 MHz	Xerox/ITMS/ACS	RF	Orbital	OrbGuide	ASAS	Yes	Canceiver	Yes
2016-2018 NEW FLYER XCELSIOR BRAVO 5801-5814, 5861-5866	20	12/24V	EMP 450	No	Transtech REG24C	GRP31/AGM	Vanner 70-100	Yes	Parker-Vansco	VMM 1615	J1939 CAN	800 MHz	Harris	RF	Xerox ACS	OrbStar 8400-4	ASAS	Yes	JX55	Yes
2015 -2016 NEW FLYER XCELSIOR 5701-5799, 5815-5858	143	12/24V	EMP 450	No	Transtech REG24C	GRP31/AGM	Vanner 70-100	Yes	Parker-Vansco	VMM 1615	J1939 CAN	800 MHz	Harris	RF	Xerox ACS	OrbStar 8400-4	ASAS	Yes	JX55	Yes
2013 NEW FLYER ARTICULATED 7601-7620	20	12/24V	EMP 450	No	Transtech REG24C	GRP31/AGM	Vanner 80-100 CAN	Yes	Parker-Vansco	VMM 1615	J1939 CAN	800 MHz	Xerox/ITMS/ACS	RF	Orbital	OrbGuide	ASAS	Yes	Canceiver	Yes
2008 NEW FLYER NEAR ZERO 5121-5150	30	12/24V	50DN	No	Delco	GRP31/AGM	Vanner	Yes	Parker-Vansco	VMM 1210	J1939 CAN	800 MHz	M/A Com-OpenSKY	RF	Orbital	OrbGuide	ASAS	Yes	Canceiver	Yes
2008 NEW FLYER BRAVO NEAR ZERO 7575-7588	14	12/24V	50DN	No	Delco	GRP31/AGM	Vanner 70-100	Yes	Parker-Vansco	VMM 1210	J1939 CAN	800 MHz	M/A Com-OpenSKY	RF	Orbital	OrbGuide	ASAS	Yes	Canceiver	Yes
2006-2008 NEW FLYER NEAR ZERO 5675-5678, 7529-7574, 7589-7592	54	12/24V	50DN	No	Delco	GRP31/AGM	Vanner 70-100	Yes	Parker-Vansco	VMM 1210	J1939 CAN	800 MHz	M/A Com-OpenSKY	RF	Orbital	OrbGuide	ASAS	Yes	Canceiver	Yes
2006-2008 NEW FLYER 5501-5599, 5601-5674, 7501-7528	201	12/24V	50DN	No	Delco	GRP31/AGM	Vanner 70-100	Yes	Parker-Vansco	VMM 1210	J1939 CAN	800 MHz	M/A Com-OpenSKY	RF	Orbital	OrbGuide	ASAS	Yes	Canceiver	Yes
1998 NEW FLYER CONTINGENCY 5401, 5403, 5406, 5408-5412, 5416	9	12/24V	50DN	No	Delco	8D	Vanner	Yes	Allen Bradley	SLC 500	J1939 CAN	800 MHz	M/A Com-OpenSKY	RF	Orbital	OrbGuide	ASAS	Yes	VIT	No
1997 NEW FLYER CONTINGENCY 5302, 5306, 5331, 5335, 5342, 5353, 5354, 5362, 5376, 5387, 5388	11	12/24V	50DN	No	Delco	8D	Vanner	Yes	Allen Bradley	SLC 500	J1939 CAN	800 MHz	M/A Com-OpenSKY	RF	Orbital	OrbGuide	ASAS	Yes	VIT	No

VEHICLE		ENGINE			EMISSIONS				
Bus Series	**Quantity**	**Type**	**Engine Year**	**Engine Model**	**Executive Order**	**NMHC**	**NOX**	**CO**	**PM**
2018 NEW FLYER HYDROGEN FUEL CELL 1111-1120	10	H2	2018	Siemens PEM 1DB2022	N/A	N/A	N/A	N/A	N/A
2015 NEW FLYER ARTICULATED 7621-7636	16	CNG	2013	ISL-G 8.9L	A-021-0606	0.14	0.2	15.5	0.01
2016-2018 NEW FLYER XCELSIOR BRAVO 5801-5814, 5861-5866	20	CNG	2013	ISL G 8.9L	A-021-0606	0.14	0.2	15.5	0.01
2015 -2016 NEW FLYER XCELSIOR 5701-5799, 5815-5858	143	CNG	2013	ISL G 8.9L	A-021-0606	0.14	0.2	15.5	0.01
2013 NEW FLYER ARTICULATED 7601-7620	20	CNG	2010	ISL-G 8.9L	A-021-0538	0.14	0.2	15.5	0.01
2008 NEW FLYER NEAR ZERO 5121-5150	30	CNG	2017/2018	ISL-G 8.9L Near Zero	A-021-0629	0.14	0.02	15.5	0.01
2008 NEW FLYER BRAVO NEAR ZERO 7575-7588	14	CNG	2017/2018	ISL-G 8.9L Near Zero	A-021-0629	0.14	0.02	15.5	0.01
2006-2008 NEW FLYER NEAR ZERO 5675-5678, 7529-7574, 7589-7592	54	CNG	2017/2018	ISL-G 8.9L Near Zero	A-021-0629	0.14	0.02	15.5	0.01
2006-2008 NEW FLYER 5501-5599, 5601-5674, 7501-7528	201	CNG	2010	ISL-G 8.9L	A-021-0457-2	0.14	0.2	15.5	0.01
1998 NEW FLYER CONTINGENCY 5401, 5403, 5406, 5408-5412, 5416	9	Diesel	2001	ISC 8.3L	A-21-291	1.3	4	15.5	0.05
1997 NEW FLYER CONTINGENCY 5302, 5306, 5331, 5335, 5342, 5353, 5354, 5362, 5376, 5387, 5388	11	Diesel	2001	ISC 8.3L	A-21-291	1.3	4	15.5	0.05

Appendix B
Bus Turning Radii Templates



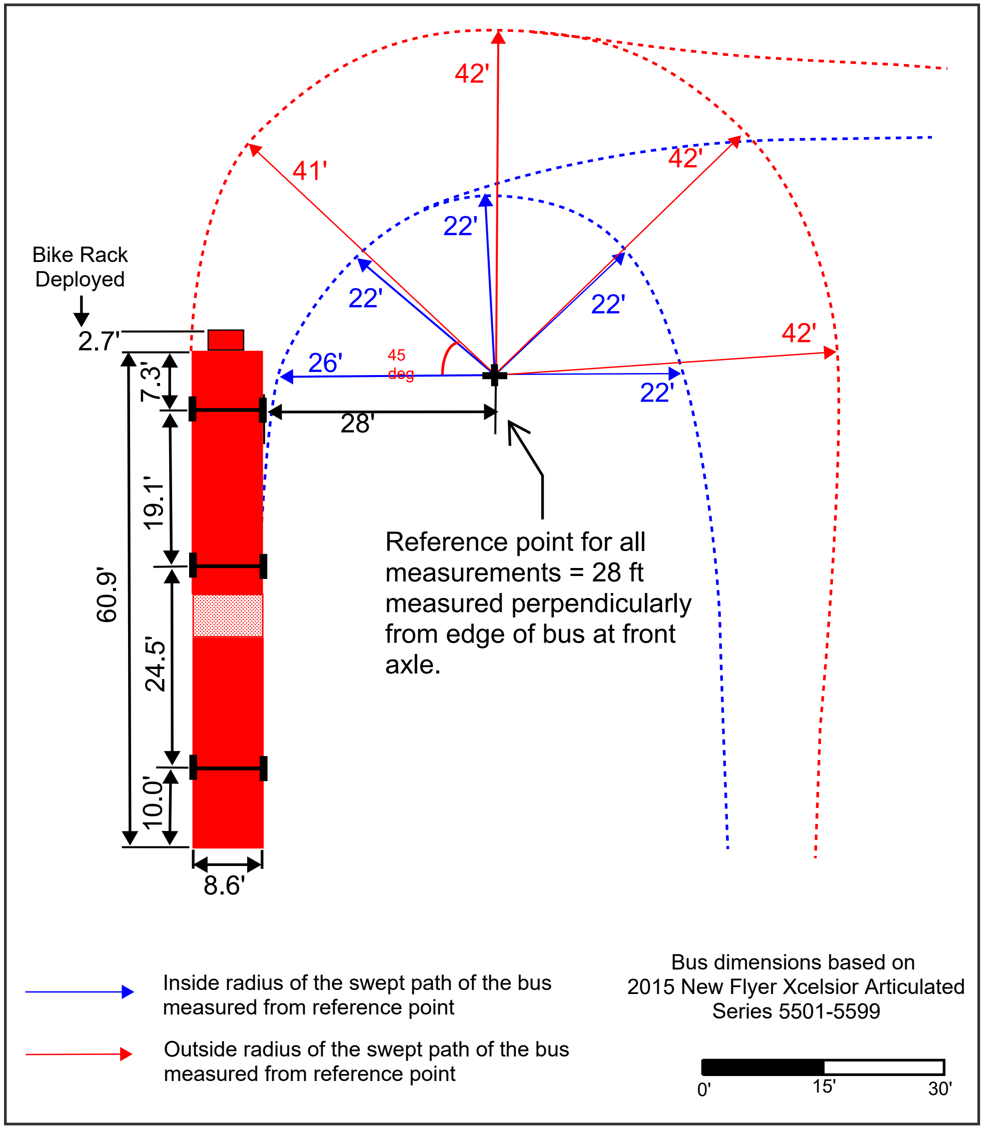
Maximum and minimum radii of the swept path of a 40 foot bus.



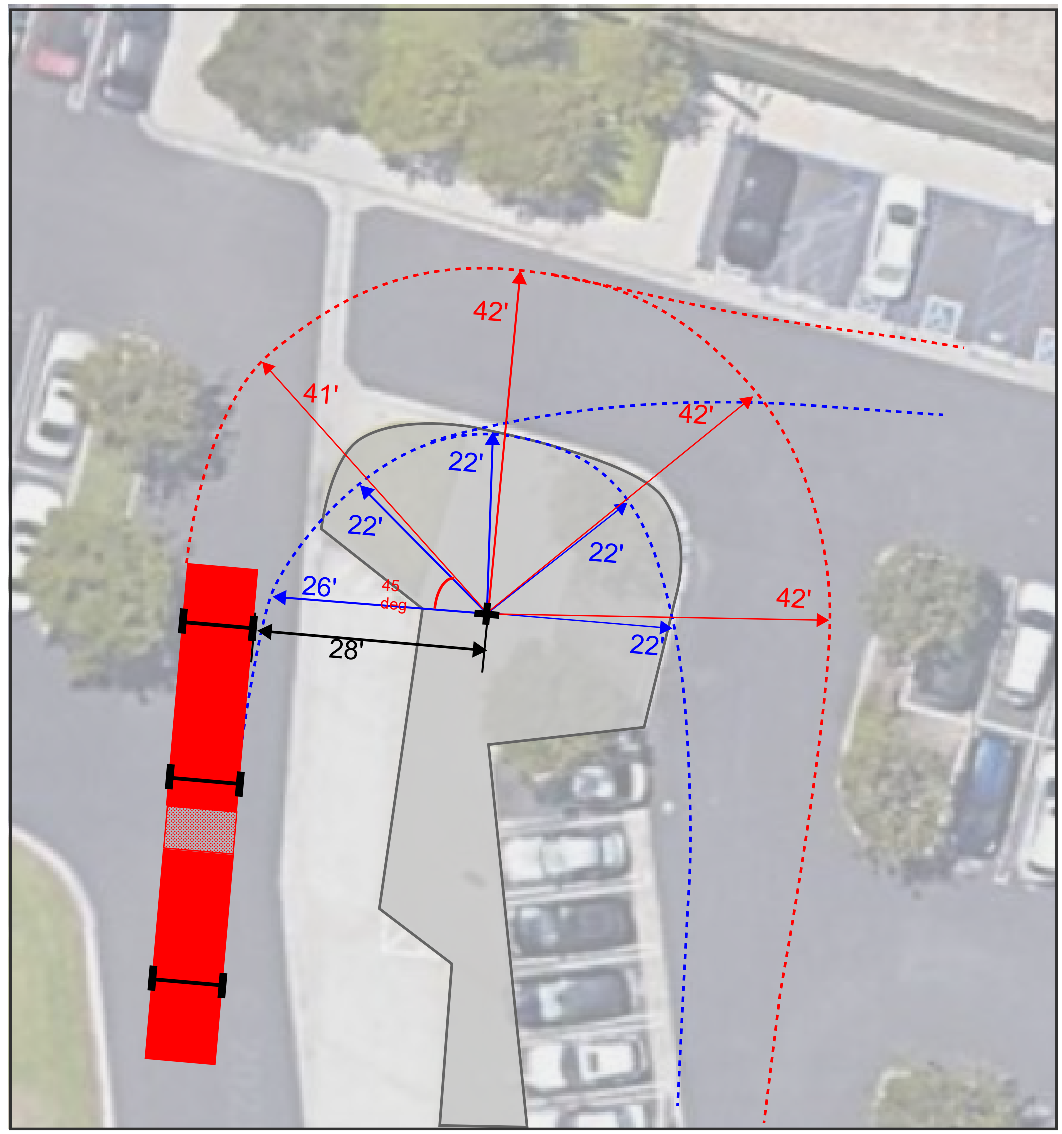
Example application of the swept path of a 40 foot bus to determine adequacy of circulation or curb radius reconstruction.

OCTA

TURNING TEMPLATE FOR A STANDARD 40-FOOT BUS



Maximum and minimum radii of the swept path of a 60 foot articulated bus.

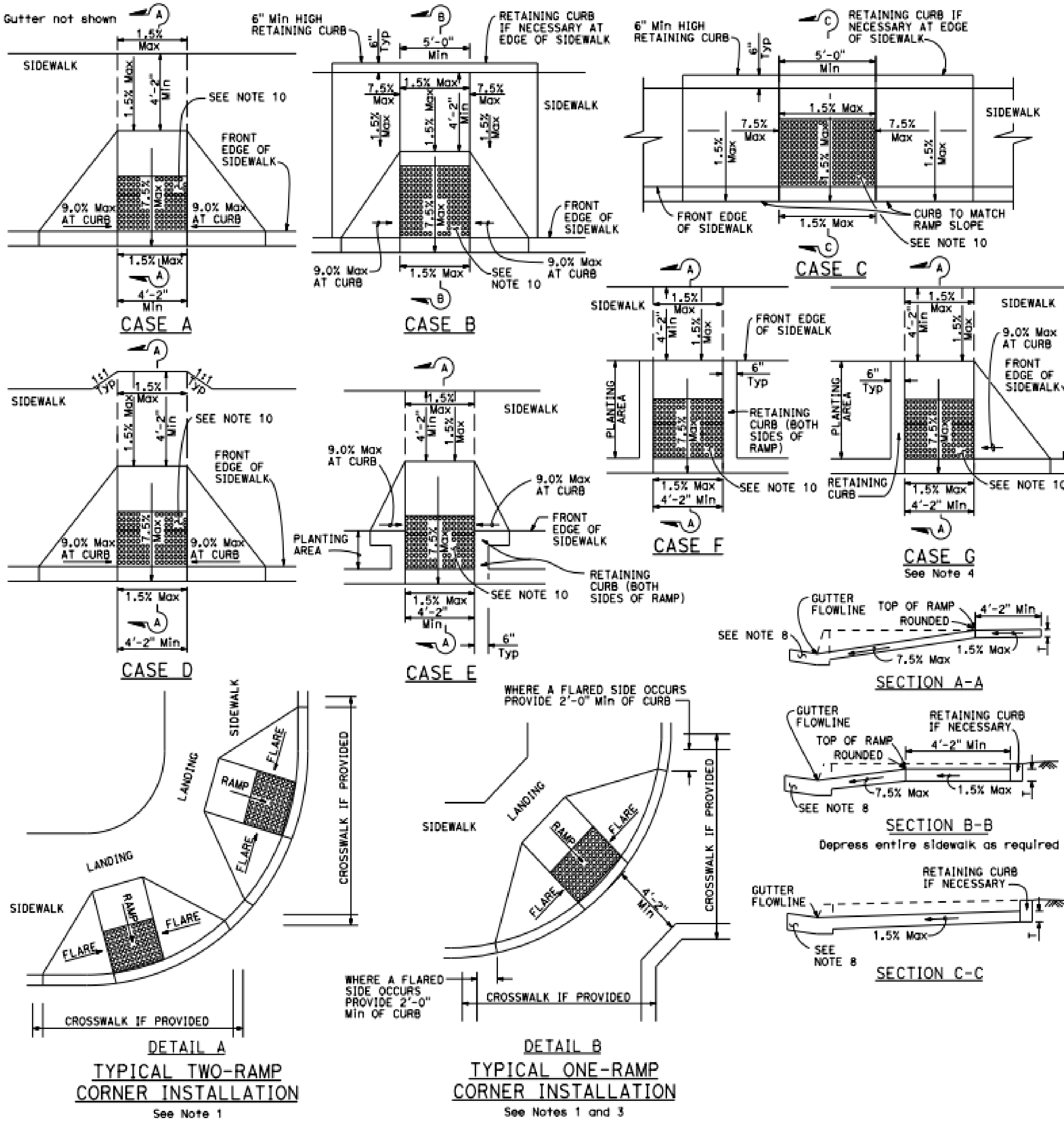


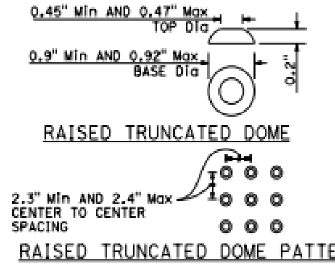
Example application of the swept path of a 60 foot articulated bus to determine adequacy of circulation or curb radius reconstruction.

OCTA

TURNING TEMPLATE FOR 60-FOOT ARTICULATED BUS

Appendix C
Bus Stop Technical Specifications





Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS

REGISTERED CIVIL ENGINEER

May 31, 2018

PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

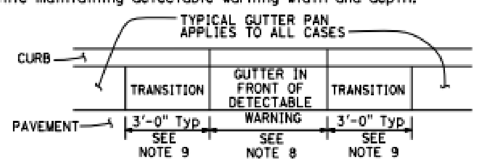
REGISTERED PROFESSIONAL ENGINEER Rebecca Lynn Mowry No. C54415 Exp. 12-31-19 CIVIL STATE OF CALIFORNIA

DETECTABLE WARNING SURFACE

See Note 10

NOTES:

1. As site conditions dictate, Case A through Case G curb ramps may be used for corner installations similar to those shown in Detail A and Detail B. The case of curb ramps used in Detail A do not have to be the same. Case A through Case G curb ramps also may be used at mid block locations, as site conditions dictate. For specific site condition configuration, including the conform to existing sidewalk, see Project Plans.
2. If distance from curb to back of sidewalk is too short to accommodate ramp and 4'-2" platform (landing) as shown in Case A, the sidewalk may be depressed longitudinally as in Case B or C or may be widened as in Case D.
3. When ramp is located in center of curb return, crosswalk configuration must be similar to that shown for Detail B.
4. As site conditions dictate, the retaining curb side and the flared side of the Case G ramp shall be constructed in reversed position.
5. The ramp portion of the curb ramp is a typical rectangle, unless modified in the Project Plans.
6. Side slope of ramp flares vary uniformly from a maximum of 9.0% at curb to conform with longitudinal sidewalk slope adjacent to top of the ramp, except in Case C and Case F.
7. The adjacent surfaces at transitions at curb ramps to walks, gutters, and streets shall be at the same level.
8. Counter slopes of adjoining gutters and road surfaces immediately adjacent to and within 24 inches of the curb ramp shall not be steeper than 1V:20H (5.0%). Gutter pan slope shall not exceed 1" of depth for each 2'-0" of width.
9. Transition gutter pan slope from 1" of depth for each 2'-0" of width to match typical gutter pan slope per Standard Plan A87A.
10. The detectable warning surface will be a rectangle as shown at back of curb, unless modified in the Project Plans. Curb ramps shall have a detectable warning surface that extends the full width and 3'-0" depth of the ramp. Detectable warning surfaces shall extend the full width of the ramp except a maximum gap of 1 inch is allowed on each side of the ramp. Detectable warning surfaces shall conform to the requirements in the Standard Specifications.
11. Sidewalk and ramp thickness, "T", shall be 3½" minimum.
12. Utility pull boxes, manholes, vaults and all other utility facilities within the boundaries of the curb ramp will be relocated or adjusted to grade by the owner prior to, or in conjunction with, curb ramp construction.
13. Detectable warning surface may have to be cut to allow removal of utility covers while maintaining detectable warning width and depth.



GUTTER PAN TRANSITION

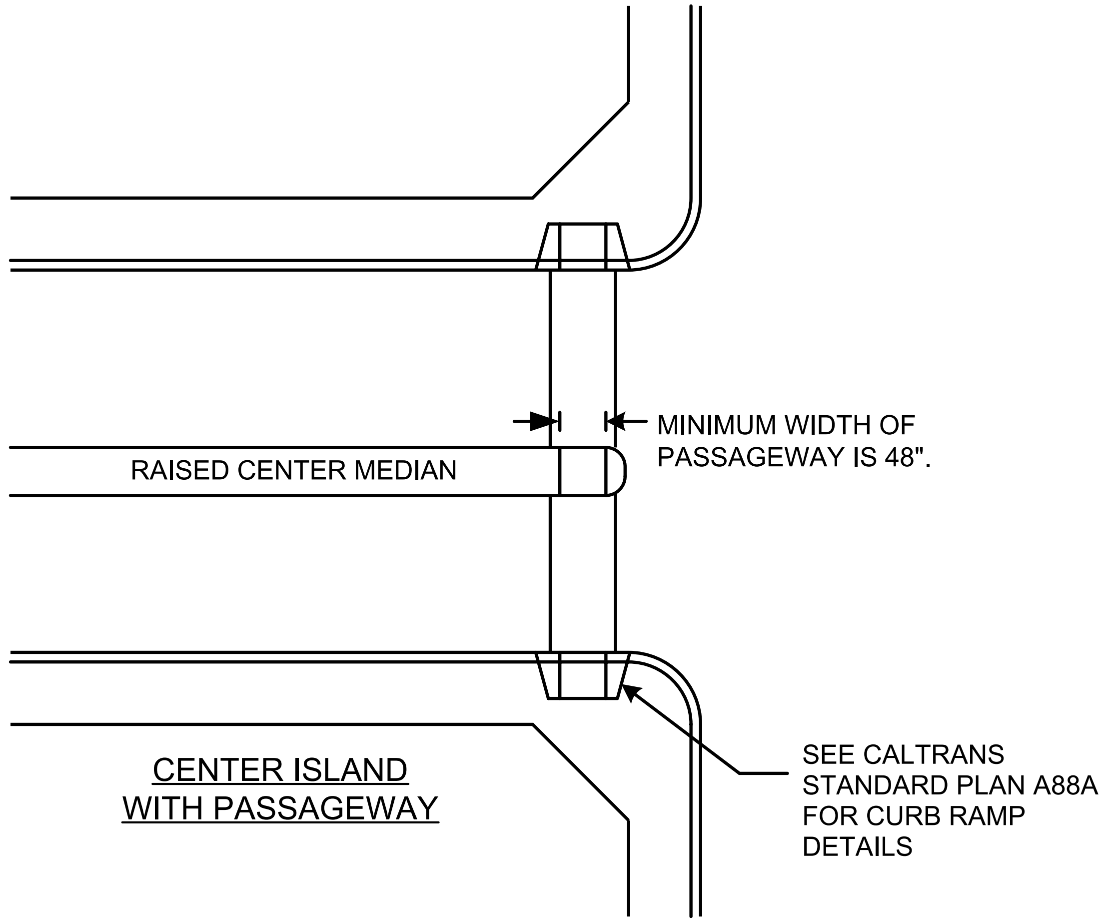
2018 STANDARD PLAN A88A

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

CURB RAMP DETAILS

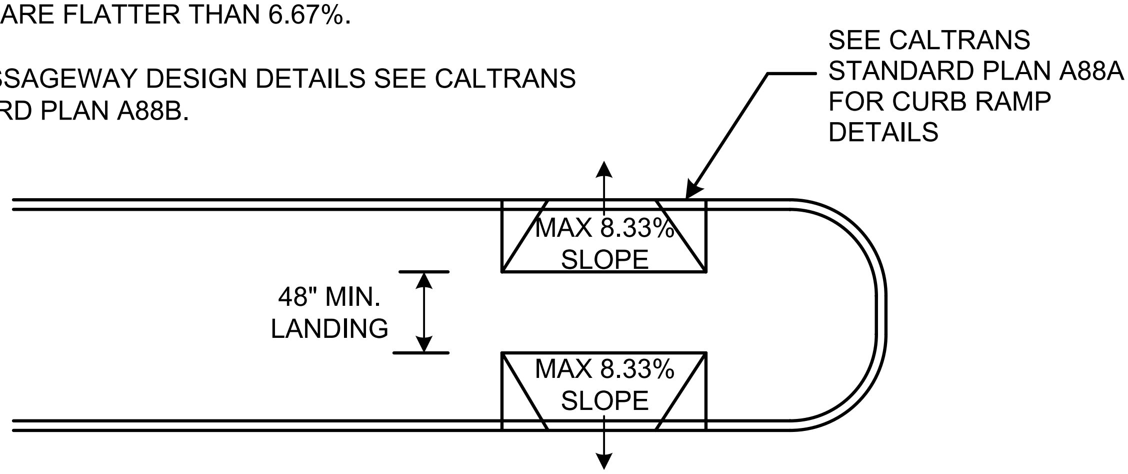
NO SCALE

A88A



CENTER ISLAND WITH PASSAGEWAY

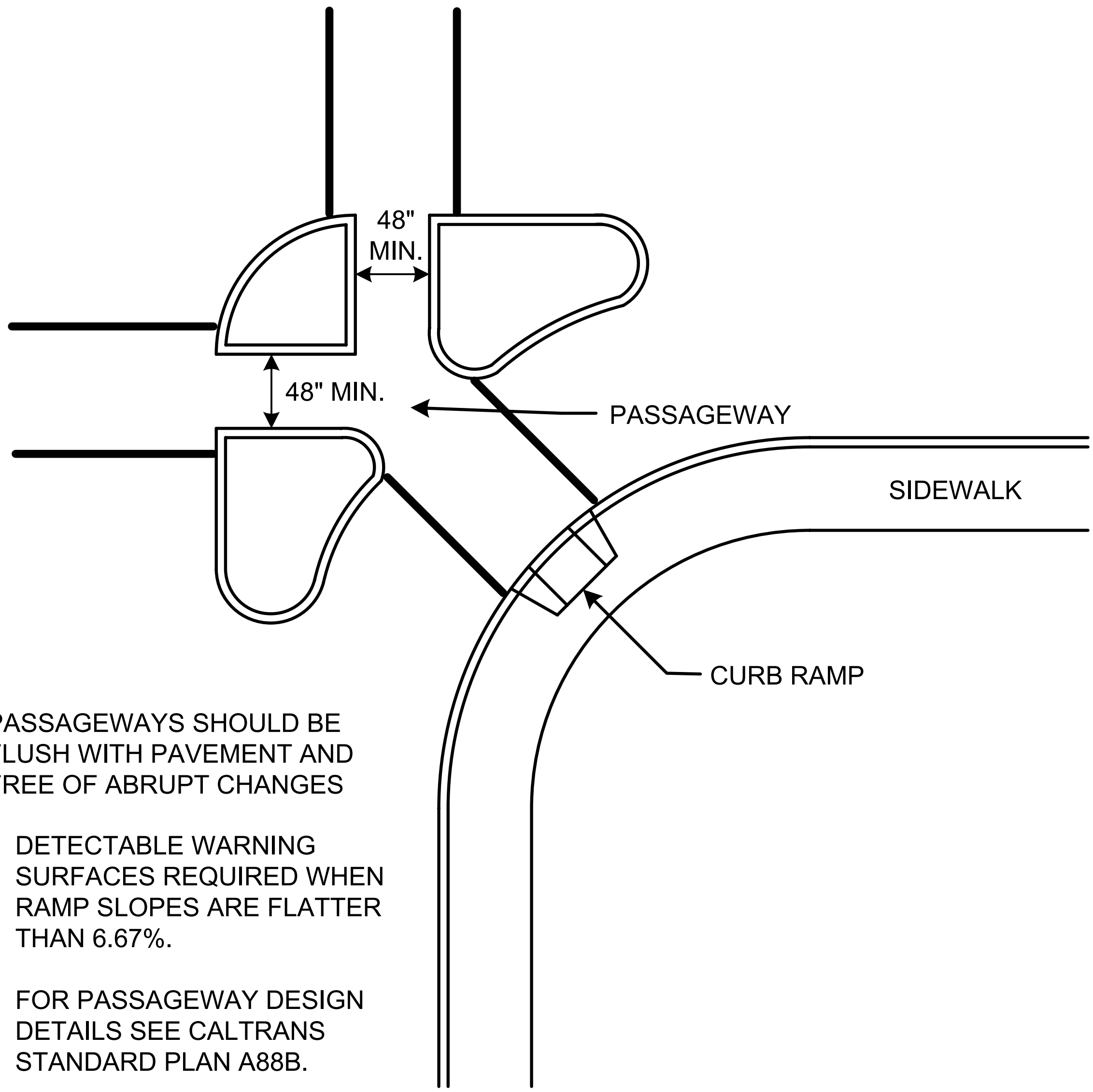
- IF RAISED MEDIAN IS WIDER THAN 12', CURB RAMPS MAY BE USED AS LONG AS MINIMUM SLOPE AND LANDING REQUIREMENTS ARE MET.
- IF NOT USING CURB RAMPS, PASSAGEWAY SHOULD BE FLUSH WITH PAVEMENT AND FREE OF ABRUPT CHANGES.
- DETECTABLE WARNING SURFACE REQUIRED WHEN RAMP SLOPES ARE FLATTER THAN 6.67%.
- FOR PASSAGEWAY DESIGN DETAILS SEE CALTRANS STANDARD PLAN A88B.



CENTER ISLAND WITH CURB RAMPS

ORANGE COUNTY TRANSPORTATION AUTHORITY

CENTER ISLAND WITH PASSAGEWAY OR CURB RAMPS FOR ACCESSIBILITY



PASSAGEWAYS SHOULD BE FLUSH WITH PAVEMENT AND FREE OF ABRUPT CHANGES

- DETECTABLE WARNING SURFACES REQUIRED WHEN RAMP SLOPES ARE FLATTER THAN 6.67%.
- FOR PASSAGEWAY DESIGN DETAILS SEE CALTRANS STANDARD PLAN A88B.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS

REGISTERED CIVIL ENGINEER

May 31, 2018

PLANS APPROVAL DATE

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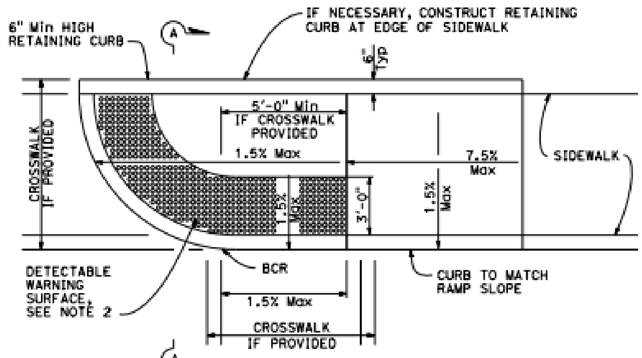
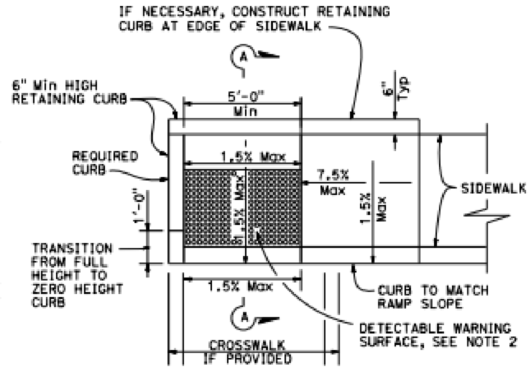
REGISTERED PROFESSIONAL ENGINEER Rebecca Lynn Mowry No. C54415 Exp. 12-31-19 CIVIL STATE OF CALIFORNIA

2018 STANDARD PLAN A88B

Gutter not shown



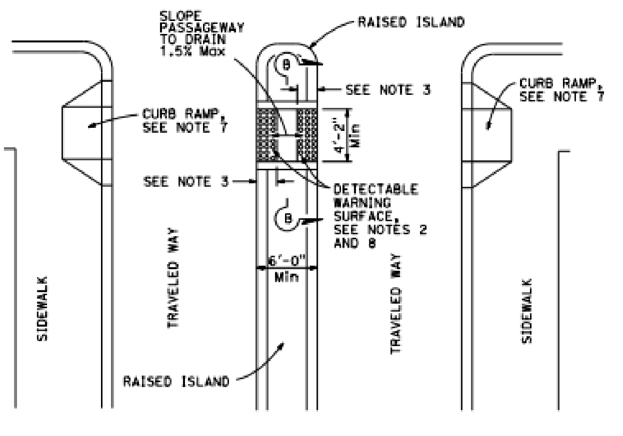
CASE CM CURB RAMP



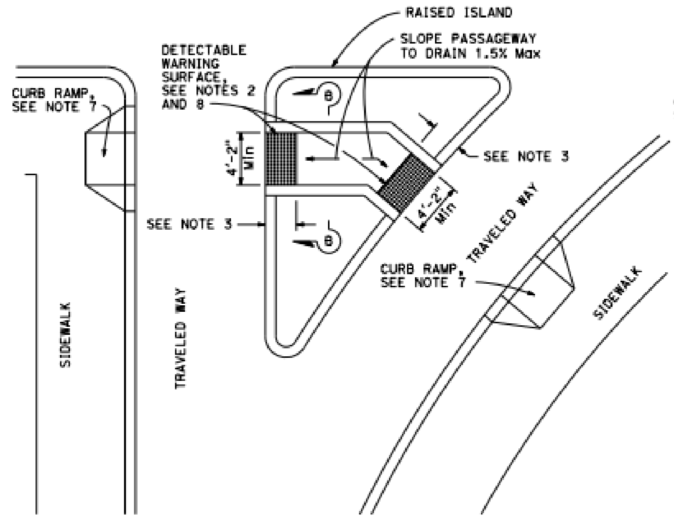
CASE CH CURB RAMP

NOTES:

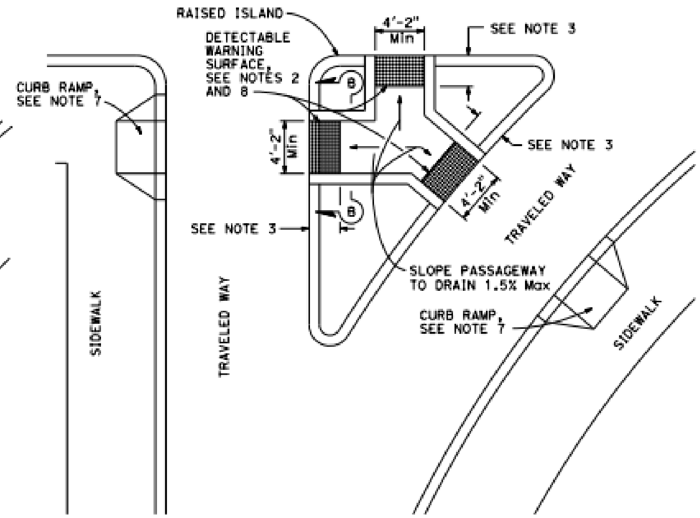
1. Sidewalk, ramp and passageway thickness, "T", shall be 3½" minimum.
2. For details of detectable warning surfaces, see Standard Plan A88A.
3. Where an island passageway length is greater than or equal to 6'-0", but less than 8'-0", each detectable warning surface shall extend the full width and 2'-0" depth of the passageway length. Where an island passageway length is greater than or equal to 8'-0", each detectable warning surface shall extend the full width and 3'-0" depth of the passageway length. Detectable warning surfaces shall extend the full width of the island passageway except a maximum gap of 1 inch is allowed on each side of the passageway.
4. The adjacent surfaces at transitions at curb ramps to walks, gutters, and streets shall be at the same level.
5. Utility pull boxes, manholes, vaults and all other utility facilities within the boundaries of the curb ramp will be relocated or adjusted to grade by the owner prior to, or in conjunction with, curb ramp construction.
6. Detectable warning surface may have to be cut to allow removal of utility covers while maintaining detectable warning width and depth.
7. For additional curb ramp details, see Standard Plan A88A.
8. The detectable warning surface will be a rectangle as shown at the face of curb, unless modified in the Project Plans.



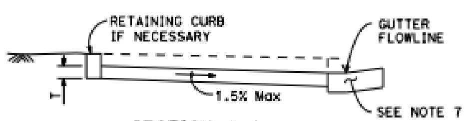
TYPE A PASSAGEWAY



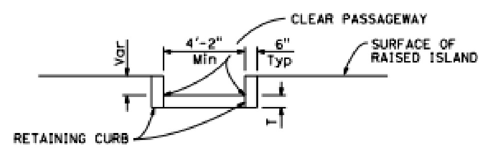
TYPE B PASSAGEWAY



TYPE C PASSAGEWAY



SECTION A-A



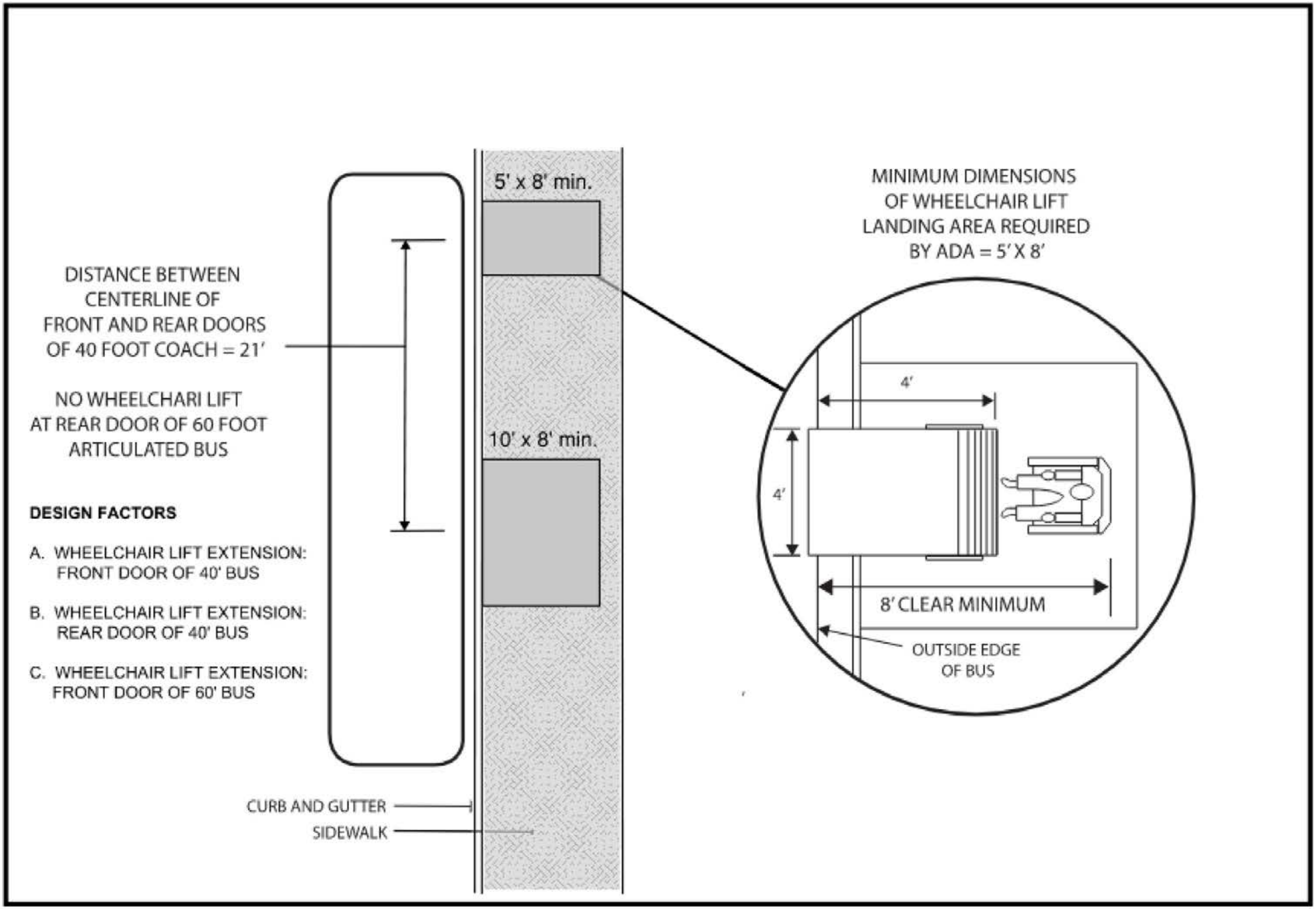
SECTION B-B

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

CURB RAMP AND ISLAND PASSAGEWAY DETAILS

NO SCALE

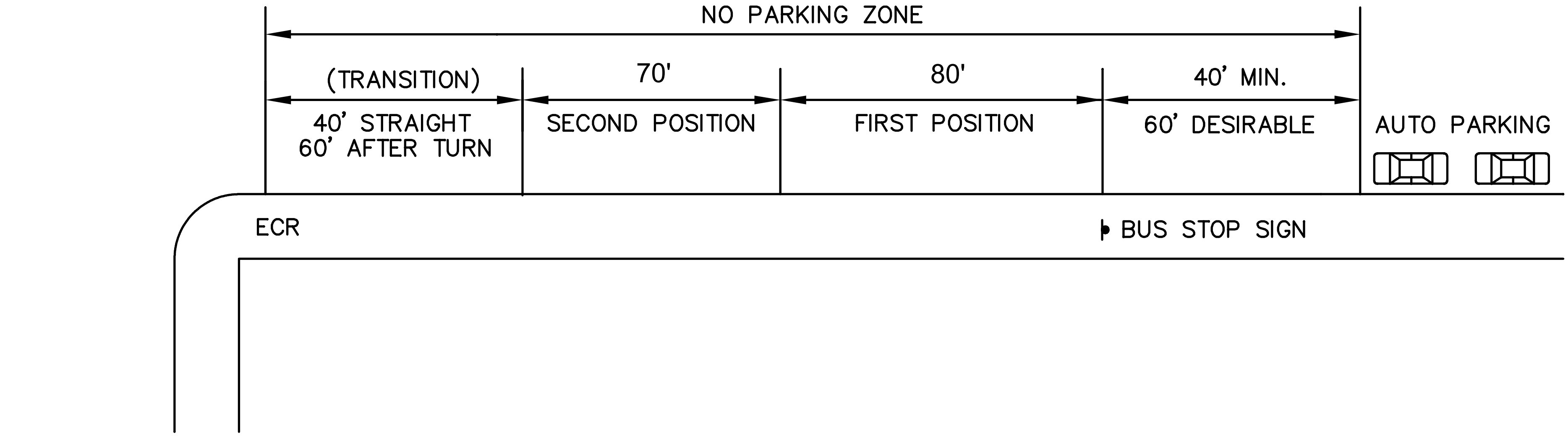
A88B

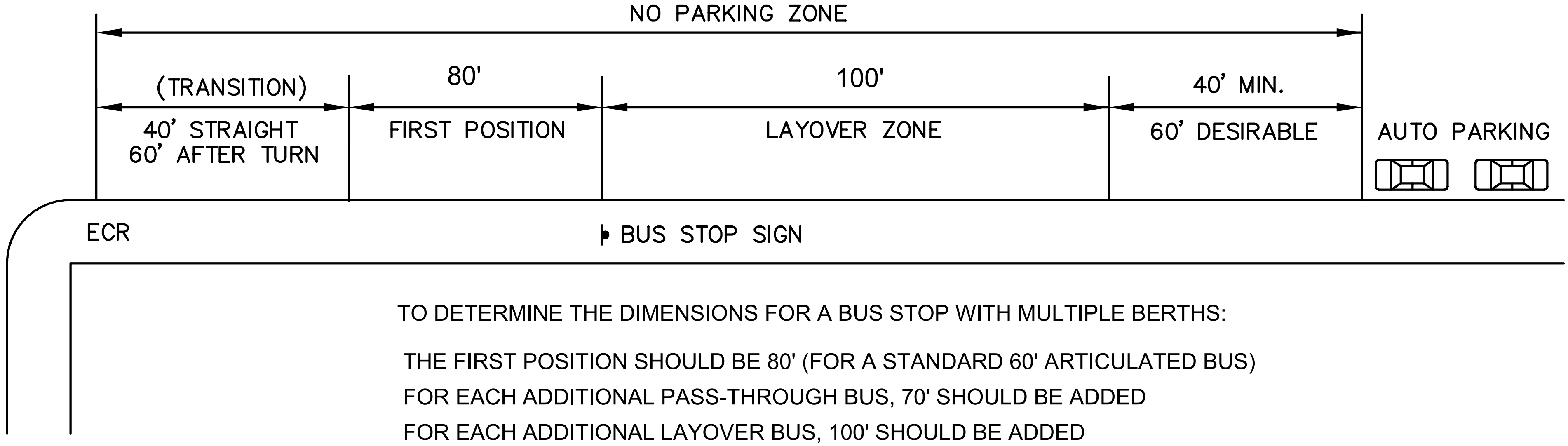


ORANGE COUNTY TRANSPORTATION AUTHORITY

OCTA

WHEELCHAIR LIFT DIMENSIONS



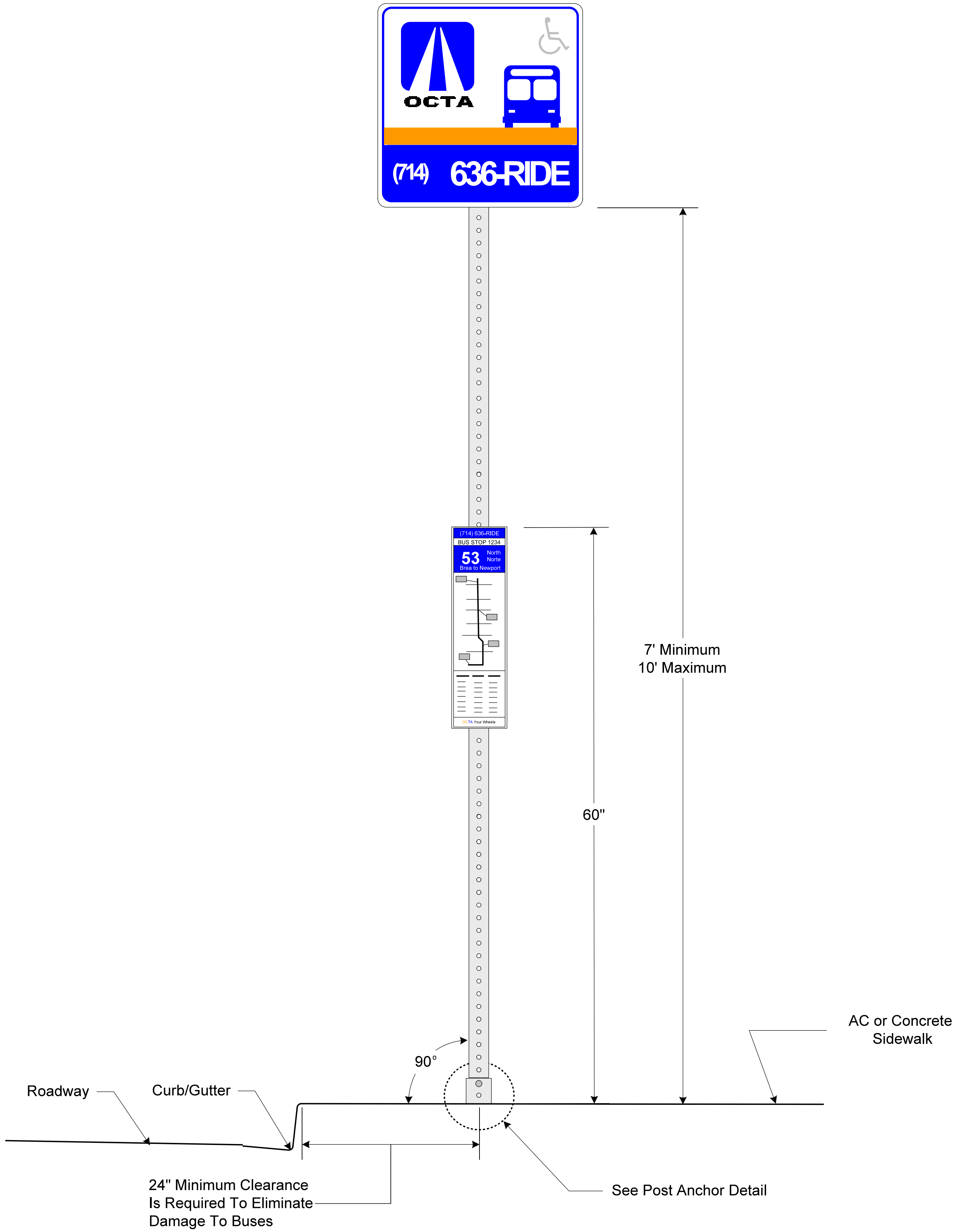


TO DETERMINE THE DIMENSIONS FOR A BUS STOP WITH MULTIPLE BERTHS:

THE FIRST POSITION SHOULD BE 80' (FOR A STANDARD 60' ARTICULATED BUS)
FOR EACH ADDITIONAL PASS-THROUGH BUS, 70' SHOULD BE ADDED
FOR EACH ADDITIONAL LAYOVER BUS, 100' SHOULD BE ADDED

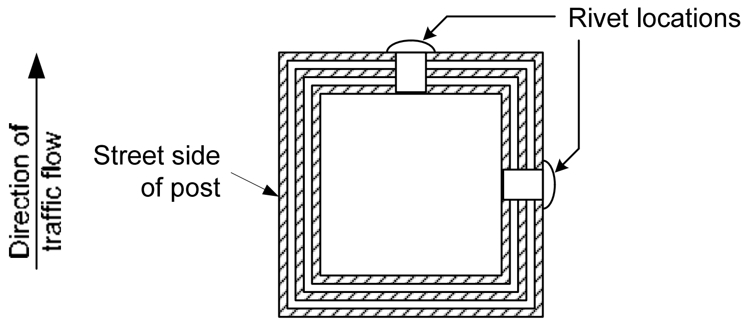
ORANGE COUNTY TRANSPORTATION AUTHORITY

DIMENSIONS FOR MULTIPLE BERTH ON-STREET BUS STOPS

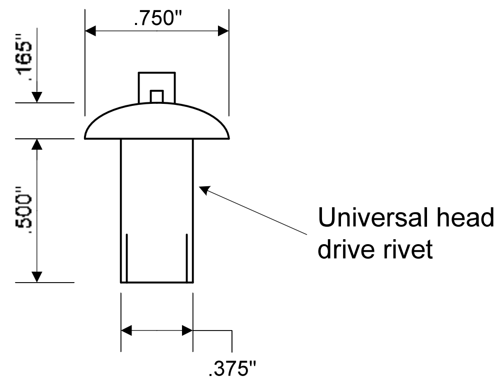


ORANGE COUNTY
TRANSPORTATION AUTHORITY

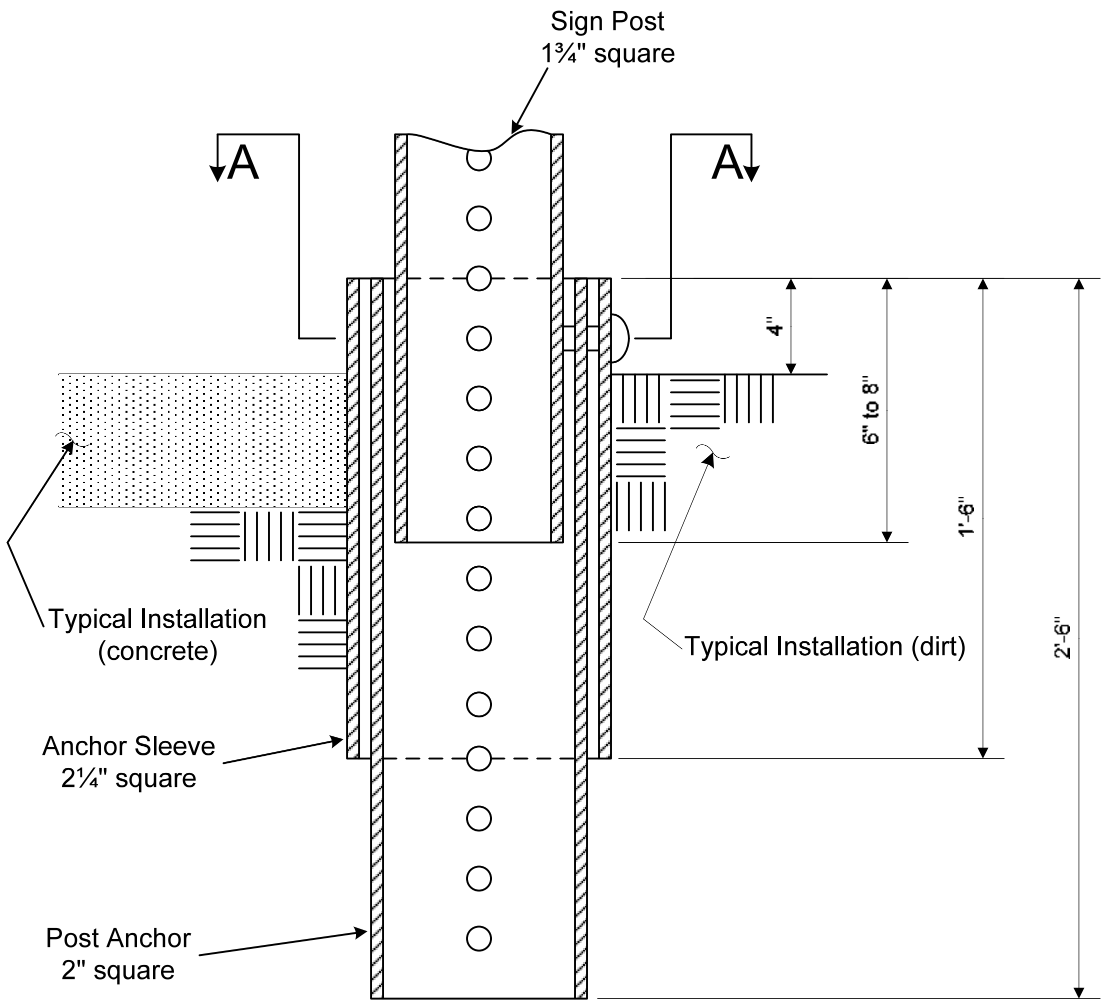
BUS STOP SIGN
PLACEMENT CRITERIA



SECTION A-A



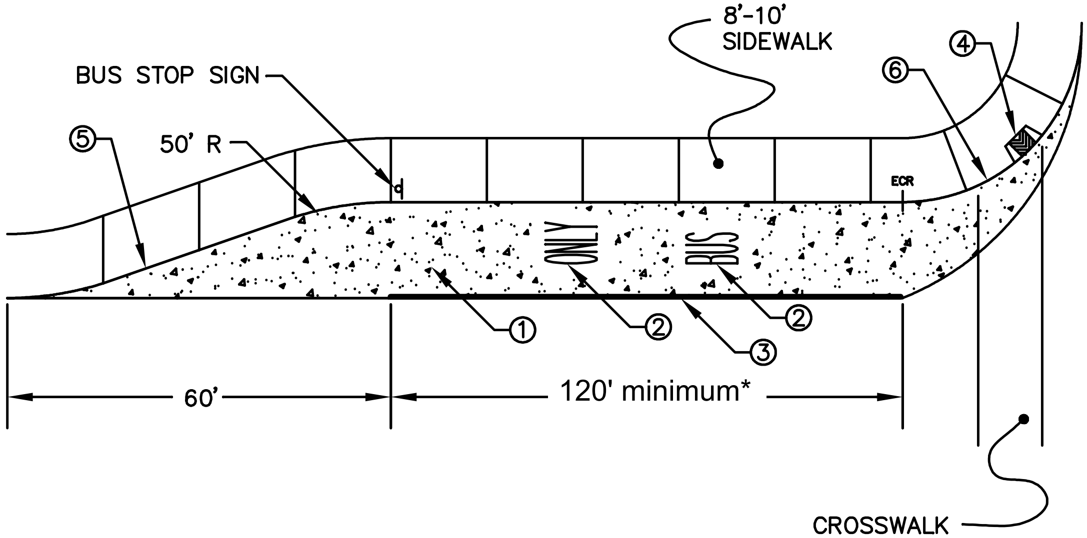
RIVET DETAIL



TYPICAL SECTION

ORANGE COUNTY
TRANSPORTATION AUTHORITY

TYPICAL POST ANCHOR DETAIL



NOTES:

1. 12' TO 14' WIDE CONCRETE BUS PAD INCLUDING MONOLITHIC CURB. STRUCTURAL SECTION OF PAD SHOULD CONFORM TO LOCAL JURISDICTION STANDARD. IF NO LOCAL STANDARD EXISTS USE 9" DEEP CONCRETE WITHOUT RE-BAR, OR 8" DEEP WITH #3 RE-BAR AT 18" ON CENTER.
   EXACT PAD PLACEMENT WILL VARY BY LOCATION. CONTACT OCTA BEFORE PLACING PAD.
2. PER CALTRANS STANDARD PLANS A24E (OPTIONAL).
3. PER CALTRANS STANDARD PLANS A20D, DETAIL 38A.
4. WHEELCHAIR ACCESS RAMP (LOCATION WILL VARY).
5. WHENEVER POSSIBLE DRIVEWAYS SHOULD NOT BE PLACED WITHIN THE TURNOUT / BUS STOP ZONE.
6. TURN RADIUS VARIES, BUT SHOULD BE A MINIMUM OF 28' (30' DESIRABLE). USE APPROPRIATE TURNING TEMPLATE FOR DESIGN.

* STANDARD TURNOUT AND CONCRETE BUS PAD IS TO ACCOMMODATE A SINGLE 60' ARTICULATED BUS.

DIMENSIONS FOR A BUS PAD USED BY MULTIPLE BUSES:

- ADD 100' FOR EACH ADDITIONAL PASS-THROUGH BUS.

- IF BUS STOP WILL BE USED AS A LAYOVER ZONE, ADD AN ADDITIONAL 100'.

ORANGE COUNTY
TRANSPORTATION AUTHORITY

FARSIDE TURNOUT DESIGN

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS

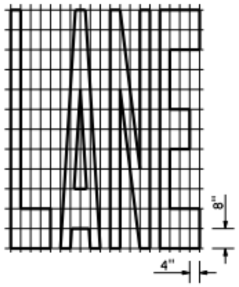
REGISTERED CIVIL ENGINEER

May 31, 2018

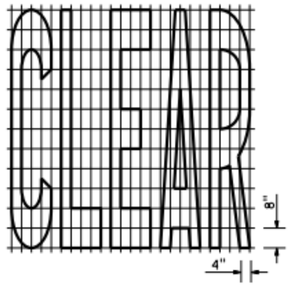
PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

REGISTERED PROFESSIONAL ENGINEER
Atifa Feroz
No. C80402
Exp. 3-31-19
CIVIL
STATE OF CALIFORNIA



A=24 ft^2



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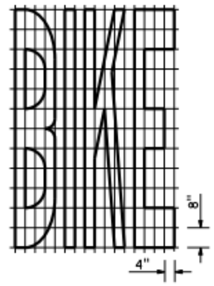

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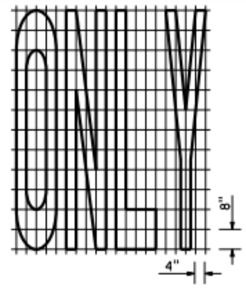
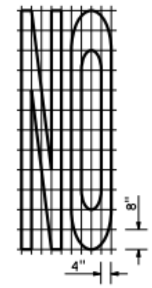


A=22 ft^2



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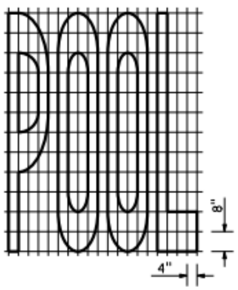
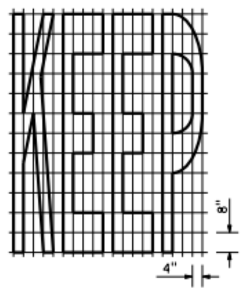


A=23 ft^2



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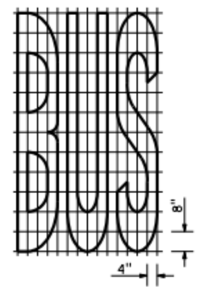
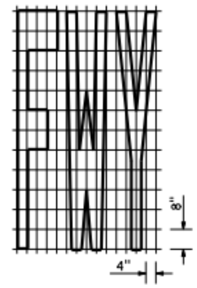
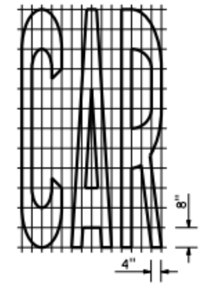


A=20 ft^2



A=16 ft^2

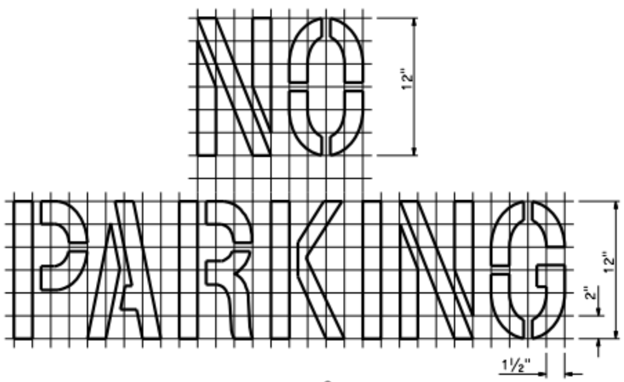


A=17 ft^2

WORD MARKINGS

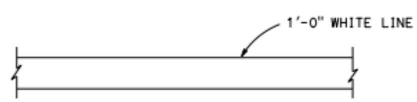
ITEM	ft^2	ITEM	ft^2
LANE	24	NO	14
POOL	23	BIKE	21
CAR	17	BUS	20
CLEAR	27	ONLY	22
KEEP	24	FWY	16

2018 STANDARD PLAN A24E

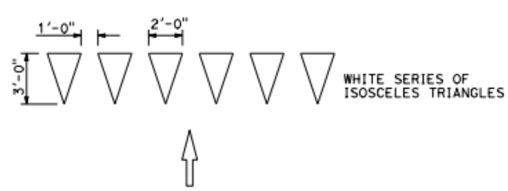


A=2 ft^2

See Notes 6 and 7



LIMIT LINE (STOP LINE)



YIELD LINE

NOTES:

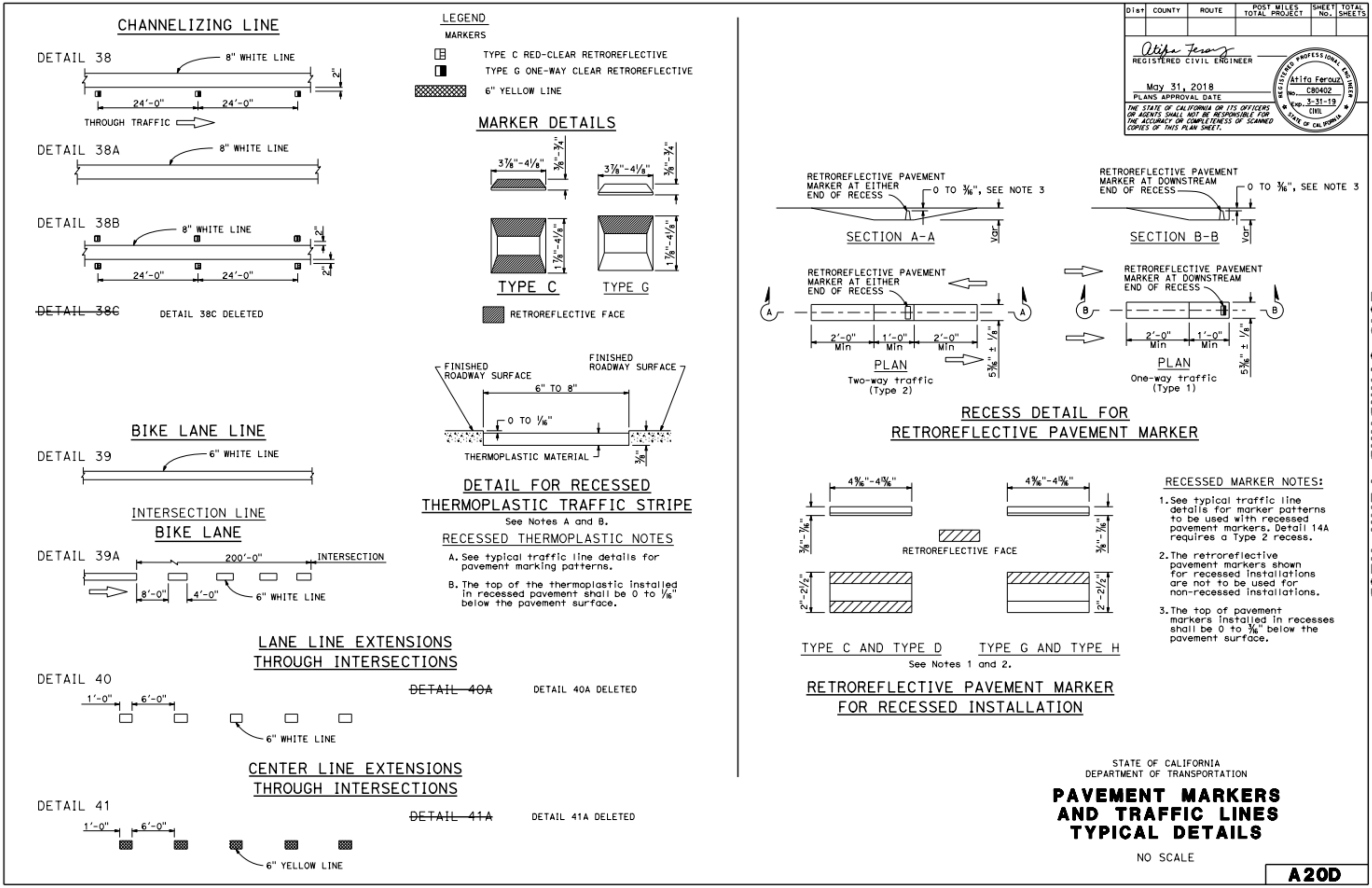
1. If a message consists of more than one word, it must read "UP", i.e., the first word must be nearest the driver.
2. The space between words must be at least four times the height of the characters for low speed roads, but not more than ten times the height of the characters. The space may be reduced appropriately where there is limited space because of local conditions.
3. Minor variations in dimensions may be accepted by the Engineer.
4. Portions of a letter, number or symbol may be separated by connecting segments not to exceed 2" in width.
5. The words "NO PARKING" pavement marking is to be used for parking facilities. For typical locations of markings, see Standard Plans A90A and A90B.
6. The words "NO PARKING", shall be painted in white letters no less than 1'-0" high on a contrasting background and located so that it is visible to traffic enforcement officials.

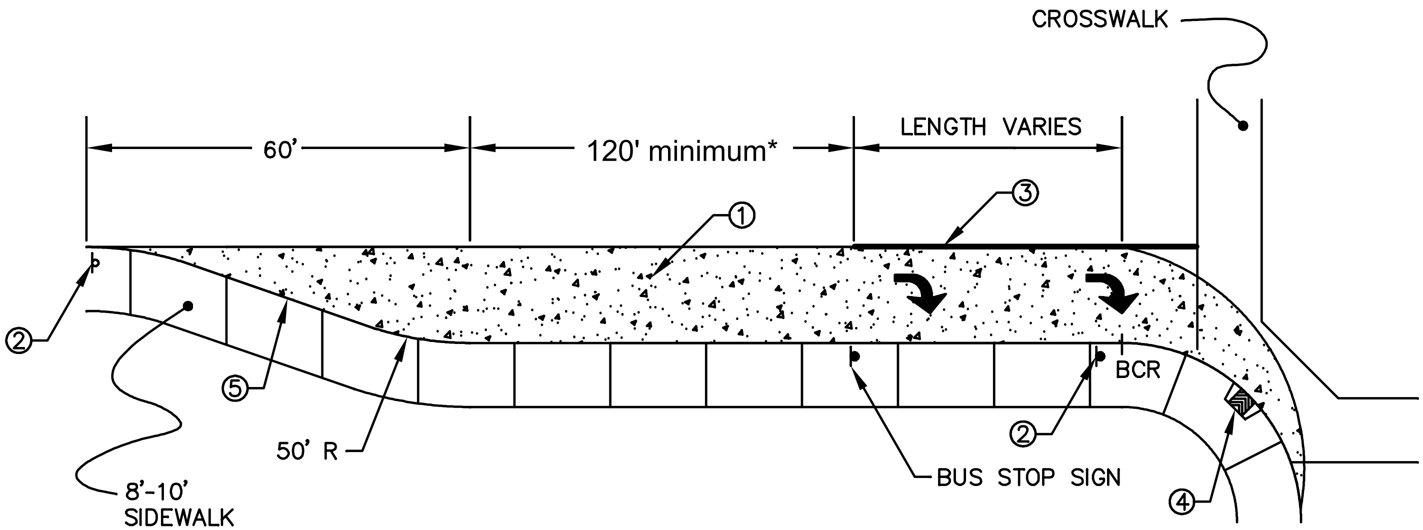
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

PAVEMENT MARKINGS
WORDS, LIMIT AND YIELD LINES

NO SCALE

A24E


CHANNELIZING LINE
DETAIL 38
8" WHITE LINE
2"
24'-0"
24'-0"
THROUGH TRAFFIC
DETAIL 38A
8" WHITE LINE
DETAIL 38B
8" WHITE LINE
2"
2"
24'-0"
24'-0"
~~DETAIL 38C~~
DETAIL 38C DELETED
BIKE LANE LINE
DETAIL 39
6" WHITE LINE
INTERSECTION LINE
BIKE LANE
DETAIL 39A
200'-0"
INTERSECTION
8'-0"
4'-0"
6" WHITE LINE
LANE LINE EXTENSIONS
THROUGH INTERSECTIONS
DETAIL 40
1'-0"
6'-0"
6" WHITE LINE
~~DETAIL 40A~~
DETAIL 40A DELETED
CENTER LINE EXTENSIONS
THROUGH INTERSECTIONS
DETAIL 41
1'-0"
6'-0"
6" YELLOW LINE
~~DETAIL 41A~~
DETAIL 41A DELETED
LEGEND
MARKERS
TYPE C RED-CLEAR RETROREFLECTIVE
TYPE G ONE-WAY CLEAR RETROREFLECTIVE
6" YELLOW LINE
MARKER DETAILS
3⅞"-4⅛"
⅜"-¾"
1⅞"-4⅛"
TYPE C
TYPE G
RETROREFLECTIVE FACE
FINISHED ROADWAY SURFACE
FINISHED ROADWAY SURFACE
6" TO 8"
0 TO 1/16"
THERMOPLASTIC MATERIAL
⅜"
DETAIL FOR RECESSED
THERMOPLASTIC TRAFFIC STRIPE
See Notes A and B.
RECESSED THERMOPLASTIC NOTES
A. See typical traffic line details for pavement marking patterns.
B. The top of the thermoplastic installed in recessed pavement shall be 0 to 1/16" below the pavement surface.
Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS
REGISTERED CIVIL ENGINEER
May 31, 2018
PLANS APPROVAL DATE
THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.
REGISTERED PROFESSIONAL ENGINEER
Atifa Ferouz
No. C80402
Exp. 3-31-19
CIVIL
STATE OF CALIFORNIA
RETROREFLECTIVE PAVEMENT MARKER AT EITHER END OF RECESS
0 TO 3/16", SEE NOTE 3
SECTION A-A
Var
RETROREFLECTIVE PAVEMENT MARKER AT DOWNSTREAM END OF RECESS
0 TO 3/16", SEE NOTE 3
SECTION B-B
Var
RETROREFLECTIVE PAVEMENT MARKER AT EITHER END OF RECESS
2'-0" Min
1'-0" Min
2'-0" Min
5 5/16" ± ⅛"
PLAN
Two-way traffic (Type 2)
RETROREFLECTIVE PAVEMENT MARKER AT DOWNSTREAM END OF RECESS
2'-0" Min
1'-0" Min
5 5/16" ± ⅛"
PLAN
One-way traffic (Type 1)
RECESS DETAIL FOR
RETROREFLECTIVE PAVEMENT MARKER
4 3/16"-4 5/16"
4 3/16"-4 5/16"
⅜"-7/16"
⅜"-7/16"
RETROREFLECTIVE FACE
2"-2½"
2"-2½"
TYPE C AND TYPE D
TYPE G AND TYPE H
See Notes 1 and 2.
RETROREFLECTIVE PAVEMENT MARKER
FOR RECESSED INSTALLATION
RECESSED MARKER NOTES:
1. See typical traffic line details for marker patterns to be used with recessed pavement markers. Detail 14A requires a Type 2 recess.
2. The retroreflective pavement markers shown for recessed installations are not to be used for non-recessed installations.
3. The top of pavement markers installed in recesses shall be 0 to 3/16" below the pavement surface.
2018 STANDARD PLAN A20D
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
PAVEMENT MARKERS
AND TRAFFIC LINES
TYPICAL DETAILS
NO SCALE
A20D



NOTES:

1. 12' TO 14' WIDE CONCRETE BUS PAD INCLUDING MONOLITHIC CURB. STRUCTURAL SECTION OF PAD SHOULD CONFORM TO LOCAL JURISDICTION STANDARD. IF NO LOCAL STANDARD EXISTS USE 9" DEEP CONCRETE WITHOUT RE-BAR, OR 8" DEEP WITH #3 RE-BAR AT 18" ON CENTER.
   EXACT PAD PLACEMENT WILL VARY BY LOCATION. CONTACT OCTA BEFORE PLACING PAD.
2. R18 SIGN WITH "BUS EXEMPT" PLAQUE.
3. PER CALTRANS STANDARD PLANS A20D, DETAIL 38A.
4. WHEELCHAIR ACCESS RAMP (LOCATION WILL VARY).
5. WHENEVER POSSIBLE DRIVEWAYS SHOULD NOT BE PLACED WITHIN THE TURNOUT / BUS STOP ZONE.

* STANDARD TURNOUT AND CONCRETE BUS PAD IS TO ACCOMMODATE A SINGLE 60' ARTICULATED BUS.

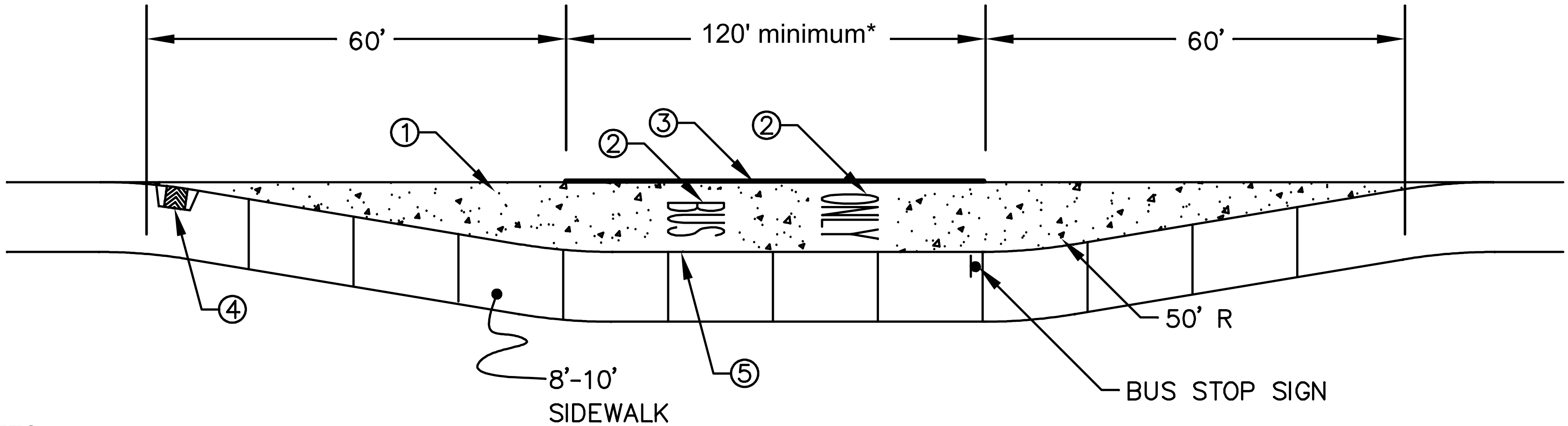
DIMENSIONS FOR A BUS PAD USED BY MULTIPLE BUSES:

- ADD 100' FOR EACH ADDITIONAL PASS-THROUGH BUS.

- IF BUS STOP WILL BE USED AS A LAYOVER ZONE, ADD AN ADDITIONAL 100'.

ORANGE COUNTY
TRANSPORTATION AUTHORITY

NEARSIDE TURNOUT DESIGN



NOTES:

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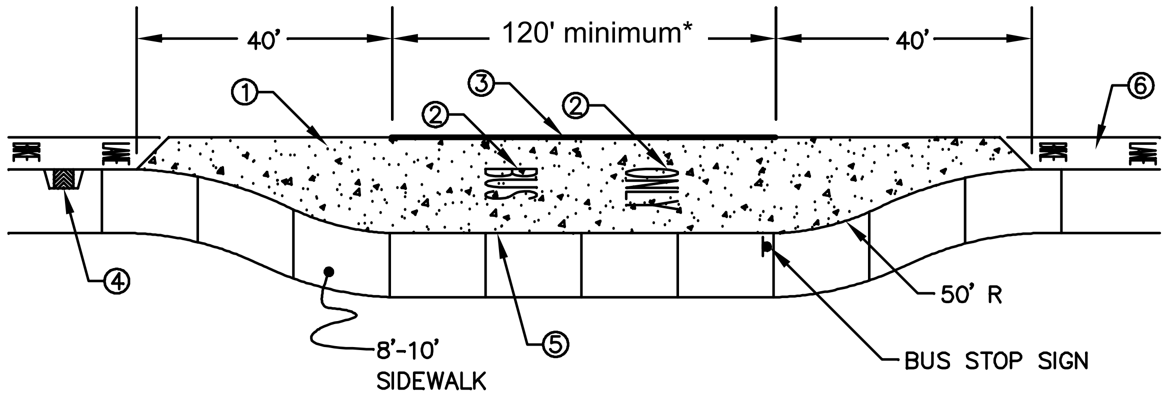
DIMENSIONS FOR A BUS PAD USED BY MULTIPLE BUSES:

- ADD 100' FOR EACH ADDITIONAL PASS-THROUGH BUS.

- IF BUS STOP WILL BE USED AS A LAYOVER ZONE, ADD AN ADDITIONAL 100'.

ORANGE COUNTY
TRANSPORTATION AUTHORITY

TYPICAL MID BLOCK TURNOUT DESIGN (TYPE 1A)



NOTES:

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EXACT PAD PLACEMENT WILL VARY BY LOCATION. CONTACT OCTA BEFORE PLACING PAD.

2. PER CALTRANS STANDARD PLANS A24E (OPTIONAL).

3. PER CALTRANS STANDARD PLANS A20D, DETAIL 38A.

4. WHEELCHAIR ACCESS RAMP (LOCATION WILL VARY).

5. WHENEVER POSSIBLE DRIVEWAYS SHOULD NOT BE PLACED WITHIN THE TURNOUT / BUS STOP ZONE.

* STANDARD TURNOUT AND CONCRETE BUS PAD IS TO ACCOMMODATE A SINGLE 60' ARTICULATED BUS.

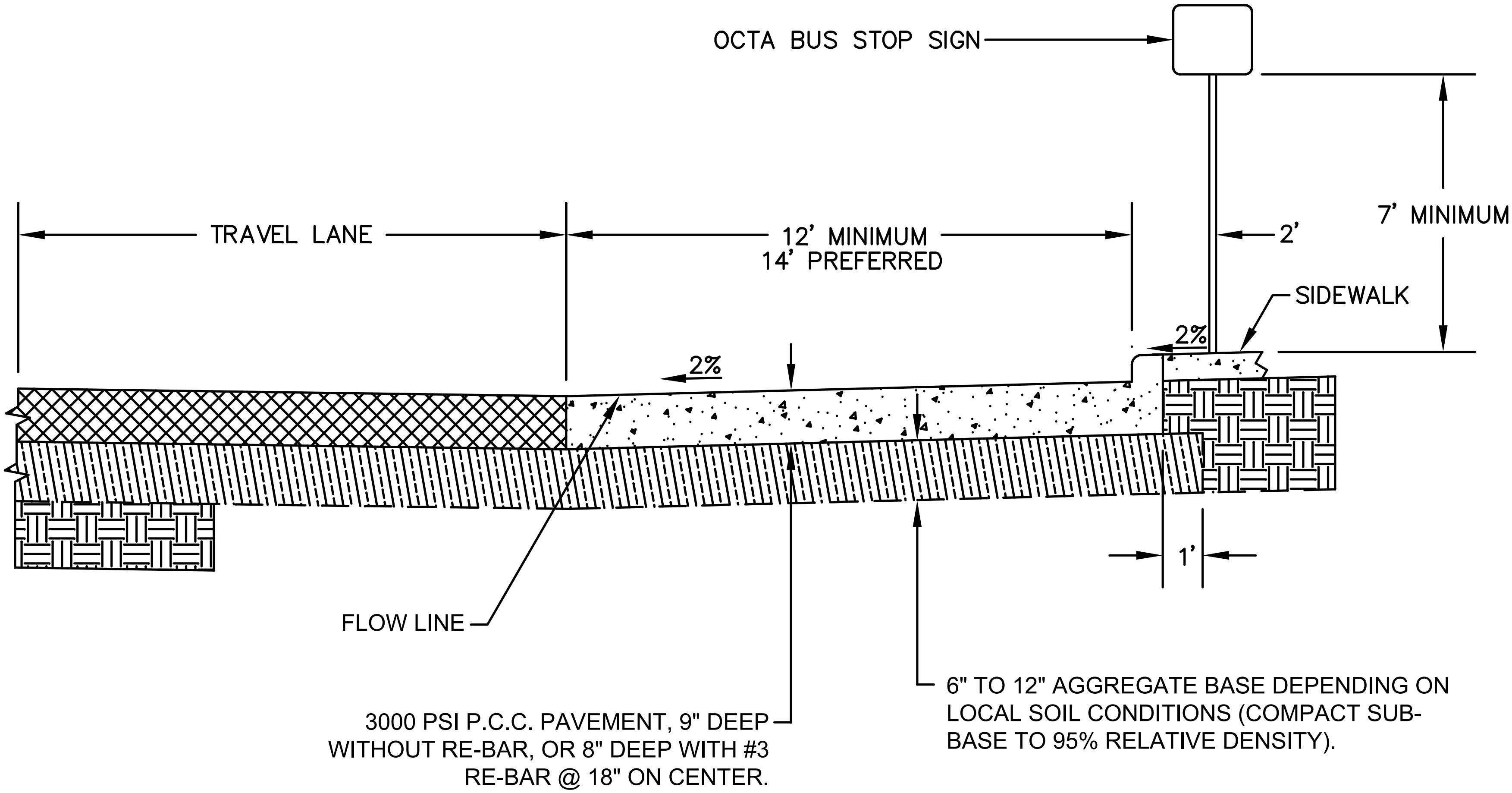
DIMENSIONS FOR A BUS PAD USED BY MULTIPLE BUSES:

- ADD 100' FOR EACH ADDITIONAL PASS-THROUGH BUS.

- IF BUS STOP WILL BE USED AS A LAYOVER ZONE, ADD AN ADDITIONAL 100'.

ORANGE COUNTY TRANSPORTATION AUTHORITY

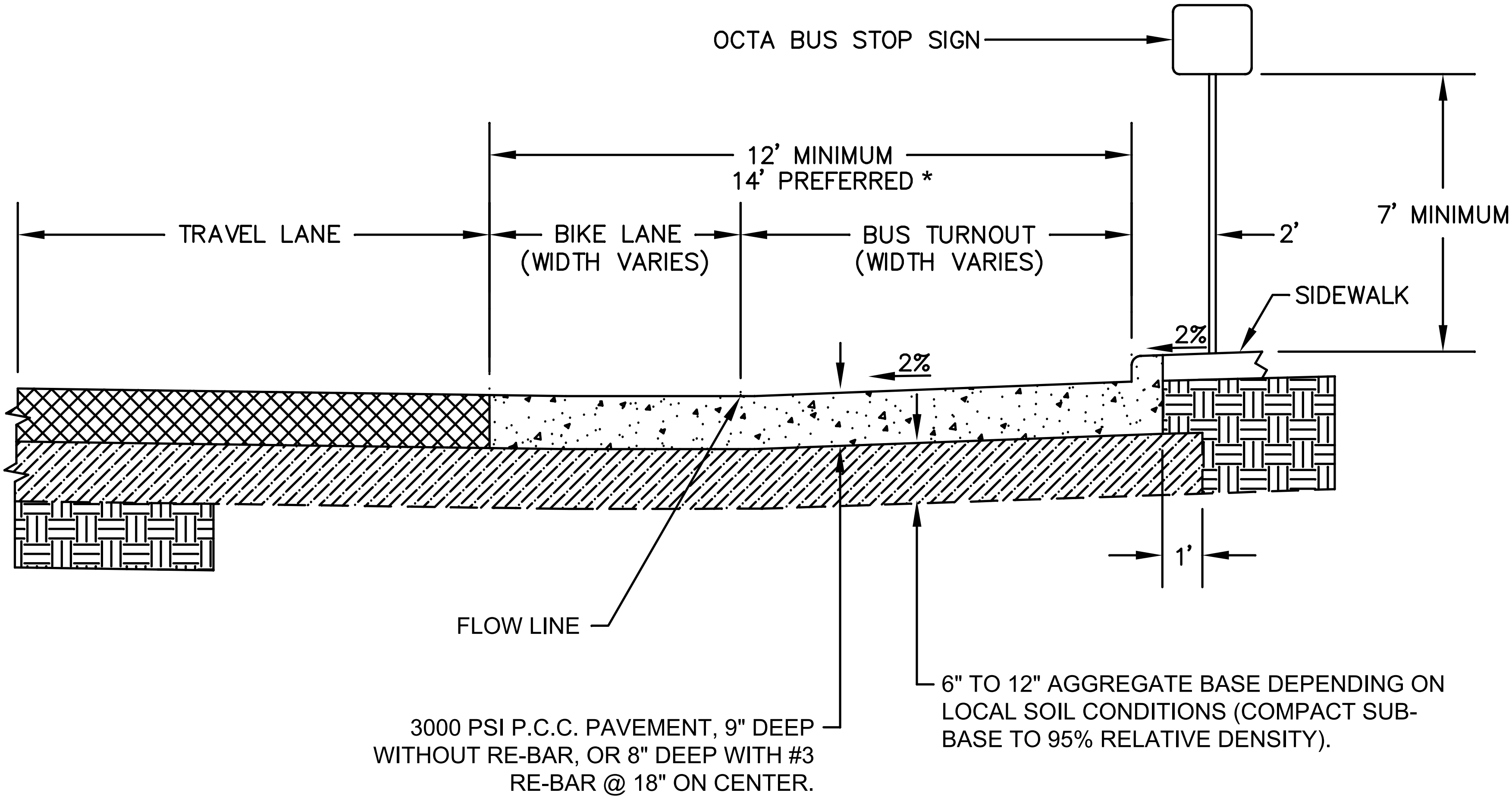
TYPICAL MID BLOCK TURNOUT DESIGN (TYPE 1B)



STRUCTURAL SECTION OF PAD SHOULD CONFORM TO LOCAL JURISDICTION STANDARD. IF NO LOCAL STANDARD EXISTS USE RECOMMENDATIONS ABOVE.

ORANGE COUNTY TRANSPORTATION AUTHORITY

MID BLOCK TURNOUT CROSS-SECTION DESIGN (TYPE 1A)

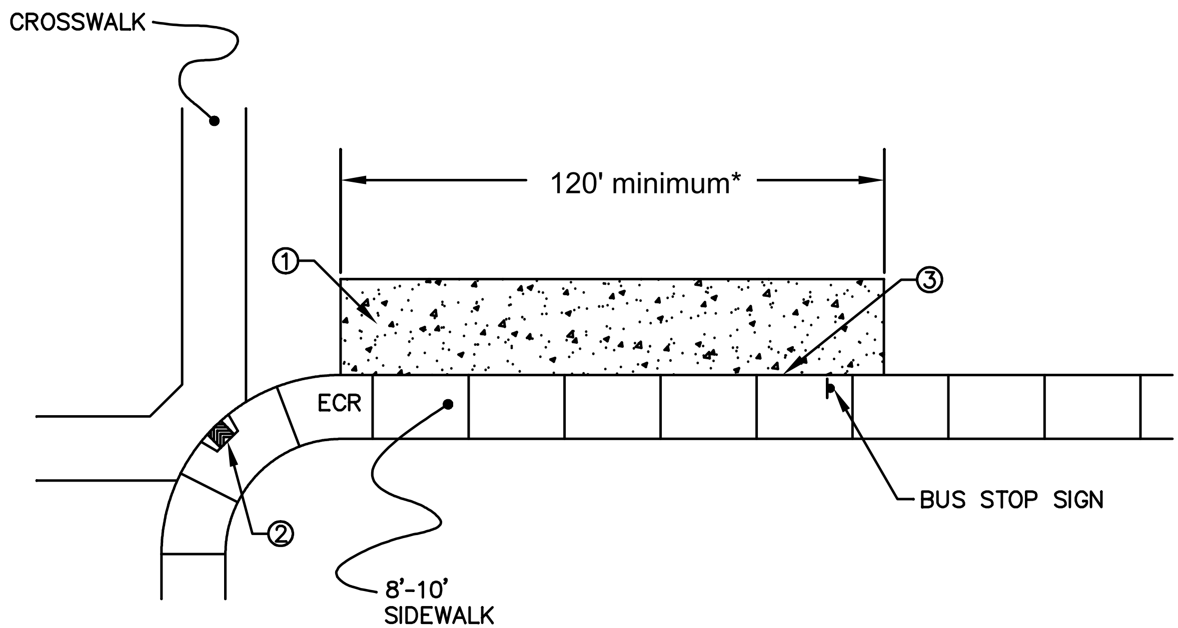


* IF TURNOUT WILL BE USED AS A LAYOVER ZONE, THEN TURNOUT SHOULD BE WIDENED TO 12'-14' SO BUS WILL NOT OBSTRUCT BIKE LANE.

STRUCTURAL SECTION OF PAD SHOULD CONFORM TO LOCAL JURISDICTION STANDARD. IF NO LOCAL STANDARD EXISTS USE RECOMMENDATIONS ABOVE.

ORANGE COUNTY TRANSPORTATION AUTHORITY

TYPICAL MID-BLOCK TURNOUT CROSS-SECTION DESIGN (TYPE 1B)



NOTES:

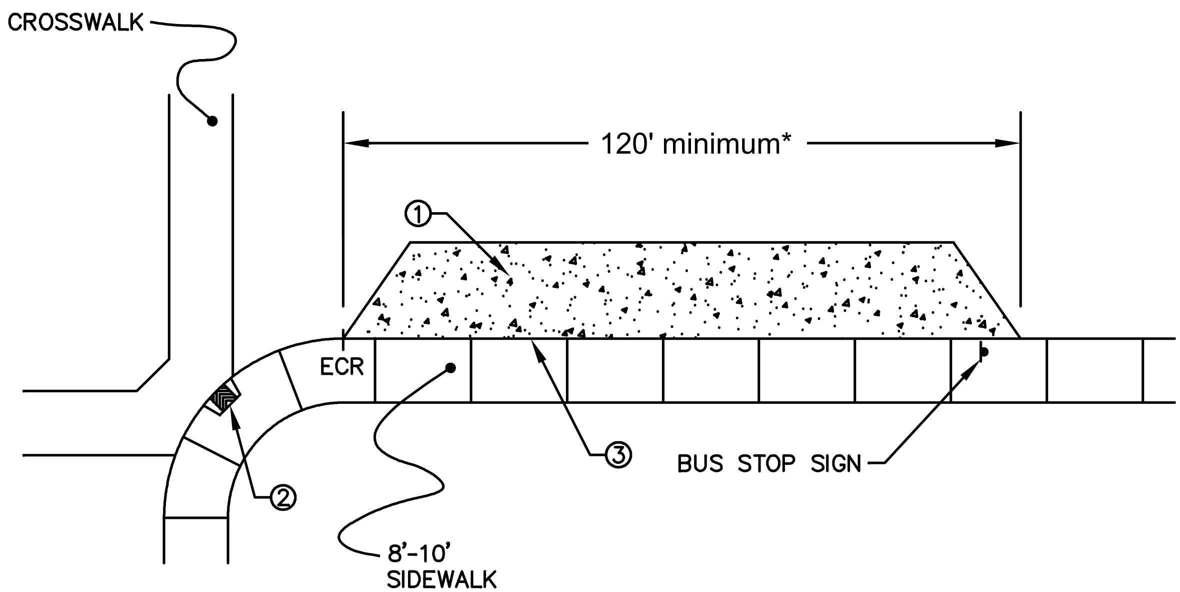
1. 12' TO 14' WIDE CONCRETE BUS PAD INCLUDING MONOLITHIC CURB. STRUCTURAL SECTION OF PAD SHOULD CONFORM TO LOCAL JURISDICTION STANDARD. IF NO LOCAL STANDARD EXISTS USE 9" DEEP CONCRETE WITHOUT RE-BAR, OR 8" DEEP WITH #3 RE-BAR AT 18" ON CENTER.
   EXACT PAD PLACEMENT WILL VARY BY LOCATION. CONTACT OCTA BEFORE PLACING PAD.
2. WHEELCHAIR ACCESS RAMP (LOCATION WILL VARY).
3. WHENEVER POSSIBLE DRIVEWAYS SHOULD NOT BE PLACED WITHIN THE TURNOUT / BUS STOP ZONE.

* STANDARD CONCRETE BUS PAD IS TO ACCOMMODATE A SINGLE 60' ARTICULATED BUS.

DIMENSIONS FOR A BUS PAD USED BY MULTIPLE BUSES:

- ADD 100' FOR EACH ADDITIONAL PASS-THROUGH BUS.

- IF BUS STOP WILL BE USED AS A LAYOVER ZONE, ADD AN ADDITIONAL 100'.



NOTES:

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   EXACT PAD PLACEMENT WILL VARY BY LOCATION. CONTACT OCTA BEFORE PLACING PAD.
2. WHEELCHAIR ACCESS RAMP (LOCATION WILL VARY).
3. WHENEVER POSSIBLE DRIVEWAYS SHOULD NOT BE PLACED WITHIN THE TURNOUT / BUS STOP ZONE.

* STANDARD CONCRETE BUS PAD IS TO ACCOMMODATE A SINGLE 60' ARTICULATED BUS.

DIMENSIONS FOR A BUS PAD USED BY MULTIPLE BUSES:

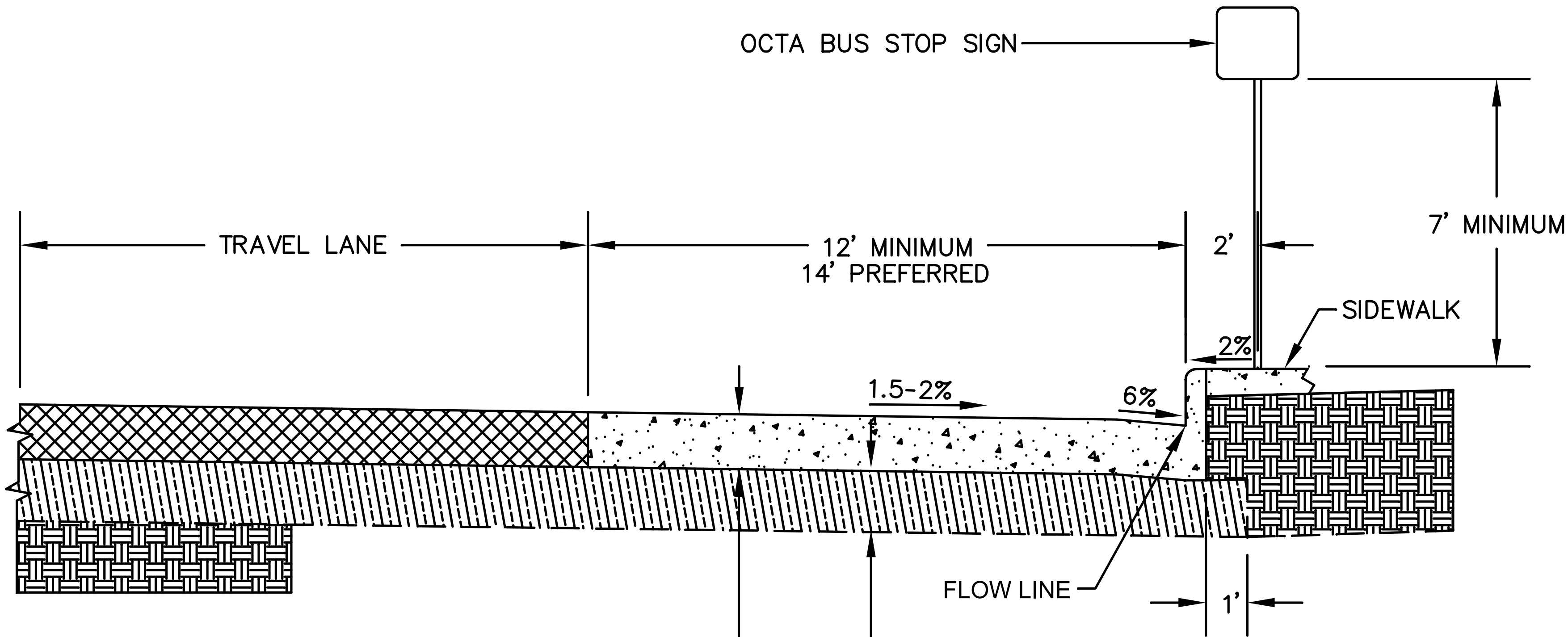
- ADD 100' FOR EACH ADDITIONAL PASS-THROUGH BUS.

- IF BUS STOP WILL BE USED AS A LAYOVER ZONE, ADD AN ADDITIONAL 100'.

OCTA

ORANGE COUNTY
TRANSPORTATION AUTHORITY

MODIFIED CONCRETE BUS PAD DESIGN



3000 PSI P.C.C. PAVEMENT, 9" DEEP WITHOUT RE-BAR, OR 8" DEEP WITH #3 RE-BAR @ 18" ON CENTER.

6" TO 12" AGGREGATE BASE DEPENDING ON LOCAL SOIL CONDITIONS (COMPACT SUB-BASE TO 95% RELATIVE DENSITY).

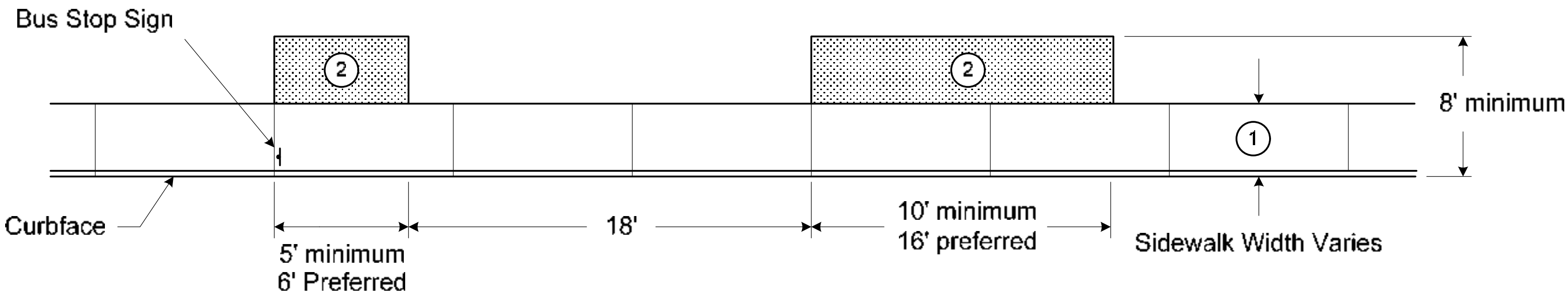
STRUCTURAL SECTION OF PAD SHOULD CONFORM TO LOCAL JURISDICTION STANDARD. IF NO LOCAL STANDARD EXISTS USE RECOMMENDATIONS ABOVE.

OCTA

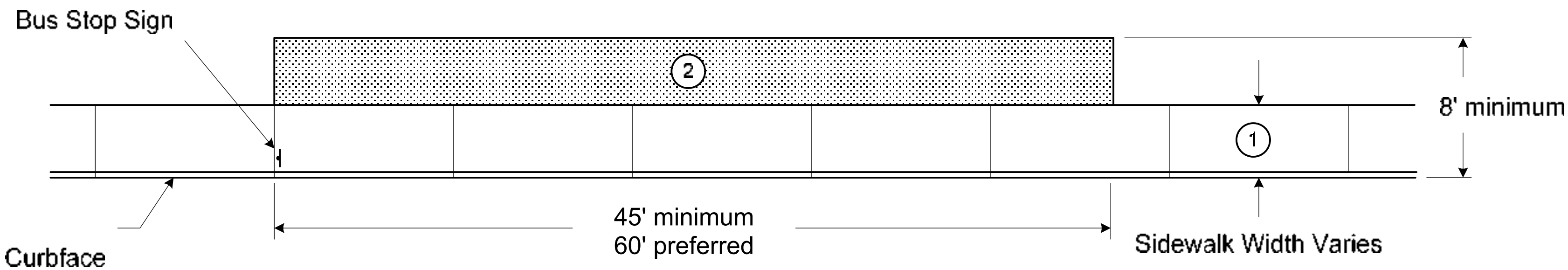
ORANGE COUNTY TRANSPORTATION AUTHORITY

TYPICAL CONCRETE BUS PAD CROSS-SECTION DESIGN

MINIMUM BOARDING AREA
(ACCOMODATES BOTH A 40' BUS AND 60' ARTICULATED BUS)



PREFERRED BOARDING AREA



Note:

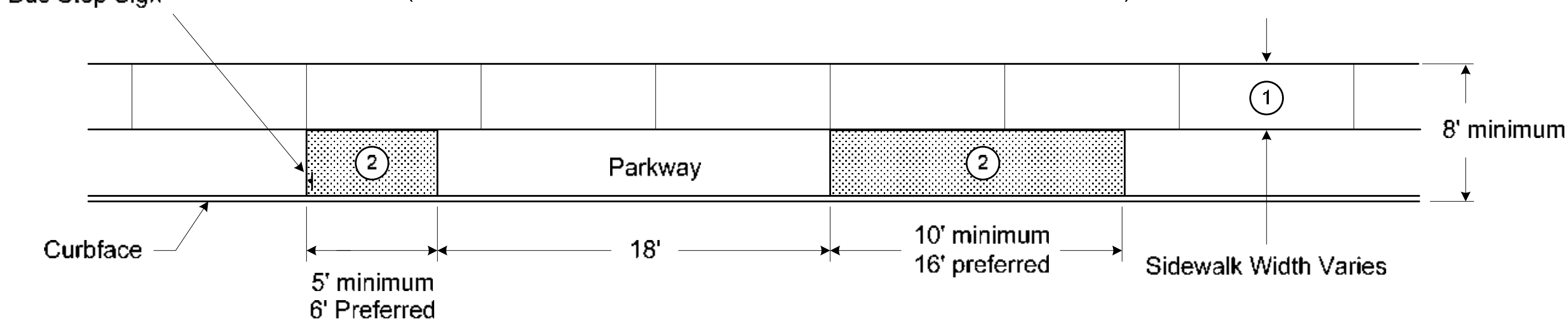
1) The minimum sidewalk/pathway width should be 48" wide, with a 84" vertical clearance.

2) When the existing sidewalk is less than 8 feet wide, it should be widened accordingly to meet current ADA standards for accommodating both a front and rear door wheelchair lift. Wheelchair boarding areas should be constructed with either P.C.C. or A.C. pavement. Above grade obstacles, or street furniture should be placed in such a manner as to not interfere with the designated front of rear door boarding areas.

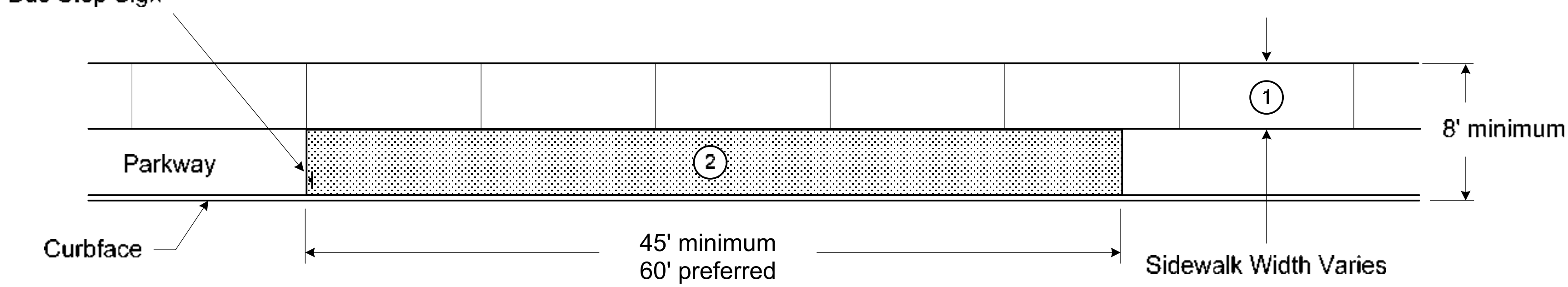
ORANGE COUNTY TRANSPORTATION AUTHORITY

PASSENGER BOARDING AREA - SIDEWALK ATTACHED TO CURB

MINIMUM BOARDING AREA
(ACCOMODATES BOTH A 40' BUS AND 60' ARTICULATED BUS)



PREFERRED BOARDING AREA



Note:

1) The minimum sidewalk/pathway width should be 48" wide, with a 84" vertical clearance.

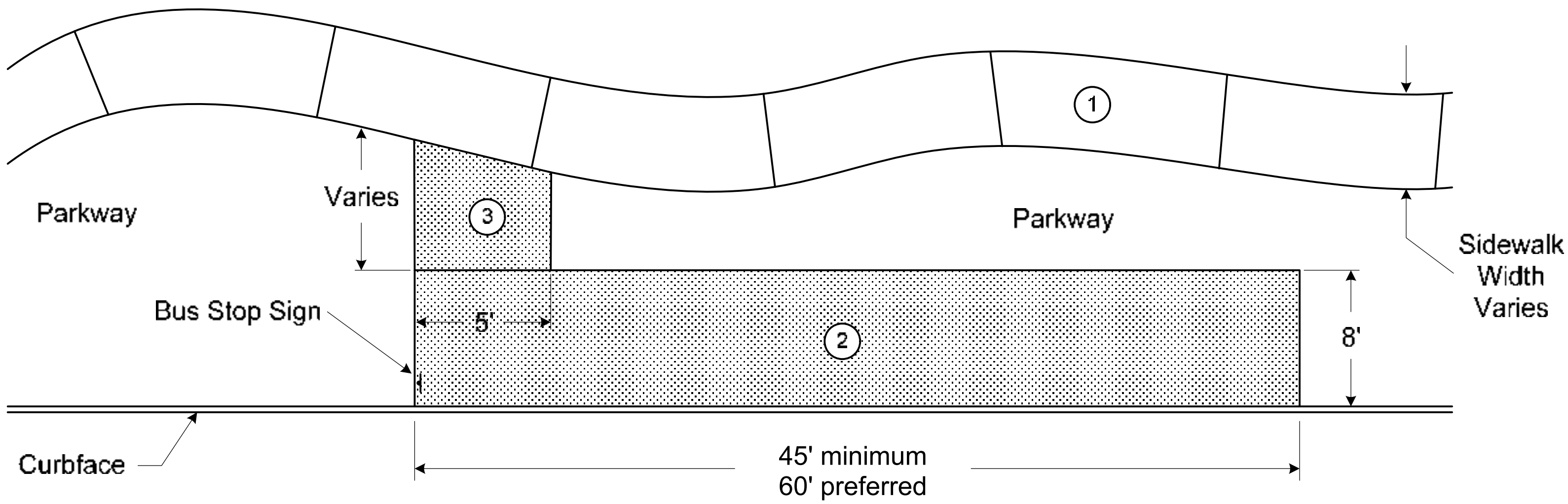
2) When the existing sidewalk is less than 8 feet wide, it should be widened accordingly to meet current ADA standards for accommodating both a front and rear door wheelchair lift. Wheelchair boarding areas should be constructed with either P.C.C. or A.C. pavement. Above grade obstacles, or street furniture should be placed in such a manner as to not interfere with the designated front of rear door boarding areas.

OCTA

ORANGE COUNTY TRANSPORTATION AUTHORITY

PASSENGER BOARDING AREA - SIDEWALK DETACHED FROM CURB

PREFERRED BOARDING AREA

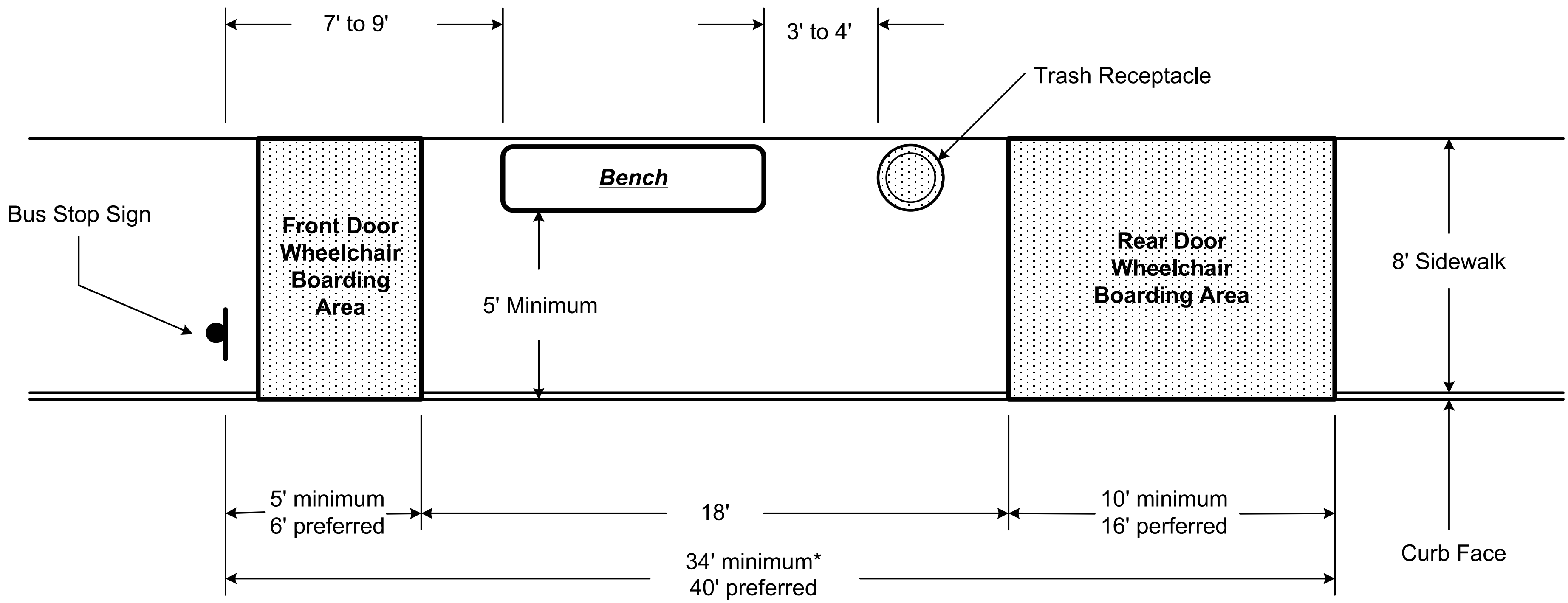


Note:

1) The minimum sidewalk/pathway width should be 48" wide, with a 84" vertical clearance.

2) At locations with large parkways, it will be necessary to construct an ADA compliant wheelchair boarding area to accommodate both a front and rear door wheelchair lift. The wheelchair boarding area should be constructed with either P.C.C. or A.C. pavement. Above grade obstacles, or street furniture should be placed in such a manner as to not interfere with the designated front of rear door boarding areas.

3) In addition to constructing the boarding area, a 5 foot wide pathway should be constructed connecting the boarding area to the existing sidewalk. As with the boarding area, it should be constructed with either P.C.C. or A.C. pavement.



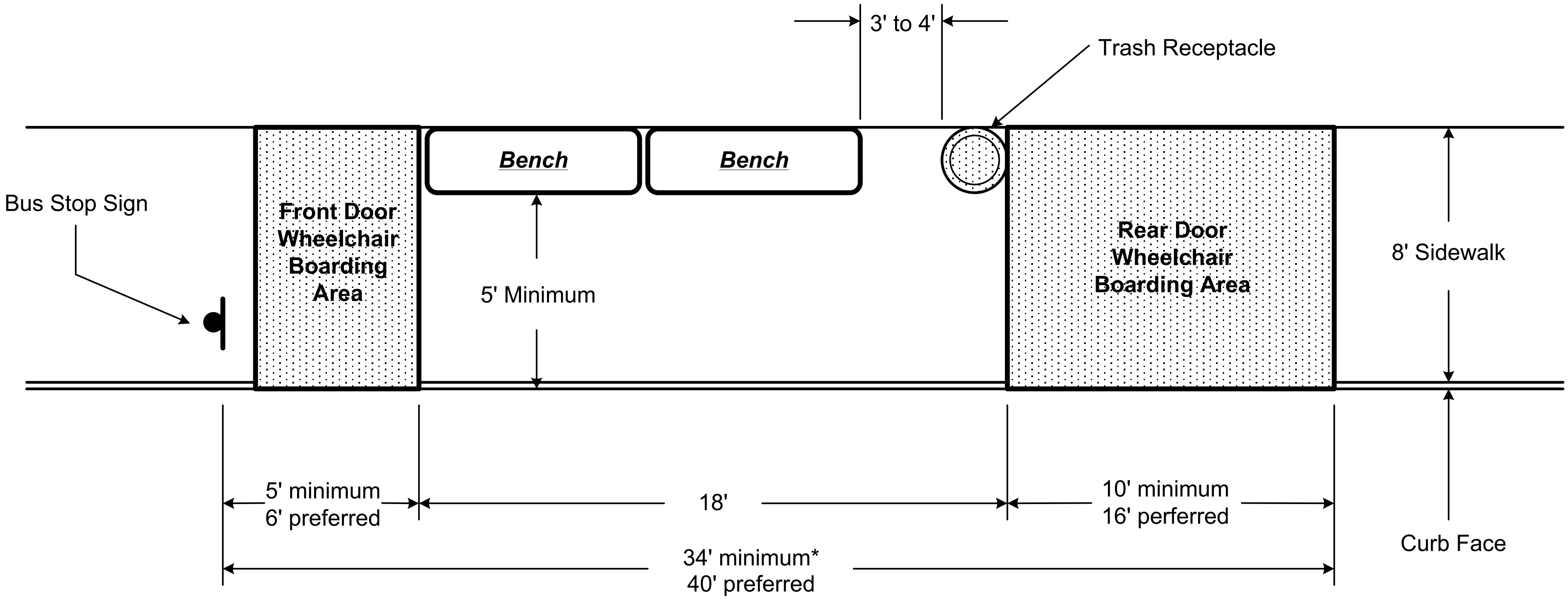
*WIDTH OF BOARDING AREA IS BASED ON MINIMUM AND PREFERRED WIDTHS REQUIRED FOR BOTH A 40' BUS AND A 60' ARTICULATED BUS WHEN WHEELCHAIR BOARDING AREAS ARE SEPARATED.

NOTE:

1) The bench should be placed between 7' to 9' from the bus stop sign, on the back side of the sidewalk. Two benches can be placed as along as they do not obstruct the front and rear wheelchair boarding areas.

2) Both front door and rear door wheelchair boarding areas need to be free of **all** above ground obstacles. This includes street furniture (benches/shelters), trash receptacles, treewells, utility poles, light standards, mail boxes, miscellaneous signs, newsracks, etc.

3) Trash receptacles can be placed on either side of the bench, but should be placed at least 3' - 4' from the bench.



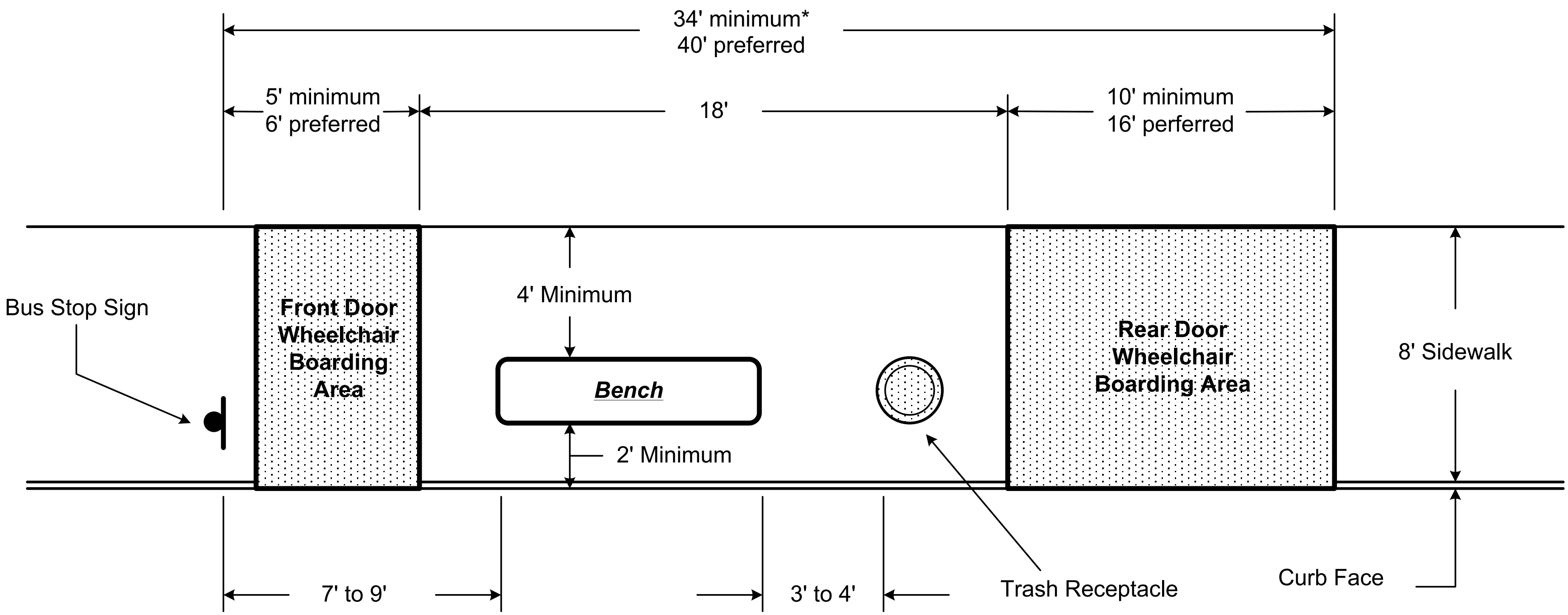
*WIDTH OF BOARDING AREA IS BASED ON MINIMUM AND PREFERRED WIDTHS REQUIRED FOR BOTH A 40' BUS AND A 60' ARTICULATED BUS WHEN WHEELCHAIR BOARDING AREAS ARE SEPARATED.

NOTE:

1) Two benches can be placed as along as they do not obstruct the front and rear wheelchair boarding areas.

2) Both front door and rear door wheelchair boarding areas need to be free of **all** above ground obstacles. This includes street furniture (benches/shelters), trash receptacles, treewells, utility poles, light standards, mail boxes, miscellaneous signs, newsracks, etc.

3) Trash receptacles can be placed on either side of the bench, but should be placed at least 3' to 4' from the bench.



*WIDTH OF BOARDING AREA IS BASED ON MINIMUM AND PREFERRED WIDTHS REQUIRED FOR BOTH A 40' BUS AND A 60' ARTICULATED BUS WHEN WHEELCHAIR BOARDING AREAS ARE SEPARATED.

NOTE:

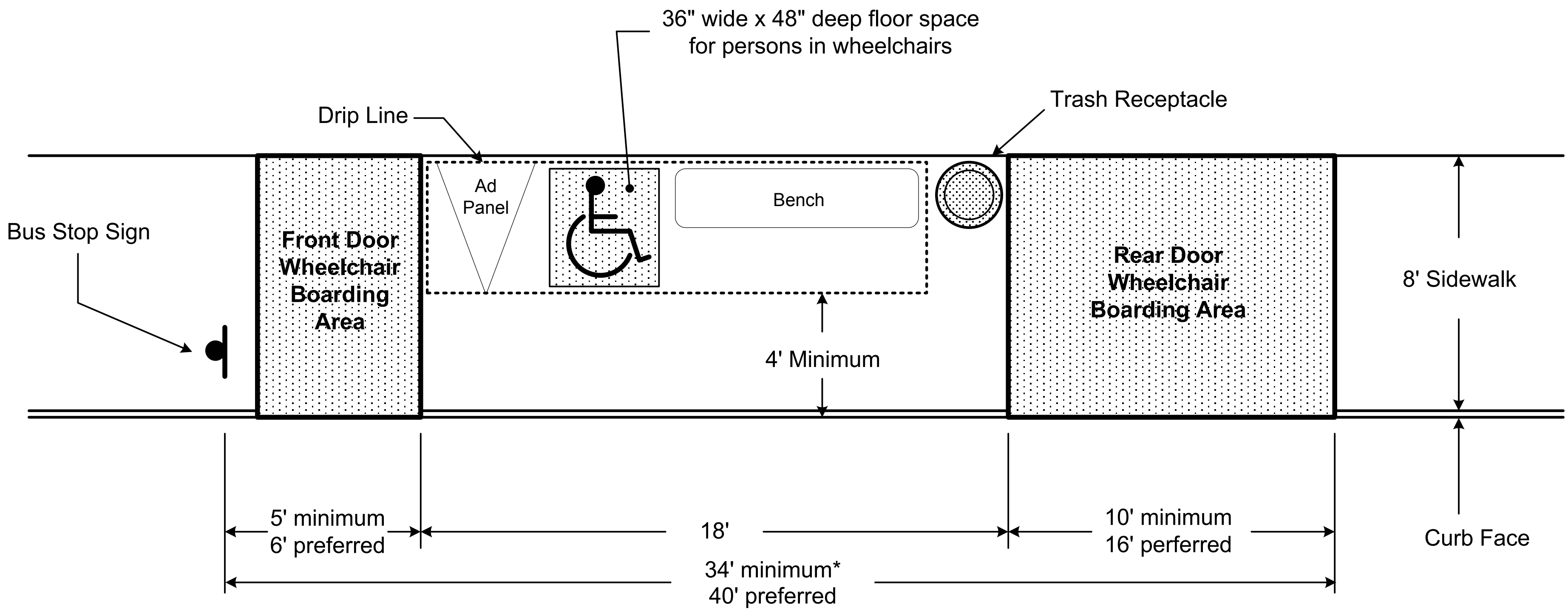
1) The bench should be placed between 7' to 9' from the bus stop sign, and a minimum of 2' back from the curb face. Two benches can be placed as along as they do not obstruct the front and rear wheelchair boarding areas.

2) Both front door and rear door wheelchair boarding areas need to be free of **all** above ground obstacles. This includes street furniture (benches/shelters), trash receptacles, treewells, utility poles, light standards, mail boxes, miscellaneous signs, newsracks, etc.

3) Trash receptacles can be placed on either side of the bench, but should be placed at least 3' to 4' from the bench.

ORANGE COUNTY TRANSPORTATION AUTHORITY

MODIFIED BENCH PLACEMENT - 8 FOOT WIDE SIDEWALK



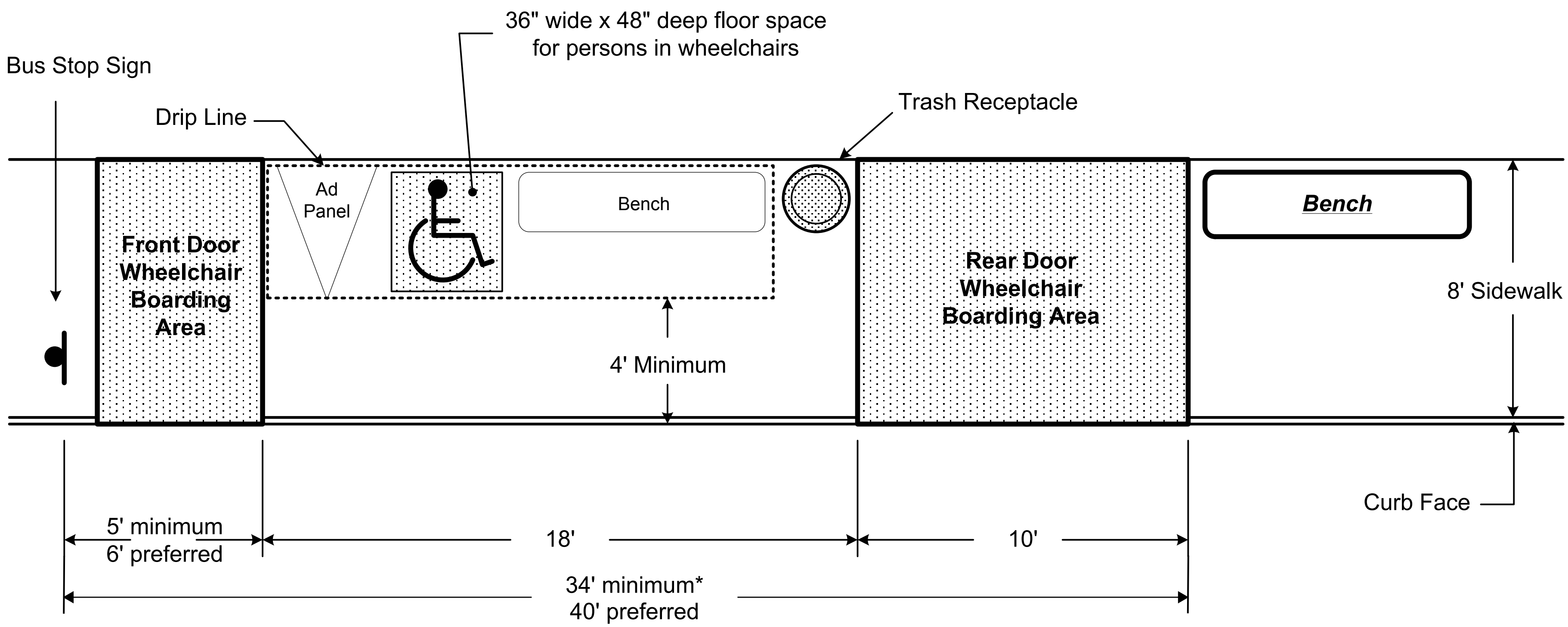
*WIDTH OF BOARDING AREA IS BASED ON MINIMUM AND PREFERRED WIDTHS REQUIRED FOR BOTH A 40' BUS AND A 60' ARTICULATED BUS WHEN WHEELCHAIR BOARDING AREAS ARE SEPARATED.

NOTE:

1) The shelter should be placed between the front and rear wheelchair boarding areas, 6' to 24' from the bus stop sign.

2) The shelter should be placed on the back side of the sidewalk, with a minimum clearance of 4' between the shelter and the curb face.

3) Both front door and rear door wheelchair boarding areas need to be free of **all** above ground obstacles. This includes street furniture (benches/shelters), trash receptacles, treewells, utility poles, light standards, mail boxes, miscellaneous signs, newsracks, etc.



*WIDTH OF BOARDING AREA IS BASED ON MINIMUM AND PREFERRED WIDTHS REQUIRED FOR BOTH A 40' BUS AND A 60' ARTICULATED BUS WHEN WHEELCHAIR BOARDING AREAS ARE SEPARATED.

NOTE:

1) The shelter should be placed between the front and rear wheelchair boarding areas, 6' to 24' from the bus stop sign.

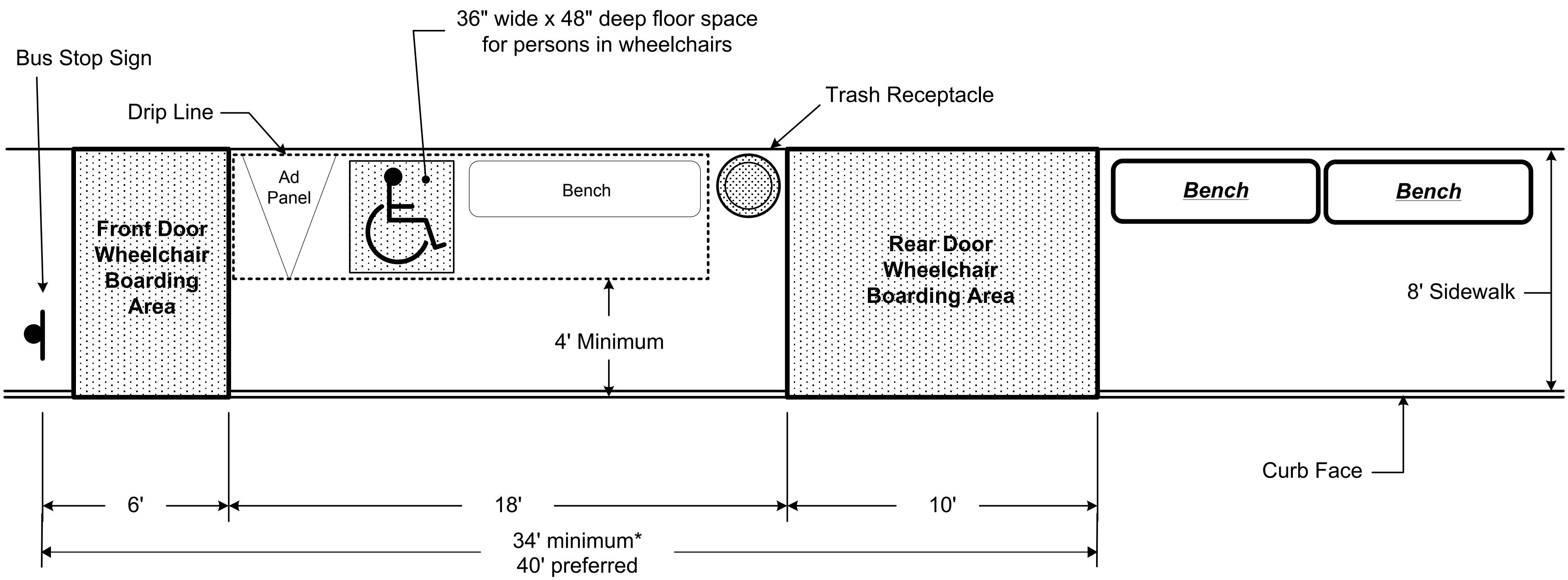
2) The shelter should be placed on the back side of the sidewalk, with a minimum clearance of 4' between the shelter and the curb face.

3) If a bench is placed in addition to the shelter, it should be placed on the back side of the sidewalk at least 34' from the bus stop sign.

4) Both front door and rear door wheelchair boarding areas need to be free of **all** above ground obstacles. This includes street furniture (benches/shelters), trash receptacles, treewells, utility poles, light standards, mail boxes, miscellaneous signs, newsracks, etc.

OCTA

TYPICAL SHELTER/BENCH PLACEMENT - 8 FOOT WIDE SIDEWALK



*WIDTH OF BOARDING AREA IS BASED ON MINIMUM AND PREFERRED WIDTHS REQUIRED FOR BOTH A 40' BUS AND A 60' ARTICULATED BUS WHEN WHEELCHAIR BOARDING AREAS ARE SEPARATED.

NOTE:

1) The shelter should be placed between the front and rear wheelchair boarding areas, 6' to 24' from the bus stop sign.

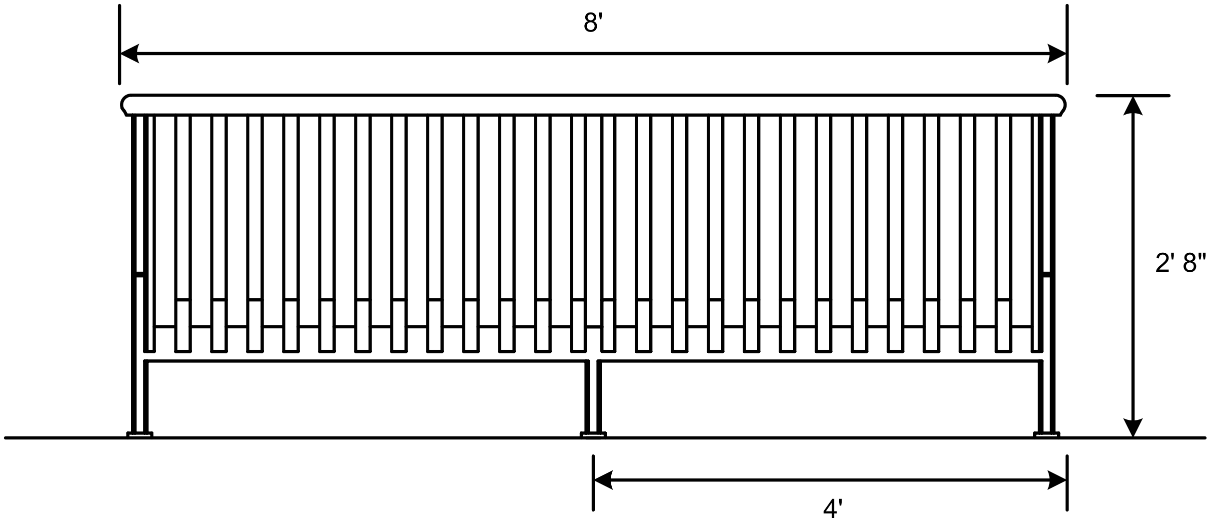
2) The shelter should be placed on the back side of the sidewalk, with a minimum clearance of 4' between the shelter and the curb face.

3) If a bench is placed in addition to the shelter, it should be placed on the back side of the sidewalk at least 34' from the bus stop sign.

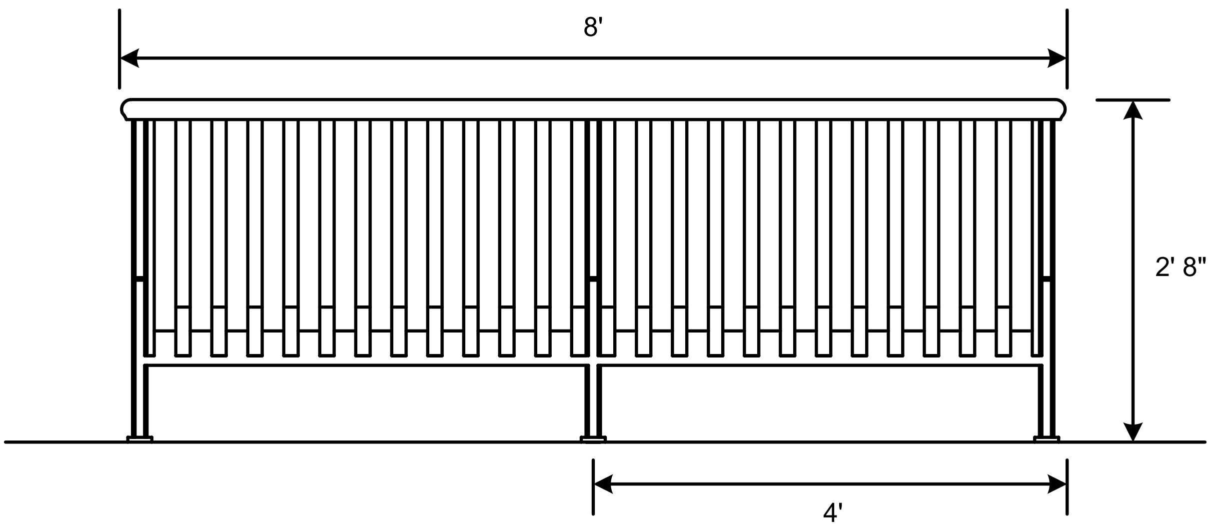
4) Both front door and rear door wheelchair boarding areas need to be free of **all** above ground obstacles. This includes street furniture (benches/shelters), trash receptacles, treewells, utility poles, light standards, mail boxes, miscellaneous signs, newsracks, etc.

OCTA

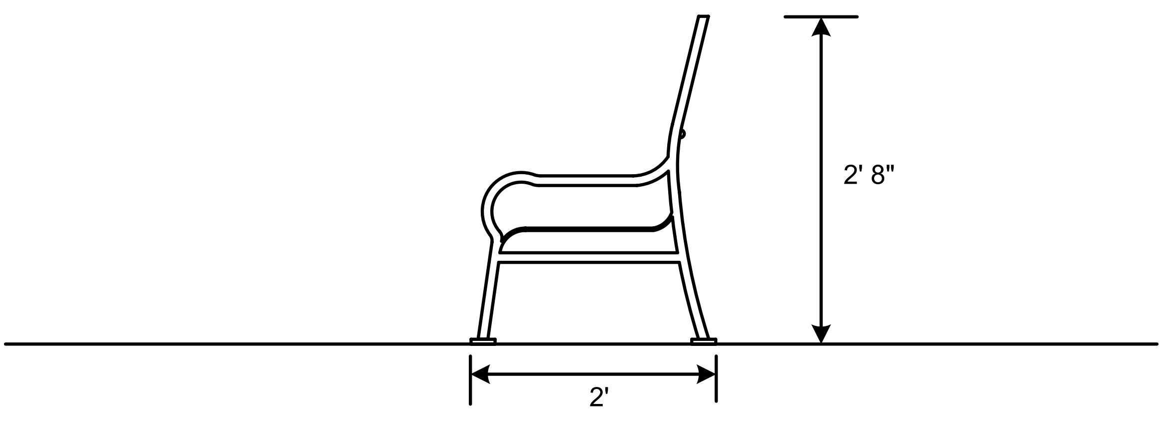
TYPICAL SHELTER/MULTIPLE BENCH PLACEMENT - 8 FOOT WIDE SIDEWALK



FRONT VIEW - BENCH WITHOUT CENTER ARM



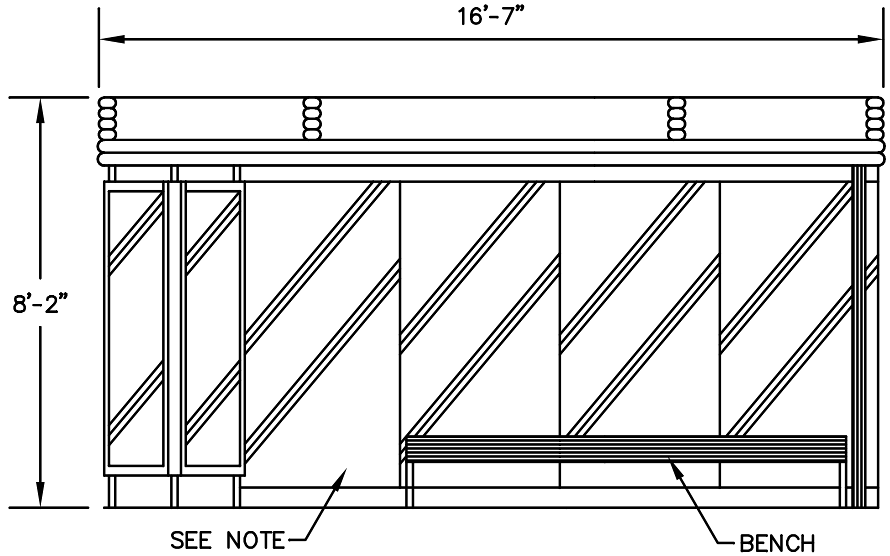
FRONT VIEW - BENCH WITH CENTER ARM



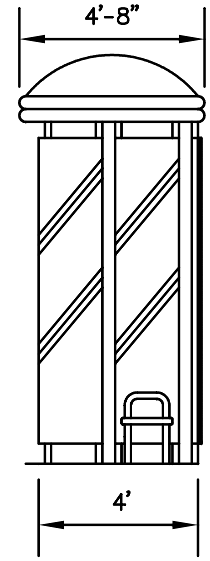
SIDE VIEW

ORANGE COUNTY
TRANSPORTATION AUTHORITY

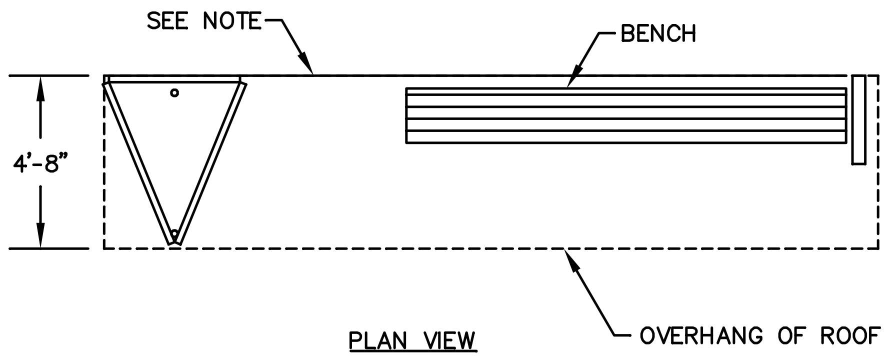
TYPICAL BUS BENCH DESIGN
WITH BACK SUPPORT



FRONT ELEVATION



RIGHT SIDE ELEVATION



PLAN VIEW

NOTE: LEFT-MOST REAR GLASS PANEL MAY BE REMOVED IF ACCESS FROM THE REAR OF THE SHELTER IS REQUIRED.

ORANGE COUNTY
TRANSPORTATION AUTHORITY

TYPICAL PASSENGER SHELTER

Appendix D
ADA Checklists

BUS STOP CHECKLIST **PART A: IDENTIFICATION/LOCATION**

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

	PART A: IDENTIFICATION/LOCATION				
					Yes No N/A
A1	Is there a bus shelter?				☐ ☐ ☐
	If YES, what is the number of the shelter?				
	If NO, is there an exterior alternative shelter nearby (i.e. - awning, overhangs, underpass)?				Yes No N/A ☐ ☐ ☐
A2	Street Name:				
A3	Nearest Cross Street (street name or landmark if mid-block):				
A4	Bus Route Direction:				
	North Bound ☐	South Bound ☐	More than one direction ☐		
	East Bound ☐	West Bound ☐			
A5	What is the purpose of the stop?				
	Park and Ride ☐	Boarding ☐	Both Boarding and Alighting ☐	Other (specify): ☐	
	Kiss and Ride ☐	Alighting ☐	Transfer ☐		
A6	What is the average number of daily boardings at the stop?				
A7	Where is the bus stop positioned in relation to the nearest intersection?				
	Nearside (Before the bus crosses the intersection)				☐
	Far Side (After the bus crosses the intersection)				☐
	Mid-block				☐
	Not near an intersection				☐
	Freeway bus pad				☐
	N/A				☐

Date	*Time:*	*Surveyor:*

BUS STOP CHECKLIST **PART A: IDENTIFICATION/LOCATION**

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

A8	Distance from bus stop pole to curb of cross street in feet:							
A9	Adjacent property address or name of business (only if readily visible):							
A10	Adjacent Property Description**:**							
	Apartment Building	☐	Industrial Site/Bldg.	☐	Park	☐	School	☐
	Day Care	☐	Library	☐	Park and Ride	☐	Supermarket	☐
	Government Building	☐	Mall/Shopping Center	☐	Place of Worship	☐	Transit station/center	☐
	Hospital	☐	Nursing Home	☐	Residence – townhouse	☐	Vacant lot	☐
	Human Service Agency	☐	Office Building	☐	Residence – detached	☐	Other (specify):	☐
					Retail Store	☐		
A11	Distance from previous bus stop (in feet):							

Date	*Time:*	*Surveyor:*

BUS STOP CHECKLIST **PART B: PEDESTRIAN ACCESS FEATURES**

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

PART B: PEDESTRIAN ACCESS FEATURES

Section B-1: Landing Area Assessment

B1	Is there a landing area at least 5 feet wide and 8 feet deep adjacent to the curb/street?							Yes ☐ No ☐
B2	Where is the landing area positioned in relation to the curb/street?							
	Below street level (low ground or shoulder)	☐	Shoulder	☐	Other (specify):	☐		
			Adjacent	☐				
	Sidewalk	☐	Bus Bulb	☐	Off-Road/No sidewalk	☐		
B3	What is the material of the landing area?							
	Asphalt ☐	Dirt ☐	Gravel	☐	Other (specify):	☐		
	Concrete ☐	Grass ☐	Pavers	☐				
B4	Are there problems with the landing area surface?							Yes ☐ No ☐
	If YES, rank resulting accessibility potential:							
		Not Accessible	Minimally Accessible	Accessible				
	Uneven	☐	☐	☐				
	Slopes up from the street	☐	☐	☐				
	Slopes down from the street	☐	☐	☐				
	Requires stepping over drain inlet	☐	☐	☐				
	Other (Specify)	☐	☐	☐				
B5	Are there any obstacles that would limit the mobility of a wheelchair?							Yes ☐ No ☐

Date	*Time:*	*Surveyor:*

BUS STOP CHECKLIST **PART B: PEDESTRIAN ACCESS FEATURES**

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

	If YES, describe obstruction:					
B6	Additional landing area comments:					
B7	Landing area recommendations:					
	Widen sidewalk to expand landing area to 5 feet wide and 8 feet deep	☐				
	Install curb bulb or remove on street parking	☐				
	Move object to improve accessibility (specify where):					
	Make the following repairs (specify):					
	Other (specify):					
	Section B-2: Connections (Trip Generators)					
B8	What are the primary trip generators for passengers at this stop? (Check all that apply)					
	Apartments - large building/complex	☐	Human service agency – what kind?	☐	School –Elementary/Middle	☐
	Apartments - small building	☐	Library	☐	School -High	☐
	Townhomes	☐	<u>Major Shopping/employment</u> (Mall, Wal-Mart, Kmart, Target, other big department store)	☐	School - College/University/ Technical school	☐
	Detached homes	☐	<u>Neighborhood Shopping</u> (supermarket, drugstore, Goodwill, strip mall with basic needs shopping)	☐	Senior center	☐
	Day care/pre-school	☐	Nursing home/assisted living	☐	Transfer to other bus routes	☐

Date	*Time:*	*Surveyor:*

BUS STOP CHECKLIST **PART B: PEDESTRIAN ACCESS FEATURES**

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

	Gas station ☐	Office building/employment ☐	Transit station/center ☐		
	Government building ☐	Park and Ride lot ☐	Other (Specify): ☐		
	Hospital/major clinic ☐	Place of worship ☐			
	Hotel ☐	Restaurant ☐			
B9	How wide is the sidewalk?				
	No sidewalk ☐	less than 3' ☐	3'-5' ☐	5' or greater ☐	N/A ☐
B10	Are there physical barriers that constrict the width of the sidewalk within the block on which the bus stop is located?				Yes ☐ No ☐
	If YES, what is the narrowest useable width:				
	Less than 3' ☐	3' or greater ☐			
B11	Rank the condition of the sidewalk:				
	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
	1=hazardous – large breaks, cracks, root uplifting, someone could get hurt from normal use or use of a wheelchair would be difficult *2=in poor shape though not hazardous – very rough, some root uplifting, cracks, breaks* *3=fair – minor root uplifting, minor cracks or breaks* *4=good – not perfect but no immediate repair* *5=cosmetically excellent; new*				
B12	Does the landing pad connect to the sidewalk?				Yes ☐ No ☐
	If YES, what does the sidewalk connect to:				
	One of the trip generators listed in Question B8 ☐	The nearest intersection ☐			
B13	Where is the nearest street crossing opportunity?				
	The nearest intersection ☐	Mid-block crosswalk ☐			
B14	What pedestrian amenities are at the nearest intersection (or other crossing opportunity)?				
	Curb cuts all corners/ both sides ☐	Pedestrian crossing signal ☐	Traffic Light ☐		

Date	*Time:*	*Surveyor:*

BUS STOP CHECKLIST **PART B: PEDESTRIAN ACCESS FEATURES**

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

	Visible crosswalk ☐		Audible crosswalk signal ☐		Crossing guard assistance ☐	
	Curb cuts at some corners/one side ☐		Accessible Pedestrian Signal (APS) ☐		Tactile warning strip on curb cut ☐	
					Other (specify): ☐	
B15	Is there a companion bus stop across the street?					Yes ☐ No ☐ N/A ☐
B16	Are there connections to other transportation services at this bus stop?					Yes ☐ No ☐
	If YES, check all that apply					
	Bus services, same or other agency ☐		Local Rail ☐		Commuter Rail ☐	
	Greyhound ☐		Other (Specify): ☐			
B17	Pedestrian connection recommendations:					
	Construct sidewalk					☐
	Widen sidewalk					☐
	Improve landing area connections to sidewalk					☐
	Install curb cut(s) at:					
	Move object to improve accessibility (specify where):					
	Make the following repairs (specify):					
	Other (specify):					

Date	*Time:*	*Surveyor:*

BUS STOP CHECKLIST **PART B: PEDESTRIAN ACCESS FEATURES**

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

B18	Additional pedestrian connection comments:

Date	*Time:*	*Surveyor:*

BUS STOP CHECKLIST **PART C: PASSENGER COMFORT AMENITIES**

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

PART C: PEDESTRIAN COMFORT AMENITIES

Section C-1: Shelters (move to Section C-2 if there is no shelter)

C1	What is the orientation of the bus shelter in relation to the street?						
	Facing towards the street						☐
	Facing on-coming traffic						☐
	Facing away from the street						☐
C2	What kind of shelter is it? Insert shelter relevant to your system.						
	Own transit agency ☐		Another transit agency (shared stop) ☐		Other (Specify): ☐		
C3	If non-standard shelter, what are the approximate dimensions (width, height and depth in feet) of the interior standing area?						
	Width:						
	Height:						
	Depth:						
C4	Does the shelter have a front center panel (i.e. two openings)?						Yes ☐ No ☐
	If YES, what are the dimensions of the opening?						
C5	Could a person using a wheelchair maneuver into the shelter?						Yes ☐ No ☐
C6	Could a person using a wheelchair fit completely under the shelter (minimum space of a common mobility device is 30 in. by 48 in. (760 mm by 1200mm))?						Yes ☐ No ☐
	What are the dimensions of the clear space in the shelter?						
C7	What is the distance of the front of the shelter from the curb in feet?						
	0 - 2' ☐	2' - 4' ☐	4' - 6' ☐	6' - 8' ☐	8' - 10' ☐	>10' ☐	
C8	Are there damages to the bus shelter?						Yes ☐ No ☐
	If YES, check all that apply:						

Date	*Time:*	*Surveyor:*

BUS STOP CHECKLIST **PART C: PASSENGER COMFORT AMENITIES**

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

	Broken panels	☐
	Graffiti	☐
	Holes in the roof	☐
	Missing panels	☐
	Needs repainting	☐
	Other (specify):	☐
C9	What is the approximate age of the shelter?	
C10	Rank the condition of the shelter:	
	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐	
	1=hazardous – broken glass, unstable *2=in poor shape though not hazardous* *3=fair – needs repainting, glass panels need thorough cleaning, protruding but not hazardous bolts* *4=good – not perfect but no immediate repair need* *5=cosmetically excellent; new*	
C11	Additional shelter comments:	
C12	Shelter recommendations:	
	Remove center panel	☐
	Make the following repairs (specify):	☐

Date	*Time:*	*Surveyor:*

BUS STOP CHECKLIST **PART C: PASSENGER COMFORT AMENITIES**

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

	Move object to improve accessibility (specify where):											
	Move shelter to improve accessibility (specify where):											
	Other (specify):											
Section C-2: Seating Assessment (move to Section C-3 if there is no seating)												
C13	What is the type of seating available?											
	Bench inside shelter – ***skip to question C15***											☐
	Freestanding bench											☐
	Fold down bench											☐
	Leaning bench											☐
	Other (specify):											☐
C14	If not inside shelter, what is the distance of the seating from the curb in feet?											
	0 - 2'	☐	2' - 4'	☐	4' - 6'	☐	6' - 8'	☐	8' - 10'	☐	>10'	☐
C15	Are there problems with the seating?											Yes ☐ No ☐
	If YES, check all that apply:											
	Broken pieces											☐
	Needs painting											☐
	Graffiti											☐
	Not securely installed											☐
	Other (specify):											☐
C16	Rank the condition of the seating:											
	1	☐	2	☐	3	☐	4	☐	5	☐		

Date	*Time:*	*Surveyor:*

BUS STOP CHECKLIST **PART C: PASSENGER COMFORT AMENITIES**

Route Name:	Location:	Weather Conditions:	Stop No.:

	1=hazardous – broken, someone could get hurt from normal use *2=in poor shape though not hazardous* *3=fair – needs repainting, needs cosmetic attention,, protruding but not hazardous bolts* *4=good – not perfect but no immediate repair need* *5=cosmetically excellent; new*
C17	Additional seating comments:
C18	Seating recommendations:
	Move seating to improve accessibility (specify where):
	Make the following repairs (specify):
	Other (specify):
	Section C-3: Trash Assessment (move to Section C-4 if there is no trash receptacle)
C19	What is the type of installation for the trash receptacle?

Date	*Time:*	*Surveyor:*

BUS STOP CHECKLIST **PART C: PASSENGER COMFORT AMENITIES**

Route Name:	Location:	Weather Conditions:	Stop No.:

	Attached to the shelter	☐
	Free standing	☐
	Garbage bag	☐
	Bolted to sidewalk	☐
	Other (specify):	☐
C20	Are there problems with the trash receptacle and surrounding area?	Yes ☐ No ☐
	If YES, check all that apply:	
	Trash can very full	☐
	Graffiti at bus stop	☐
	Bus stop littered	☐
	Grocery carts left at stop	☐
	Trash can not securely installed	☐
	Adjacent property littered	☐
	Other (specify):	☐
C21	Additional Comments:	
C22	Trash recommendations:	
	Install trash can due to litter problem	☐
	Make the following repairs (specify):	
	Move trash can to improve accessibility (specify where):	
	Other (specify):	

Section C-4: Newspaper Boxes (move to Part D if there are no newspaper boxes)

Date	Time:	Surveyor:

BUS STOP CHECKLIST **PART C: PASSENGER COMFORT AMENITIES**

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

C23	Are the newspaper boxes a barrier to sidewalk use?	Yes ☐ No ☐
C24	Are the newspaper boxes a barrier to bus access/egress?	Yes ☐ No ☐
C25	Are they chained to the bus stop pole, shelter, or bench?	Yes ☐ No ☐
C26	Are they blocking access to posted bus schedule info?	Yes ☐ No ☐
C27	Additional newspaper box comments:	
C28	Newspaper box recommendations:	
	Move trash can to improve accessibility (specify where):	
	Other (specify):	

Date	*Time:*	*Surveyor:*

BUS STOP CHECKLIST **PART D: SAFETY AND SECURITY FEATURES**

Route Name:	Location:	Weather Conditions:	Stop No.:

PART D: Safety and Security Features		
Section D-1: Traffic and Pedestrian Issues		
D1	Where is the bus stop area located?	
	In travel lane	☐
	Bus lane/pull off area	☐
	Paved shoulder	☐
	In right turn only lane	☐
	Unpaved shoulder	☐
	Off street	☐
	“No Parking” portion of street parking lane	☐
	Other (specify):	☐
D2	Is the bus stop zone designated as a no parking zone?	Yes ☐ No ☐
	If YES, indicated by:	
	One “No Parking” sign	☐
	2 or more “No Parking” signs	☐
	“Bus Only” sign	☐
	Painted curb	☐
	Painted street	☐
D3	Are cars parked between the landing area and the bus stopping area?	Yes ☐ No ☐
D4	What is the posted speed limit in MPH?	Not posted ☐
D5	What are the traffic controls at the nearest intersection for the street?	
	Traffic signals	☐
	Flashing lights	☐
	Stop/Yield sign	☐
	None	☐
	Other (specify):	☐
D6	How many total lanes are on both sides of the road?	

Date	Time:	Surveyor:

BUS STOP CHECKLIST **PART D: SAFETY AND SECURITY FEATURES**

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

	1 ☐ | 2 ☐ | 3 ☐ | 4 ☐ | Other (specify): ☐	N/A ☐
D7	Is there on-street parking permitted just before or after the bus stop zone?	Yes ☐ No ☐ N/A ☐
	If YES, what is the length of the "No Parking" area in feet:	
D8	Are there potential traffic hazards?	Yes ☐ No ☐
	Yes, *check all that apply:*	
	The bus stop is just over the crest of a hill	☐
	The bus stop is just after a curve in the road	☐
	The bus stop is near an at-grade railroad crossing	☐
	Waiting passengers are hidden from view of approaching bus	☐
	A stopped bus straddles the crosswalk	☐
	Bus stop just before crosswalk	☐
	High speed traffic	☐
	No crosswalk	☐
	Other (specify)	☐
D9	Additional traffic safety comments / recommendations:	
Section D-2: Lighting Assessment (assessment preferably taken in the evening or at night) Go to Section D-3 if no lighting		
D10	What type of lighting is available?	
	Street light	☐
	Shelter lighting	☐
	Outside light on adjacent building	☐
	Other (specify):	☐

Date	*Time:*	*Surveyor:*

BUS STOP CHECKLIST **PART D: SAFETY AND SECURITY FEATURES**

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

D11	Does the light produce a glare?	Yes ☐ No ☐
D12	How even is the light distributed?	Yes ☐ No ☐
D13	Additional comments:	
	Section D-3: Pay Phone	
D14	Is there a pay phone within the immediate vicinity?	Yes ☐ No ☐
	If NO, skip to Question D16.	
D15	Is the pay phone within reach of a wheelchair user?	Yes ☐ No ☐
D16	If no pay phone is provided, is there a police call box?	Yes ☐ No ☐
D17	Additional comments:	
	Section D-4: Landscaping Assessment	
D18	Are there problems with the landscaping around the bus stop?	Yes ☐ No ☐
	If YES, check all that apply:	
	Trees/bushes encroaching on the landing area	☐
	Trees/bushes encroaching on the sidewalk	☐
	Tree branches that would hit the bus	☐
	Other (specify):	☐

Date	*Time:*	*Surveyor:*

BUS STOP CHECKLIST **PART D: SAFETY AND SECURITY FEATURES**

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

D19	Additional comments:	
	Section D-5: Safety Recommendations	
D20	Improve pedestrian safety by:	☐
	Trim trees or branches	☐
	Move bus stop to:	
	Other (specify):	

Date	*Time:*	*Surveyor:*

BUS STOP CHECKLIST **PART E: INFORMATION FEATURES**

Route Name:	Location:	Weather Conditions:	Stop No.:

PART E: Information Features		
E1	Is there a bus stop sign?	Yes ☐ No ☐
	If NO, move to question E6.	
E2	What provider name is on the bus stop (*list all providers utilizing stop*)?	
	Provider 1:	
	Provider 2:	
	Provider 3:	
	Provider 4:	
E3	Are bus routes indicated on the bus stop sign?	Yes ☐ No ☐
	If YES, what routes?	
E4	How is the sign installed?	
	On its own pole	☐
	On a building	☐
	On a utility pole	☐
	On a shelter	☐
	Other (specify):	☐
E5	Are there problems with the signage?	Yes ☐ No ☐
	If YES, check all that apply:	
	Sign in poor condition	☐
	Pole in poor condition	☐
	Sign position hazardous to pedestrians	☐
	Sign not permanently mounted	☐
	Lighting on sign is poor	☐
	Other (specify):	☐
E6	Is there route/schedule/map (circle as appropriate) information posted?	Yes ☐ No ☐
	If NO please move to question E9.	

Date	*Time:*	*Surveyor:*

E

BUS STOP CHECKLIST **PART E: INFORMATION FEATURES**

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

E7	Where is the route/schedule/map (circle as appropriate) information posted?	
	On Pole under bus stop sign	☐
	On its own pole	☐
	On a building	☐
	On a utility pole	☐
	On a shelter	☐
	In a shelter	☐
	Other (specify):	☐
E8	Is the information at eye level of a wheelchair user?	Yes ☐ No ☐
E9	Is there a schedule rack?	Yes ☐ No ☐
	If YES, are repairs needed?	Yes ☐ No ☐
E10	Is there real time information display?	Yes ☐ No ☐
	If YES, is it at eye level of a wheelchair user?	Yes ☐ No ☐
E11	Is signage text ADA compliant (refer to the *Toolkit for the Assessment of Bus Stop Accessibility and Safety* for guidelines)?	Yes ☐ No ☐
E12	Is information provided in Braille or by a Talking Signs® transmitter for people with visual impairments?	Yes ☐ No ☐
E13	Additional signage & information comments:	
E14	Signage & information recommendations:	
	Make the following repairs:	☐
	Other (specify):	☐

Date	*Time:*	*Surveyor:*

BUS STOP CHECKLIST **PART F: DIAGRAMMATIC SKETCH OR PHOTOGRAPH**

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

PART F: Diagrammatic Sketch or Photograph

Sketch or photograph the layout of the bus stop area and any traffic controls. On sketch or photograph, be sure to note locations of:

☐ Bus stop sign pole	☐ Newspaper boxes	☐ Traffic signals/stop signs
☐ Other poles	☐ Anything else installed at bus stop	☐ Railroad tracks
☐ Landing Pad	☐ Sidewalks	☐ Bus stop across the street
☐ Shelter	☐ Sidewalk barriers	☐ Heating units in shelters
☐ Bench	☐ Crosswalks	☐ Bike racks
☐ Trash can	☐ Curb cuts	☐ North/South/East/West

Date	*Time:*	*Surveyor:*

BUS STOP CHECKLIST **PART F: DIAGRAMMATIC SKETCH OR PHOTOGRAPH**

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

Date	*Time:*	*Surveyor:*

QUICK BUS STOP CHECKLIST

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

	PART A: IDENTIFICATION/LOCATION					
A1	Street Name:					
A2	Nearest Cross Street (street name or landmark if mid-block):					
A3	Bus Route Direction:					
	North Bound	☐	South Bound	☐	More than one direction	☐
	East Bound	☐	West Bound	☐		
A4	Where is the bus stop positioned in relation to the nearest intersection?					
	Nearside (Before the bus crosses the intersection)					☐
	Far Side (After the bus crosses the intersection)					☐
	Mid-block or not near an intersection					☐
	Freeway bus stop boarding and alighting area					☐
	N/A					☐
A5	Distance from bus stop pole to curb in feet:					
A6	Adjacent property address or name of business (only if readily visible):					

Date	*Time:*	*Surveyor:*

QUICK BUS STOP CHECKLIST

Route Name:	Location:	Weather Conditions:	Stop No.:

PART B: Boarding and Alighting Area Assessment

B1	Is there a boarding and alighting area at least five feet wide parallel to the edge of the roadway and eight feet deep perpendicular to the edge of the roadway adjacent to the curb/street?							Yes ☐ No ☐
B2	B2. Where is the boarding and alighting area positioned in relation to the curb/street?							
	Below street level (low ground or shoulder)	☐	Shoulder	☐	Other (specify):	☐		
			Adjacent	☐				
	Sidewalk	☐	Bus Bulb	☐	Off-Road/No sidewalk	☐		
B3	What is the material of the boarding and alighting area?							
	Asphalt ☐	Dirt ☐	Gravel	☐	Other (specify):	☐		
	Concrete ☐	Grass ☐	Pavers	☐				
B4	Are there problems with the boarding and alighting area surface?							Yes ☐ No ☐
	If YES, rank resulting accessibility potential:							
		Not Accessible	Minimally Accessible	Accessible				
	Uneven	☐	☐	☐				
	Slopes up from the street	☐	☐	☐				
	Slopes down from the street	☐	☐	☐				
	Requires stepping over drain inlet	☐	☐	☐				
	Other (Specify)	☐	☐	☐				
B5	Are there any obstacles that would limit the mobility of a person using a wheelchair (trash receptacle, newspaper boxes, landscaping, other?							Yes ☐ No ☐
	If YES, describe obstruction:							

Date	*Time:*	*Surveyor:*

QUICK BUS STOP CHECKLIST

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

B6	Additional boarding and alighting area comments:	
	PART C: PEDESTRIAN COMFORT AMENITIES	
	Section C-1: Shelters (move to Section C-2 if there is no shelter)	
C1	What are the approximate dimensions (width, height and depth in feet) of the interior standing area?	
	Width:	
	Height:	
	Depth:	
C2	Could a person using a wheelchair or other mobility device maneuver into the shelter?	Yes ☐ No ☐
C3	Could a person using a wheelchair or other mobility device fit completely under the shelter (minimum space of a common mobility device is 30 in. by 48 in. (760 mm by 1200mm))?	Yes ☐ No ☐
C4	What is the distance of the front of the shelter from the curb in feet?	
	0 - 2' ☐ 2' - 4' ☐ 4' - 6' ☐ 6' - 8' ☐ 8' - 10' ☐ >10' ☐	
C5	Additional shelter comments:	
	Section C-2: Seating Assessment (move to Part D if there is no seating)	
C6	What is the type of seating available?	
	Bench inside shelter – ***skip to question C8***	☐
	Freestanding bench	☐
	Fold down bench	☐
	Leaning bench	☐
	Other (specify):	☐
C7	If not inside shelter, what is the distance of the seating from the curb in feet?	

Date	*Time:*	*Surveyor:*

QUICK BUS STOP CHECKLIST

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

	0 - 2' ☐	2' - 4' ☐	4' - 6' ☐	6' - 8' ☐	8' - 10' ☐	>10' ☐		
C8	Rank the condition of the seating:							
	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐			
	1=hazardous – broken, someone could get hurt from normal use *2=in poor shape though not hazardous* *3=fair – needs repainting, needs cosmetic attention,, protruding but not hazardous bolts* *4=good – not perfect but no immediate repair need* *5=cosmetically excellent; new*							
C9	Additional seating comments:							

PART D: Information Features

D1	Is there a bus stop sign?	Yes ☐ No ☐
	If NO, move to question D5.	
D2	Are bus the routes served indicated on the bus stop sign?	Yes ☐ No ☐
	If YES, what routes?	
D3	How is the sign installed?	
	On its own pole	☐
	On a building	☐
	On a utility pole	☐
	On a shelter	☐
	Other (specify):	☐

Date	*Time:*	*Surveyor:*

QUICK BUS STOP CHECKLIST

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

D4	Are there problems with the signage?	Yes ☐ No ☐
	If YES, check all that apply:	
	Sign in poor condition	☐
	Pole in poor condition	☐
	Sign position hazardous to pedestrians	☐
	Sign not permanently mounted	☐
	Lighting on sign is poor	☐
	Other (specify):	☐
D5	Is there route/schedule/map (circle as appropriate) information posted?	Yes ☐ No ☐
	If NO, skip to Question D8	
D6	Where is the route/schedule/map (circle as appropriate) information posted?	
	On pole under bus stop sign	☐
	On its own pole	☐
	On a building	☐
	On a utility pole	☐
	On a shelter	☐
	In a shelter	☐
	Other (specify):	☐
D7	Is the information at eye level of a person using a wheelchair and no lower than 40 inches (1015 mm) above the finished floor ground surface?	Yes ☐ No ☐
D8	Additional signage & information comments:	
	PART E: Other Amenities	
E1	What other amenities are at the bus stop?	

Date	*Time:*	*Surveyor:*

QUICK BUS STOP CHECKLIST

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

	Trash receptacle	☐
	Telephone or police call box	☐
	Newspaper boxes	☐
	No other amenities	☐
	Other (specify):	☐
E2	Do any of these amenities obstruct the access of a person using a wheelchair or other mobility device to the boarding and alighting area or other amenities within the site?	Yes ☐ No ☐
	If YES, specify what the amenity is blocking access to:	
	Bus shelter	☐
	-Seating area for people using wheelchairs or other mobility devices	☐
	Bus ingress or egress	☐
	Bus stop information	☐
	Other (specify):	☐
	PART F: Traffic and Pedestrian Safety Issues	
	Section F-1: Traffic and Pedestrian Issues	
F1	Where is the bus stop area located?	
	In travel lane	☐
	Bus lane/pull off area	☐
	Paved shoulder	☐
	In right turn only lane	☐
	Unpaved shoulder	☐
	Off street	☐
	"No Parking" portion of street parking lane	☐
	Other (specify):	☐
F2	Is the bus stop zone designated as a no parking zone?	Yes ☐ No ☐
	If YES, indicated by:	

Date	*Time:*	*Surveyor:*

QUICK BUS STOP CHECKLIST

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

	One "No Parking" sign	☐
	2 or more "No Parking" signs	☐
	"Bus Only" sign	☐
	Painted curb	☐
	Painted street	☐
F3	Are cars parked between the landing area and the bus stopping area?	Yes ☐ No ☐
F4	What is the posted speed limit in MPH? Not posted	☐
F5	What are the traffic controls at the nearest intersection for the street?	
	Traffic signals	☐
	Flashing lights	☐
	Stop/Yield sign	☐
	None	☐
	Other (specify):	☐
F6	How many total lanes are on both sides of the road?	
	1 ☐ 2 ☐ 3 ☐ 4 ☐ Other (specify): ☐	N/A ☐
F7	Are there potential traffic hazards?	Yes ☐ No ☐
	Yes, *check all that apply:*	
	The bus stop is just over the crest of a hill	☐
	The bus stop is just after a curve in the road	☐
	The bus stop is near an at-grade railroad crossing	☐
	Waiting passengers are hidden from view of approaching bus	☐
	A stopped bus straddles the crosswalk	☐
	Bus stop just before crosswalk	☐
	High speed traffic	☐
	No crosswalk	☐
	Other (specify)	☐

Date	*Time:*	*Surveyor:*

QUICK BUS STOP CHECKLIST

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

F8	Additional traffic safety comments / recommendations:									
Section F-2: Lighting Assessment (assessment preferably taken in the evening or at night) Go to Part G if no lighting										
F9	What type of lighting is available?									
	Street light	☐								
	Shelter lighting	☐								
	Outside light on adjacent building	☐								
	Other (specify):	☐								
F10	Additional comments:									
PART G: Getting to the Bus Stop										
G1	How wide is the sidewalk?									
	No sidewalk	☐	less than 3'	☐	3'-5'	☐	5' or greater	☐	N/A	☐
G2	Rank the condition of the sidewalk:									
	1	☐	2	☐	3	☐	4	☐	5	☐
	1=hazardous – large breaks, cracks, root uplifting, someone could get hurt from normal use or use of a wheelchair would be difficult *2=in poor shape though not hazardous – very rough, some root uplifting, cracks, breaks* *3=fair – minor root uplifting, minor cracks or breaks* *4=good – not perfect but no immediate repair* *5=cosmetically excellent; new*									
G3	Are there physical barriers that constrict the width of the sidewalk within the block on which the bus stop is located?	Yes ☐ No ☐								
	If YES, what is the narrowest useable width:									

Date	*Time:*	*Surveyor:*

QUICK BUS STOP CHECKLIST

Route Name:	*Location:*	*Weather Conditions:*	*Stop No.:*

	Less than 3'	☐	3' or greater			☐
G4	G4. Does the boarding and alighting area connect to the sidewalk?					Yes ☐ No ☐
G5	Where is the nearest street crossing opportunity?					
	The nearest intersection	☐	Mid-block crosswalk			☐
G6	What pedestrian amenities are at the nearest intersection (or other crossing opportunity)?					
	Curb ramps at all points where a curb is encountered along the accessible route(s)	☐	Pedestrian crossing signal	☐	Traffic light	☐
	Visible crosswalk	☐	Audible crosswalk signal	☐	Crossing guard assistance	☐
	Curb cuts at some corners/one side	☐	Accessible Pedestrian Signal (APS)	☐	Tactile warning strip on curb cut	☐
	Other (specify):					☐

Date	*Time:*	*Surveyor:*

Appendix E
Bus Stop Design Process Checklist

BUS STOP PLANNING AND DESIGN CHECKLIST

HOW TO USE THIS CHECKLIST

This section provides checklists for planning and designing a relocated or new bus stop. The procedure includes checklists for evaluating potential stop locations and determining the stop configuration.

The chart below identifies four technical areas within the broader discipline of Transit System Planning. OCTA's Transit Supportive Design Guideline's (TSDG) focus on Bus Stop Design and some of the topics under Bus Operations Planning, specifically, strategies for improving speed and reliability. Although the TSDG includes guidelines for some of the topics under Bus Service Planning, the design checklists in this appendix assumes that bus route structure, bus stop spacing, and frequency of service is already established.

Bus Service Planning	Bus Stop Design	Bus Operations Planning	Short Range Transit Plan
• Service Area and Coverage • Ridership Estimates • Route Structure and Spacing • Stop Density and Spacing • Frequency and Scheduling	• Stop Location • Stop Configuration • Passenger Safety • Accessibility • Pedestrian Access to Stops • Boarding Area Layout • Passenger Amenities • Street and Intersection Design for Buses	• Service Analysis • Service Change Implementation • Scheduling and Headways • Strategies for Improving Speed, Reliability - Traffic Control Strategies (Transit Priority) - Bus Operations Strategies - Bus Facility Strategies	• Service and System Evaluation • Service Changes and Improvements • Fleet Needs • Fare Structure • Capital and Operating Costs • Revenue • Operating Plan and Budget • Funding Sources

BUS STOP PLACEMENT CHECKLIST	
A. Determine if the stop will be located at an intersection or mid-block	
As a rule, **the farside of an intersection is the preferred location for a bus stop under most circumstances.** In some cases, however, an intersection farside location may be undesirable. There are a number conditions under which a nearside of an intersection or a mid-block location is the best choice.	
A1. Consider a mid-block location if one or more of the following conditions exist:	
	The potential bus stop serves a major transit generator located within a large block such as a hospital, university, significant employment center, or regional retail center, and the stop can be located central to the generator's main point of entry.
	The bus route is adjacent to a rail station without an off-street bus transfer center (or a center that has exceeded its capacity) and there is adequate curb space to configure the stop as an **on-street bus transfer center** with capacity for multiple buses.
	The distance between intersections exceeds the recommended minimum bus stop spacing criteria.

A1. Consider a mid-block location if one or more of the following conditions exist (Continued):	
	It is infeasible or undesirable to provide a farside or nearside bus stop at an intersection due to significant safety issues at the intersection that cannot be mitigated, there is insufficient streetside or curbside space meeting the minimum requirements for a bus stop; or the intersection is operating over-capacity and is frequently congested and the addition of bus stops would exacerbate these conditions.
	The potential location of the mid-block stop has access to a street crossing that connects to a mid-block stop in the opposite direction, particularly a transfer stop (this excludes one-way loop routes). The connection to the opposite side of the street should meet the following criteria:
	A. The nearest crosswalk to the opposite side of the street is located at an intersection at the end of the block and the walking distance to the crosswalk is considered acceptable.
	B. The bus stop in the opposite direction is also located mid-block, as nearly directly opposite as possible, and a nearby mid-block crosswalk (or minor intersection crosswalk) connects the stops. See Criteria C.
	C. On multi-lane streets with speed over 40 mph, the mid-block crosswalk is either signal controlled, or uncontrolled with RRFBs and a raised median pedestrian refuge. Crosswalk safety lighting must be present in either condition.
A2. Consider an intersection nearside location if one or more of the following conditions exist or is desirable:	
	An intersection with low right turning volumes at the nearside corner with a right turn lane, but preferably without a right turn lane.
	When minimizing service delay is imperative and a nearside stop can reduce the number of times the bus needs to stop at the intersection (i.e. once for traffic control and once again at the stop).
	When there is a large transit trip generator on the nearside of the intersection so that passengers can access the stop without having to cross a street.
	When the route turns right at the intersection.
	At a transfer bus stop where at least one of the routes turns right at the intersection.
	In a corridor where transit signal priority (TSP) measures exist or are desirable, particularly where a right turn lane can serve as a queue jump lane, or a passive TSP system uses alternating farside and nearside bus stops.
	Where the length of the bus stop needs to be minimal (such as when street parking is a high priority) and a farside curb extension stop is not feasible, use a nearside curb extension stop. Alternatively, the length of a nearside curbside bus stop (pull-in or in-lane) is reduced by eliminating the pull-out zone and using the intersection to accelerate away from the curb.
	Where a farside bus stop isn't feasible because of a conflict (i.e., a driveway curb cut is located there) or the curbside space is inadequate for the required bus stop layout, passenger waiting area, or desired amenities.
	Where traffic on the farside of the intersection is heavy and frequently backs up to the intersection causing buses to wait on the nearside for traffic to clear.
	Where the cross street has a high volume of traffic turning right at the farside corner, or if the cross street right turn volume has, or requires, dual right turn lanes, or the farside corner is constructed with a free right turn lane.
	At signalized intersections with long cycle lengths where passengers can board and alight while buses are stopped for the red light.
	At intersections with only one nearside crosswalk. A nearside stop would avoid passengers having to cross streets twice to get to the opposite side. A nearside curb extension bus stop would reduce the pedestrian crossing distance, particularly if combined with a farside stop on the opposite side of the street.
	At intersections where buses frequently queue while waiting to access the bus stop during peak periods and the use of a farside stop may cause queued buses to block the intersection.
	A nearside stop can be paired with a farside stop used by an intersecting route with frequent transfers if there is inadequate curb space for multiple buses at either stop.

Table E-1: Conditions for Selecting Various Bus Stop Configurations at Farside, Nearside and Mid-Block Locations

Bus Stop Location	Curbside In-Lane Stop	Curbside Pull-In Stop	Curb Extension Stop	Turnout Stop
Farside	• On lower speed (40 mph or less) transit priority streets without street parking or shoulder, or where a transit-only lane is provided. • On streets that or at or near vehicular capacity and/or where traffic conditions make it difficult for a bus to re-enter traffic and causes excessive delay. • On high-frequency service corridors with high levels of ridership. • On single-lane streets where the stop can be placed far enough away from the intersection so that vehicles can queue behind the bus without backing up into the intersection. • Where curb space for an acceleration zone is limited. • On streets where lane blockage is unacceptable but has two lanes to allow passing of stopped buses. • Where cost is limited or there is a possibility the bus stop may be relocated in the future. • Where a curb extension bus stop is desirable but infeasible or too costly to provide.	• When traffic flow is a high priority or part of a coordinated system. • Where bus layovers are required. • On two-lane streets with parking or shoulder where lane blockage is unacceptable. • On high-speed (< 40 mph) and low-volume (>500 vplph) streets or highways. • On two-lane transit priority streets where maintaining traffic flow is important, periodic pull-in stops allow vehicles to pass while a bus is boarding and alighting passengers. • Streets with high bicycle traffic and bus stop can be located where it does not block bike lane. • Where cost is limited or there is a possibility the bus stop may be relocated in the future.	• On lower speed (40 mph or less) transit priority streets with street parking. • On streets where parking is a high priority. • On streets where lane blockage is unacceptable but has two or more lanes in each direction to allow passing of stopped buses. • On single-lane streets where the curb extension stop can be long enough that vehicles can queue behind the bus without backing up into the intersection. • Where there are frequent high levels of passengers waiting at stop. • At stops requiring large area for amenities such as multiple shelters. • On streets with crowded or narrow sidewalks. • On streets with bike facilities where the bus stop can be separated from the curb (see Boarding Island Bus Stops). • Where street drainage modifications such as relocating stormwater catch basins are feasible to avoid obstructing the gutter flowline and cause pooling.	• Where adequate right of way exists for the turnout and passenger boarding area without impacting pedestrian movement on adjacent sidewalk. • On high-speed (< 40 mph) and high-volume (< 500 vplph) arterial streets or highways. • On streets where traffic flow is a high priority. • Where obstructed sight distance prevents traffic from safely stopping when encountering a bus stopped in the lane (i.e. horizontal or vertical curvature of the road). • On streets without parking or shoulder and stop requires bus layovers or long dwell times (<30 seconds per bus). • On high-speed streets with adequate curb space for an acceleration zone for buses to safely re-enter the traffic flow.

Table E-1: Conditions for Selecting Various Bus Stop Configurations at Farside, Nearside and Mid-Block Locations (Continued)

Bus Stop Location	Curbside In-Lane Stop	Curbside Pull-In Stop	Curb Extension Stop	Turnout Stop
Nearside	Same criteria as for farside curbside in-lane stops plus: • Where buses turn right, and the effective curb return radius can accommodate a bus turning path without encroaching into opposing lanes. • Where traffic frequently backs up through the intersection and curb extension stops prevent buses from being blocked from re-entering the traffic flow.	Same criteria as for farside curbside pull-in stops plus: • Where buses turn right, and the effective curb return radius can accommodate a bus turning path without encroaching into opposing lanes. • At intersections without an exclusive right turn lane and low to moderate right turning volumes, allowing vehicles to use the bus stop for right turns when buses are not present improves intersection capacity.	Same criteria as for farside curb extension bus stops plus: • Where traffic frequently backs up through the intersection and curb extension stops prevent buses from being blocked from re-entering the traffic flow. • At intersections with low to moderate right turning volumes	Same criteria as for turnout stops plus: • On high-speed streets (< 40 mph) with adequate curb space for a deceleration zone for buses to safely enter the stop. • At intersections where an open-ended turnout can be used in conjunction with transit signal priority and/or a right turn queue jump lane.
Mid-Block	Same criteria as for farside curbside in-lane stops.	Same criteria as for farside curbside pull-in stops plus: • On streets where parking is a lower priority and adequate curb space is available for long curb restrictions comprised of a deceleration zone, a bus stop zone, and an acceleration zone.	Same criteria as for farside curb extension bus stops.	Same criteria as for turnout stops.

BUS STOP ENVIRONMENT CHECKLIST

1. CURRENT BUS STOP LOCATION

Current Location:	
Stop ID:	Route #:
Location of Stop in Opposite Direction:	
Other Information:	

2. REASONS FOR RELOCATING BUS STOP (IF APPLICABLE)

Check appropriate box and describe below:

	Safety		Schedule Delays		Efficiency		Other		

Describe:

Diagram:

3. PLANNING FOR NEW OR RELOCATED BUS STOP – EXPECTED USE OF BUS STOP

RIDERSHIP

Annual Ridership	Current:	Forecast:	
Daily Boardings	Current:	Forecast:	
Daily Alightings	Current:	Forecast:	
Route Headways	Period 1:	Period 2:	Period 3:
Route 1			
Route 2			
Route 3			
Max. No. of Psgrs. Waiting at Stop:			

ROUTES

Routes Currently or Proposed to Use Stop:		
Street / Direction Buses Arrive / Depart (Attach route maps):		
Max. Bus Capacity Required:	Type(s) of vehicles using stop:	
Are Layovers Required:	No. of Buses:	Duration:
Will Stop Require Electrical Power:		
Existing or Proposed Location of Stop in Opposite Direction:		
Diagram:		

4. STREETSIDE ELEMENTS

SELECTED STREET SEGMENT FOR RELOCATED BUS STOP

Street Name:		Agency with Jurisdiction:
Functional Classification / MPAH Designation:		
Segment	From (Cross Street):	To (Cross Street):

Diagram or Map:

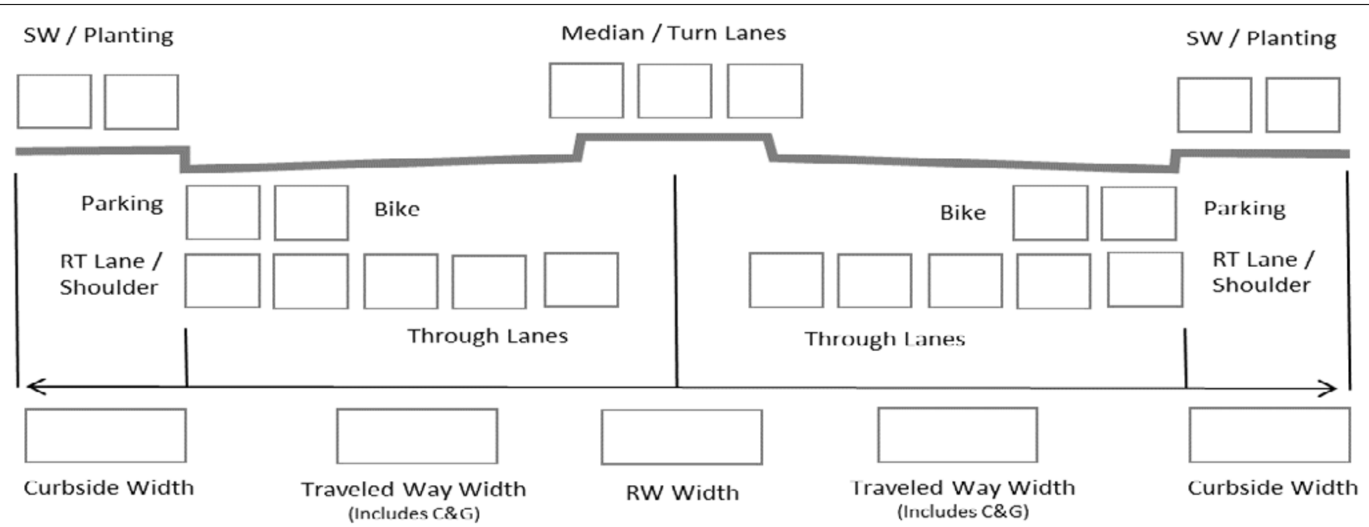
TRAFFIC AND SPEED DATA

Average Annual Daily Traffic Volume (AADT):	AM Peak Hour Directional Traffic Volume:	PM Peak Hour Directional Traffic Volume:
Posted Speed Limit (mph):	Off-Peak 85th Percentile Speed:	

CROSS SECTIONAL DATA

Right of Way (Feet):	No. of Lanes by Direction:	Divided / Undivided:

Typical Cross-Section Diagram (record widths in feet):



OTHER STREET SEGMENT CHARACTERISTICS

Existing or Planned Bikeways	Type / Class:	Width (Include in diagram above):	
Street Parking	Time Restricted / Unrestricted:	Paid / Free:	Est. Peak Utilization (%):
Existing Street Lighting	Spacing of Standards:	Pedestrian Scaled Lighting:	
Mid-Block Crosswalks	Type of Control:	Location:	
General Roadway Alignment	Horizontal (straight, curvi-linear):	Vertical (flat, grade, rolling):	

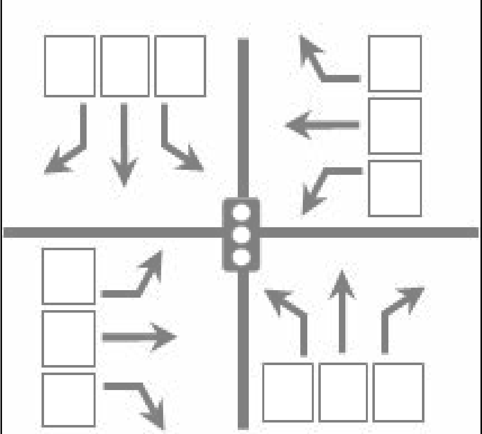
5. SIGNALIZED INTERSECTIONS

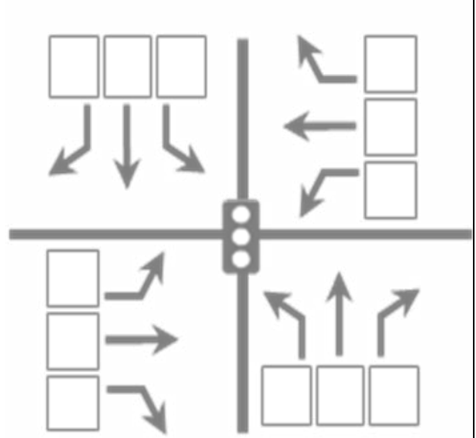
TRAFFIC CONTROL

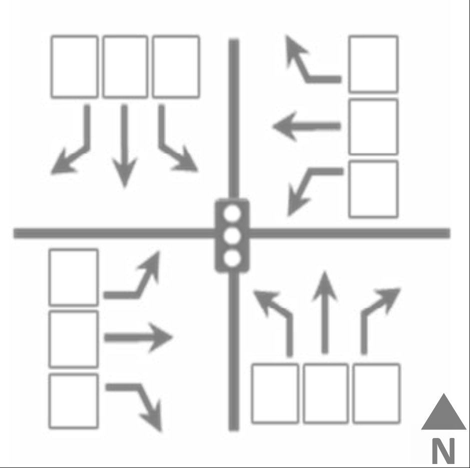
Identify intersections and type of traffic control on street segment diagram and record the following data for up to four intersections (use back for additional intersections):

		Intersection #1	Intersection #2	Intersection #3	Intersection #4
Signalized Intersection Control	EW Street Name:				
	NS Street Name:				
	Type of Phasing:				
	Number of Phases:				
	Cycle Length:				
	Type of Actuation:				
	Phasing Diagram:				

Intersection Lane Configuration (Record no. of lanes by movement, use back for additional Intersections)







Intersection #1:	Intersection #2:	Intersection #2:

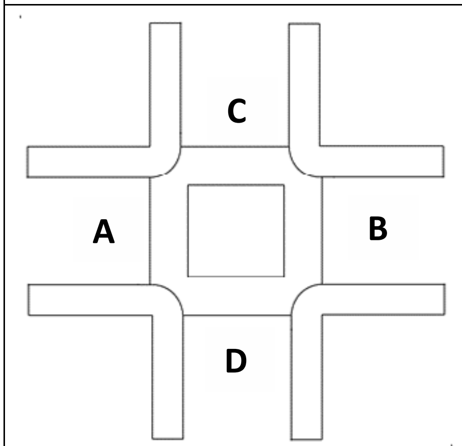
SIGNAL COORDINATION / PRE-EMPTION / TRANSIT PRIORITY

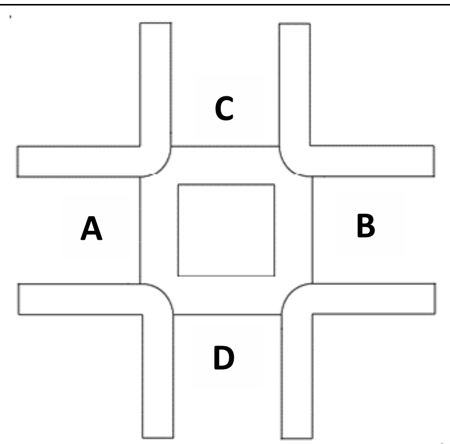
Are the intersections in the study segment part of a coordinated signal system?	Master Cycle Length:	Offset**:**
Agency(s) with jurisdiction over coordinated system:		
Is there Emergency Vehicle Preemption?	Type of system (acoustic, radio signal, GPS, etc.):	
Existing or Future Transit Priority System?	Passive (describe below):	Active (describe below):
Describe TSP System:		

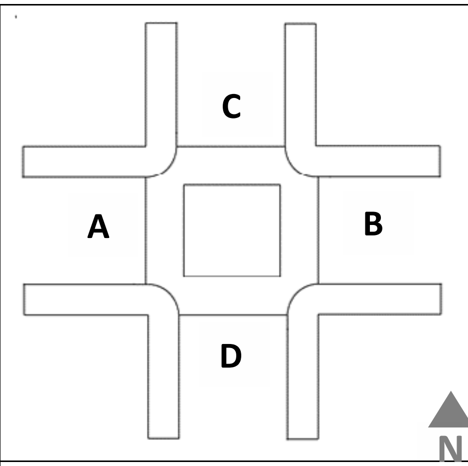
6. PEDESTRIAN FACILITIES AT SIGNAL-CONTROLLED INTERSECTIONS

CROSSWALKS

Mark approaches with crosswalks (use back for additional intersections). Indicate whether crosswalk standard, ladder, diagonal, or other style of crosswalk marking.

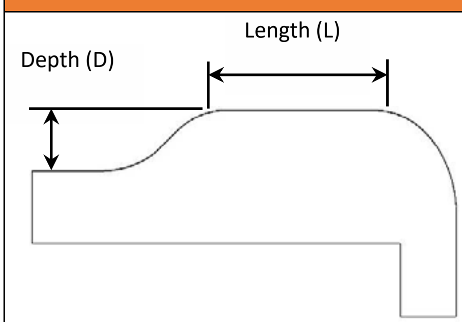






Intsx #1 EW St:	Intsx #2 EW St:	Intsx #3 EW St:
Intsx #1 NS St:	Intsx #2 NS St:	Intsx #3 NS St:

CURB EXTENSIONS (Indicate location, length and depth)



Intsx #1:	Intsx #2:	Intsx #3:
Corner:_______________	Corner:_______________	Corner:_______________
Length parallel to which street:_______________	Length parallel to which street:_______________	Length parallel to which street:_______________
Length (feet):__________	Length (feet):__________	Length (feet):__________
Depth (feet):__________	Depth (feet):__________	Depth (feet):__________

Crosswalk Length (feet)

A.	A.	A.
B.	B.	B.
C	C	C
D.	D.	D.

Estimated Curb Return Radius (feet)

NW Corner:	NW Corner:	NW Corner:
NE Corner:	NE Corner:	NE Corner:
SW Corner:	SW Corner:	SW Corner:
SE Corner:	SE Corner:	SE Corner:
ADA Compliant Curb Ramps:	ADA Compliant Curb Ramps:	ADA Compliant Curb Ramps:

Notes:

Estimated Pedestrian Crossing Volume During Peak Periods

EW: NS:	EW: NS:	EW: NS:

7. PEDESTRIAN FACILITIES AT SIGNAL-CONTROLLED INTERSECTIONS (CONTINUED)

PEDESTRIAN CROSSING EQUIPMENT					
Pedestrian Signal Heads					
EW Countdown Timer:	EW Walk Time (sec):	EW Countdown Timer:	EW Walk Time (sec):	EW Countdown Timer:	EW Walk Time (sec):
EW Countdown Timer:	EW Walk Time (sec):	EW Countdown Timer:	EW Walk Time (sec):	EW Countdown Timer:	EW Walk Time (sec):
Walk Signal Actuation and Accessibility Compliance					
Intsx #1: East-West Crosswalks		Intsx #2: East-West Crosswalks		Intsx #3: East-West Crosswalks	
Pushbutton ______ Fixed ___________	ADA Compliant Pushbutton _____	Pushbutton ______ Fixed ___________	ADA Compliant Pushbutton _____	Pushbutton ______ Fixed ___________	ADA Compliant Pushbutton _____
Intsx #1: North-South Crosswalks		Intsx #2: North-South Crosswalks		Intsx #3: North-South Crosswalks	
Ped. Pushbutton: Fixed:	ADA Compliant Pushbutton:	Ped. Pushbutton: Fixed:	ADA Compliant Pushbutton:	Ped. Pushbutton: Fixed:	ADA Compliant Pushbutton:
Audible Walk Indicator					
East-West Crosswalks:		East-West Crosswalks:		East-West Crosswalks:	
North-South Crosswalks:		North-South Crosswalks:		North-South Crosswalks:	
Pedestrian Scramble Phase					
Intsx #1:		Intsx #2:		Intsx #3:	

Pedestrian Refuge in Median Nose of Signalized Intersections (for crossings of 4 or more lanes)			
	Intersection #1	Intersection #2	Intersection #3
Pedestrian pushbutton in median nose? (Indicate street where located)			
Is median nose at least 48 inches wide?			
Is there an at-grade channel through the median nose with truncated domes for the disabled?			

OTHER PEDESTRIAN PRIORITY / SAFETY FEATURES (Describe)		
Intersection #1	Intersection #2	Intersection #3

Routes Served	Municipality	Stop Name/Location/Street and Cross Street	Stop ID# GPS Tag:
Near-side ☐ Far-side ☐ Mid-block ☐ Island ☐ Freeway bus pad ☐ Other ____________		Bus Route Direction: Northbound ☐ Southbound ☐ Eastbound ☐ Westbound ☐ More than one direction ☐ Terminus ☐ Other ____________	Name: Date:

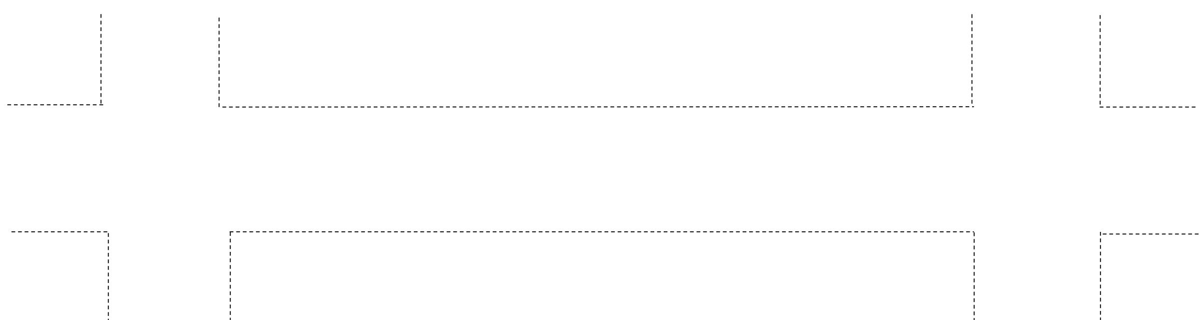
SECTION A: SKETCH

Prepare sketches of the existing or proposed bus stop layout and locus, extending to adjacent cross street or crosswalk. [A] & [B] refer to sketch that element should be shown:

- -Street Name/Address/Landmark if Mid-block Stop [A]
- -Crosswalks, Curb Ramps, Driveways [A]
- -Adjacent Curbside Regulations/Usage [A]
- -Adjacent Roadway Striping/Lane Configuration [A]
- -Nearby Bus Stop Pair [A]
- -Abutting Land-use/Property Address [B]
- -Back of Sidewalk Boundary Type [B]
- -Back of Sidewalk Doorways/Entries [B]
- -Existing/Proposed Signs/Posts [B]
- -Bus Stop Length (distance sign to sign) [B]
- -Traffic & Pedestrian Signals [B]
- -In Ground Features (Manholes, Catch Basins etc.) [B]
- -Existing/Proposed Landing Area [B]
- -Existing/Proposed Rear Door Clear Zone [B]
- -Street Furniture/Amenities [B]
- -Other Notable Features [B] or [B]

Include sidewalk widths and distances between features (within the bus stop and to the nearest crosswalk/curb ramp), where a 4' wide clear path of travel may be questionable.

BUS STOP LOCUS [A]



BUS STOP LAYOUT [B]

BUS STOP INVENTORY CHECKLIST

(Source: Rhode Island Transit Authority)

	Stop ID

Section B: General Information

	Yes	No	Notes:
Is there a sidewalk?	☐	☐	
Is there seating available?	☐	☐	
Is there a shelter?	☐	☐	
Is there a trash receptacle?	☐	☐	
Is there lighting at the stop?	☐	☐	
Is there route/schedule/map information posted?	☐	☐	

Section C: Sidewalk Within Bus Stop Zone

Is there an accessible 10' wide x 8' deep landing area? Yes ☐ No ☐
If not, what are the dimensions? Width:____ Depth: ____

Show on Section A Sketch. Designated landing area centerline is located in proximity to RIPTA bus stop sign. Near-side stop = 14', Far-side or Mid-block stop =24'

Does the landing area have a cross slope of 2% or less? Yes ☐ No ☐
If not, what is the cross slope? (if varies, indicate range) ____________ %

Are there elements that obstruct the landing area? (trees, trash receptacles) news boxes, bike racks, sign posts, poles etc.) Yes ☐ No ☐

What is the material of the landing area?
Asphalt ☐ Dirt/Gravel ☐ Pavers ☐ Other (specify): ______________________________
Concrete ☐ Grass ☐ Brick ☐

What is the material of the sidewalk?
Asphalt ☐ Dirt/Gravel ☐ Pavers ☐ Other (specify): ______________________________
Concrete ☐ Grass ☐ Brick ☐

Is there a curb? Yes ☐ No ☐
Type/Material (e.g. Granite, asphalt, concrete) ______________________________

Are there physical barriers that constrict the width of the sidewalk to less than 4' within the bus stop? If yes, show on sketch and specify Yes ☐ No ☐

Are there problems with the sidewalk and landing area surface? If yes, show on sketch and specify Yes ☐ No ☐

Is a hollow sidewalk readily apparent? Yes ☐ No ☐

Rank the condition of the sidewalk in the vicinity of the landing area: (Circle One)
1 = hazardous - large breaks, cracks, root uplifting; dangerous for normal use and/or difficult for a wheelchair
2 = in poor shape though not hazardous - very rough, some root uplifting, cracks, breaks
3 = fair - minor root uplifting, minor cracks or breaks
4 = good - not perfect but no immediate repairs needed
5 = cosmetically excellent; new

If not accessible, is it feasible to shift stop to an alternate location nearby? Yes ☐ No ☐
Indicate alternate location on sketch

Is there a level and clear boarding area at the back door of the bus? Yes ☐ No ☐

BUS STOP INVENTORY CHECKLIST
(Source: Rhode Island Transit Authority)

	Stop ID

Section D: Seating (if applicable)

What type of seating is available?

Bench (freestanding) ☐ Other (specify): ____________________

Bench (inside shelter) ☐

Fold down bench ☐

What is the height of the bench (in inches)? ____________________

What direction does the bench face? Towards roadway ☐ Away from roadway ☐

Rank the condition of each bench (circle one)

1 = hazardous - broken, someone could get hurt from normal use

2 = in poor shape though not hazardous

3 = fair - needs repainting/cosmetic attention, protuding but not hazardous bolts

4 = good - not perfect but no immediate repairs needed

5 = cosmetically excellent; new

Section E: Shelter (if applicable)

What type of shelter is it?

Lamar ☐ Other ☐ Other (Specify) ____________________

For Other, provide following interior measurements (in inches):

Depth ________ Width ________ Height ________ Width of entrance ____________________

Roof depth (if deeper than side panels) ________

Distance from front of shelter (windscreen and/or post) to curb ________ Feet

Distance from back of shelter/windscreen to back of sidewalk or building/fence/wall ________ Feet

Is the shelter in the middle of the sidewalk and obstructing general pedestrian path of travel? ☐ Yes No ☐

Is there a 32" long x 48" wide accessible space fully within, and under the shelter roof? ☐ Yes No ☐

Cross slope of the shelter's accessible space (next to bench, unless space is elsewhere) ____________ %

Does the accessible space obstruct other customers from accessing to the shelter? ☐ Yes No ☐

Does the shelter have power? (not including solar or battery) ☐ Yes No ☐

.

	Stop ID

Section F: Information Features

Is there a RIPTA bus stop sign at the front of the stop? Yes ☐ No ☐

What is the height of the bottom of the front sign?
Less than 7' ☐ Between 7' - 10' ☐ Greater than 10' ☐

What is the sign face orientation to the curb?
Parallel ☐ Perpendicular ☐ angled ☐ Other (specify)______________________

What is the distance from the pole to the street edge/curb? ________________Feet

Is sign mounted on its own post? Yes ☐ No ☐
If not, describe. ____

Is there a Bus Stop No Parking sign at the rear of the stop? Yes ☐ No ☐

What is the height of the bottom of the rear sign?
Less than 7' ☐ Between 7' - 10' ☐ Greater than 10' ☐ N/A ☐

What is the sign face orientation to the curb?
Parallel ☐ Perpendicular ☐ Angled ☐ Other (specify)______________________

What is the distance from the pole to the street edge/curb? ______________Feet

Is sign mounted on its own post? Yes ☐ No ☐
If not, describe. ____

Do bus stop arrows point towards each other? Yes ☐ No ☐

Are existing signs and/or posts damaged, worn or not secured? Yes ☐ No ☐

Is highest text/information below 60" above the ground? Yes ☐ No ☐

How long is the bus stop (between signs)? ______________Feet

Is parking currently allowed in the bus stop Yes ☐ No ☐

	Stop ID

Section G: Getting to the Bus Stop

How wide is the sidewalk? ____________ **Feet**
If it varies, indicate on Section A Sketch

Does sidewalk provide a 4' wide clear path of travel? **Yes** ☐ **No** ☐
If not, indicate constraints on Section A sketch

Rank the condition of the sidewalk between the bus stop and the nearest crosswalk: (circle one)
1 = hazardous - large breaks, cracks, root uplifting; dangerous for normal use/difficult for a wheelchair
2 = in poor shape though not hazardous - very rough, some root uplifting, cracks, breaks
3 = fair - minor root uplifting, minor cracks or breaks
4 = good - not perfect but no immediate repairs needed
5 = cosmetically excellent; new

Is there a crosswalk connecting the inbound and outbound bus stops? **Yes** ☐ **No** ☐

Does the sidewalk connect to nearby crosswalks and/or street crossings? **Yes** ☐ **No** ☐
If so, show nearest on Section A Sketch

Are there curb ramps at both sides of each crossing? **Yes** ☐ **No** ☐
Show all on Section A Sketch

For each curb ramp, indicate the following: (Indicate letter for each curb ramp on Section A Sketch)
Note the ramp closest to the stop, and note others in a clockwise direction from that ramp.

Curb Ramp	Is there a detectable panel?	What is the running slope?	Is ponding visible?
A	Yes ☐ No ☐	________%	Yes ☐ No ☐
B	Yes ☐ No ☐	________%	Yes ☐ No ☐
C	Yes ☐ No ☐	________%	Yes ☐ No ☐
D	Yes ☐ No ☐	________%	Yes ☐ No ☐
E	Yes ☐ No ☐	________%	Yes ☐ No ☐
F	Yes ☐ No ☐	________%	Yes ☐ No ☐
G	Yes ☐ No ☐	________%	Yes ☐ No ☐
H	Yes ☐ No ☐	________%	Yes ☐ No ☐

Who owns/controls the sidewalk?
RIDOT ☐ **Municipality** ☐ **RIPTA** ☐ **Other (specify)** ______________________________

What other pedestrian features are located near the bus stop? (check all that apply and indicate on Sketch)
Visible Crosswalk ☐ Pedestrian Signal ☐ Traffic Signal ☐ Accessible Pedestrian Signal (APS) ☐

			Stop ID

Section H: Miscellaneous

Does bus stop create any potential traffic hazards?
If yes, check all that apply:
- Sight line: bus stop is just over the crest of a hill ☐
- Sight line: bus stop is just after a curve in the road ☐
- A stopped bus straddles a crosswalk ☐
- Bus stop is near an at-grade railroad crossing ☐
- Bus stop just before a crosswalk ☐
- Adjacent to high speed traffic (40mph+) ☐
- No crosswalk ☐
- Other (specify) ______________________________

How many total travel lanes are on both sides of the road? ____________

How many parking lanes? ____________

How many bike lanes? ____________

Where is the bus stop area located?
- In travel lane ☐
- In right turn only lane ☐
- Paved shoulder ☐
- Unpaved shoulder ☐
- No parking portion of street parking lane ☐
- Bus lane/pull out area ☐
- Off street ☐

Is there a reciprical bus stop? Yes ☐ No ☐

			Stop ID

Existing Stop ☐ Proposed Stop ☐

Bus Stop Path of Travel

	CS (%)	CR (in)	D (ft)

To shelter/bench and/or nearest crosswalk/street crossing

Instructions:

1) Record cross slopes between landing area and existing shelter, bench, nearest street crossing/crosswalk*

2) measure cross-slopes at 5' intervals to shelters/benches and 10' elsewhere.

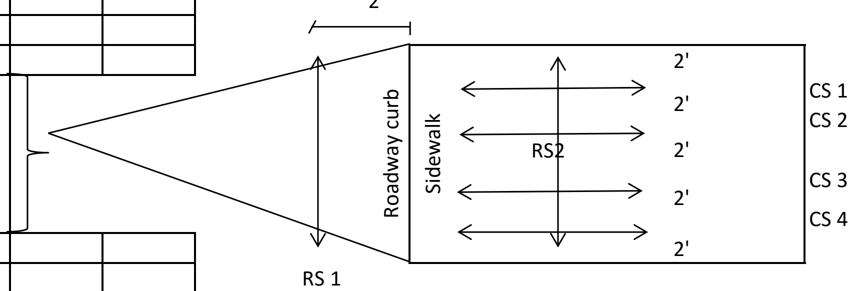
3) Indicate centerline of landing area on Section A Sketch with a dimension to a fixed point.

**For mid-block stops or stops significantly distant from a street crossing or crosswalk, record cross slopes to nearest driveway*

Bus Direction of Travel

Landing Area

Landing Area (10' wide x 8' deep)



	CS (%)	CR (in)	D (ft)

To shelter/bench and/or nearest crosswalk

Landing Area
Distance from existing bus stop sign to centerline of landing area: ________________ Feet
(if not existing bus stop sign, specify other reference point)

	CS(%)	CR(in)
RS 1		X
RS 2		X
CS 1		
CS 2		
CS 3		
CS 4		

CS = cross-slope
CR = curb reveal - measure if CS > 2%
D = distance from previous measurement (5' or 10')
RS = running slope
NOTE: All dimensions are based on field measurements only and are not based on detailed survey.

BUS STOP INVENTORY CHECKLIST

(Source: Rhode Island Transit Authority)

Appendix F

Master List of Resources

MASTER LIST OF OCTA TSDG RESOURCES
Format: Document Title. Author / publisher. Date. Website Link.

Recommended Resources

Transit Cooperative Research Program (TCRP) Publications

Transit Cooperative Research Program (TCRP) Report 183 A Guidebook on Implementing Transit-Supportive Roadway Strategies. Transportation Research Board. 2016. https://www.nap.edu/catalog/21929/a-guidebook-on-transit-supportive-roadway-strategies

Transit Cooperative Research Program (TCRP) Report 19 Guidelines for the Location and Design of Bus Stops. Transportation Research Board. 1996. http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_19-a.pdf

Transit Cooperative Research Program (TCRP) Report 12 Guidelines for Transit Facility Signing and Graphics. Transportation Research Board. 1996. https://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_12-a.pdf

Professional Organization Publications

Guide for Geometric Design of Transit Facilities on Highways and Streets. American Association of State Highway Transportation Officials (AASHTO) 2014. https://trid.trb.org/view/1320922

Transit Street Design Guide. National Association of City Transportation Officials (NACTO). 2016. https://nacto.org/publication/transit-street-design-guide/

Urban Bikeway Design Guide. National Association of City Transportation Officials (NACTO). 2014. https://nacto.org/publication/urban-bikeway-design-guide/

Urban Street Design Guide. National Association of City Transportation Officials (NACTO). 2016. https://nacto.org/publication/urban-street-design-guide/

Transit Signal Priority (TSP): A Planning and Implementation Handbook. ITS America. 2005. https://nacto.org/wp-content/uploads/2015/04/transit_signal_priority_handbook_smith.pdf

2010 ADA standards for accessible design. ADA. 2010. https://www.ada.gov/regs2010/2010ADAStandards/2010ADAStandards.pdf

Crime Prevention Through Environmental Design (CPTED) for Transit Facilities. APTA Standards Development Program Recommended Practice. American Public Transportation Association (APTA). 2010. https://www.apta.com/wp-content/uploads/Standards_Documents/APTA-SS-SIS-RP-007-10.pdf

Department of Transportation and Transit Authority Design Guidelines

California Manual on Uniform Traffic Control Devices (CA MUTCD). FHWA and Caltrans. 2014. https://dot.ca.gov/-/media/dot-media/programs/safety-programs/documents/ca-mutcd/rev6/camutcd2014-rev6.pdf

Highway Design Manual. Caltrans. 2019. https://dot.ca.gov/-/media/dot-media/programs/design/documents/hdm-complete-12312020a11y.pdf

High Occupancy Vehicle Guidelines for Planning, Design and Operations. Caltrans Division of Traffic Operations. 2018. https://dot.ca.gov/-/media/dot-media/programs/traffic-operations/documents/hov_guidelines-english-edition-jan2018-a11y.pdf

MASTER LIST OF OCTA TSDG RESOURCES
Format: Document Title. Author / publisher. Date. Website Link.

Transit Facilities Guidelines. Florida Department of Transportation Public Transit Office. 2017. https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/transit/documents/transitfacilityguidelines-8-4-2017.pdf?sfvrsn=6d929e38_2

Bus Infrastructure Design Guidelines. TransLink (Vancouver, BC area). 2018. https://www.translink.ca/-/media/translink/documents/plans-and-projects/managing-the-transit-network/bus_infrastructure_design_guidelines-sept_2018.pdf

Rhode Island Bus Stop Design Guide. Rhode Island Public Transit Authority (RIPTA). 2017 https://www.ripta.com/projects/rhode-island-bus-stop-design-guide-2017/

Bus Stop Design Guide. Maryland Department of Transportation (MDOT) and Maryland Transit Administration (MTA). 2019. https://www.mta.maryland.gov/bus-stop-design-guide

Multimodal Corridor Guidelines. AC Transit. 2018. https://www.actransit.org/website/uploads/AC_Transit_Multimodal_Corridor_Guidelines_Final.pdf

Transit Supportive Guidelines. Pace (Chicago, IL area). 2013. https://www.pacebus.com/sites/default/files/2020-04/Transit_Supportive_Guidelines.pdf

Bus Stop Planning & Design Guide. Massachusetts Bay Transportation Authority (Boston, MA area). 2018. https://cdn.mbta.com/sites/default/files/engineering/001-design-standards-and-guidelines/2018-04-01-bus-stop-planning-and-design-guide.pdf

Designing for Transit. Monterey-Salinas Transit (Monterey, CA area). 2020. https://mst.org/wp-content/media/DesigningForTransit-2020-Edition.pdf

Transit Design Guide: Standards & Best Practices. Capital MTA (Austin, TX area). 2014. https://capmetro.org//docs/default-source/plans-and-development-docs/transit-oriented-development-docs/transit-design-guide.pdf?sfvrsn=f7e538aa_2

Transit-Supportive Guidelines. Ontario Ministry of Transportation (Canada). 2012. http://www.mto.gov.on.ca/english/transit/pdfs/transit-supportive-guidelines.pdf

Academic and Local Agency Publications

Best Practices in Implementing Tactical Transit Lanes. UCLA Institute of Transportation Studies. 2019. https://www.its.ucla.edu/wp-content/uploads/sites/6/2019/02/Best-Practices-in-Implementing-Tactical-Transit-Lanes-1.pdf

Enhanced Transit Corridors Plan. Chapter 3. Capital and Operational Toolbox. Portland Bureau of Transportation (Oregon). 2018. https://www.portlandoregon.gov/transportation/article/686885

Complete Streets Initiative Design Handbook. Orange County Council of Governments (OCCOG). 2016. https://static1.squarespace.com/static/587121d0ebbd1ae2e3a080b3/t/58e2726cb8a79b14751cd0da/1491235470685/OC_Complete_Streets_Design_Handbook.pdf

ADA Related Publications

Toolkit for the Assessment of Bus Stop Accessibility and Safety. Easter Seals Project ACTION. www.projectaction.org

MASTER LIST OF OCTA TSDG RESOURCES
Format: Document Title. Author / publisher. Date. Website Link.

Federal Transit Administration. ADA Regulations. Part 37—Transportation Services for Individuals with Disabilities. ADA Standards for Transportation Facilities. https://www.transit.dot.gov/regulations-and-guidance/civil-rights-ada/ada-regulations.

U.S. Access Board. ADA Accessibility Guidelines (ADAAG). https://federalist-e3fba26d-2806-4f02-bf0e-89c97cfba93c.app.cloud.gov/preview/atbcb/usab-uswds/ada-alternative/

U.S. Access Board. Public Rights-of-Way Accessibility Guidelines (PROWAG). https://www.access-board.gov/prowag/

Guidelines for Transit Facility Signing and Graphics. Transit Cooperative Research Program (TCRP) Report 12. 1996. http://onlinepubs.trb.org/Onlinepubs/tcrp/tcrp_rpt_12-a.pdf

Resources for accessible design. National Aging and Disability Transportation Center website. https://www.nadtc.org/

2010 ADA standards for accessible design. ADA. 2010. https://www.ada.gov/regs2010/2010ADAStandards/2010ADAStandards.pdf

Resources Identified by Steer

Orange County Complete Streets Initiative Design Handbook. Orange County Council of Governments (OCCOG). 2016. https://www.occog.com/occog-complete-streets/

2010 ADA standards for accessible design. ADA. 2010. https://www.ada.gov/regs2010/2010ADAStandards/2010ADAStandards.pdf

Designing Walkable Urban Thoroughfares: A Context Sensitive Approach. Institute of Transportation Engineers (ITE). 2010. https://ecommerce.ite.org/IMIS/ItemDetail?iProductCode=RP-036A-E

Implementing Context Sensitive Design on Multimodal Corridors: A Practitioner's Handbook. Institute of Transportation Engineers (ITE). 2017. https://ecommerce.ite.org/IMIS/ItemDetail?iProductCode=IR-145-E

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