County of Hawaii
Mass Transit Agency
Bus Stop Location Study

Recommendation Report

SSFM INTERNATIONAL

Prepared by:
SSFM International, Inc.
501 Sumner Street, Suite 620
Honolulu, HI 96817

Prepared for:
County of Hawaii
Mass Transit Agency
630 E. Lanikaula Street
Hilo, HI 96720

June 2010

SSFM INTERNATIONAL

Statement of SSFM International, Inc.'s Quality Process

It is the policy of SSFM to have a consistent and systematic approach to the development and review of its reports and other project deliverables.

All projects and products of our service are subject to a quality process and in no case will the quality review be eliminated. The main purpose of this process is to assure:

- Clarity, completeness, coordination, and accuracy of documents.
- That the project, study or investigation meets the Client's objectives.
- That the requirements of our Agreement with the Client have been met, and the Client has received the value of the fee to be paid.

The Preparation of This Report Was The Responsibility of and Completed By:

signature _____ date 5.3.10

The Quality Review of This Report Was The Responsibility of and Completed By:

signature _____ date May 3, 2010

County of Hawaii Mass Transit Agency
Bus Stop Location Project

Recommendations Report

Introduction

The County of Hawaii Mass Transit Agency (MTA) currently operates on a flagstop basis. With increased ridership, MTA is moving into a designated bus stop program. SSFM International, Inc. (SSFM) was contracted to identify locations for bus stops islandwide and to determine if locations warrant an official bus stop listed in the Hawaii County Code. Official bus stops will need to be Americans with Disabilities Act (ADA) compliant.

This document is the third report in a three part series outlining improvement recommendations for the existing transit system. The first report, "Inventory and Initial Screening Report," was previously delivered which consisted of a complete inventory of 575 existing bus stops islandwide. The second, "Data Base of Priority Stops," takes into consideration a variety of determining factors and identifies a list of 224 bus stop locations recommended for improvements.

This report contains recommendations for 89 stops which should be made official in the Hawaii County Code. The report is organized into six sections:

1.0 Recommendations for Official Bus Stops - Official bus stops are ones that need to be approved and cited in the Hawaii County Code. This is necessary primarily in cases where a "No Parking Zone" needs to be established to make room for bus stops.

2.0 Recommendations for ADA Compliance - In order for a bus stop to become an official Hawaii County Code listed stop, it must first comply with The Americans with Disabilities Act (ADA). ADA primarily serves as a standard of design guidelines to ensure that those with disabilities have access to the same public amenities as those of other riders. This section describes what needs to be done to bring each official stop into compliance.

3.0 Recommendations for Bus Pullouts - Bus Pullouts are recommended for stops where safety and traffic conditions and space allow for a dedicated space for buses to pull completely off the road.

4.0 Amenities – This section outlines amenities and improvement recommendations for all 224 priority stops.

5.0 Stop Placement – Bus stops are either located at the nearside, farside, or midblock of an intersection. This section describes the advantages and disadvantages of each.

6.0 Report Summary

Section 1.0 Criteria for Establishing Official Bus Stops

Of the 224 priority stops, 89 are recommended for inclusion in the Hawaii County Code. The sites identified are in urban areas (Hilo and Kona), or where there is an anticipated need for enforcing a "No Parking Zone" at the bus stop location. Table 1 is a description of these stops. It should be noted that for the purposes of evaluating the need for a bus stop into the Hawaii County Code it was assumed that major State Highways (Hwy) such as Hwy 11 and Hwy 19 were considered "No Parking Zones."

The names of these new official stops would be added, by ordinance to Hawaii County Code Section 24-275, Schedule 23 Bus Stop Locations. For more information on bus stop guidelines, see Attachment 1.

Table 1: Recommended List of Official Bus Stops

	Stop #	Name	Description
1	0111	Mt View Aloha Gas South	(if a feasible location) Hwy 11, length of lava rock wall in front of Mt. View Aloha Gas Station
2	0115	Kilauea General Store South	Old Volcano Road from the north edge of Kilauea General Store Property to a point 100 feet south
3	0119	Pahoa Cash & Carry	Pahoa Village Road, from a point beginning at the northern driveway entrance to Pahoa Cash and Carry, extending to a point 80 feet south-west
4	0120	Pahoa High & Inter South	Pahoa Village Road, beginning at a point 60 feet south of Pahoa Village Road extending to a point 100 feet south
5	0121	Pahoa High & Inter North	Pahoa Village Road, Length of Lava rock wall fronting entire property directly across from Pahoa High & Intermediate School
6	0200	Mooheau Bus Terminal (MBT)	Already in code
7	0210	Bayfront Park and Ride East	Kamehameha Avenue, both sides, at a point 50 feet east of the crosswalk in front of the bayfront soccer fields, extending to a point 100 feet east
8	0211	Bayfront Park and Ride West	Same as 0210
9	0212	Aupuni Street	Already designated but not in code
10	0213	Aupuni Street	Already designated but not in code
11	0217	Hilo Medical Center	Waianuenue Road, fronting Hilo Medical Center from crosswalk west to driveway entrance
12	0218	Prince Kuhio West	East Makaala Street, north side, from to intersection of Hwy 11, east to the first driveway entrance

	Stop #	Name	Description
13	0219	Prince Kuhio East	East Makaala Street, south side. From the driveway entrance nearest to Hwy 11 extending west 100 feet
14	0221	Kulaimano Elderly Housing	Kumula Street, beginning from the southern driveway entrance to Elderly Housing to a point 100 feet north
15	0230	Ululani South	Lanakaula Street, both sides, beginning from the intersection of Ululani Street to a point 100 feet east
16	0231	Ululani North	Same as 0231
17	0238	Waiakea High School Kawili	Kawili Street, beginning at a point 100 feet from the north-east property line of Waiakea High School extending to a point 100 feet south-west
18	0240	HCC East	Already in code
19	0241	HCC West (Recommend moving existing Community College bus stop)	Kawili Street, beginning at the intersection with Mililani Street, extending to a point 100 feet south-west
20	0242	Bank of Hawaii West	Kawili Street, near intersection with Hawaii Belt Road 50 feet fronting Automotive Supply Center
21	0243	Bank of Hawaii East	Kawili Street south side, beginning at the intersection of Wiwoole Street, extending a distance of 40 feet
22	0244	Banyan Resorts Stop 1	Already in code
23	0245	Banyan Resorts Stop 2	Already in code
24	0246	Banyan Resorts Stop 3	Banyan Drive, makai side, beginning at a point 30 feet from the pedestrian entrance to Liliuokalani Park extending to a point 100 feet east
25	0247	Banyan Resorts Stop 4	Banyan Drive, mauka side, beginning at the intersection with Lihiwai Street, extending east 100 feet
26	0248	Leleiwi Beack Park	Kalanianaole Avenue, makai side, beginning from the east driveway entrance to Liliuokalani Park extending to a point 100 feet east
27	0250	Keaukaha Beach Park	Kalanianaole Avenue, makai side, beginning at a point 20 feet east of the driveway entrance to Keaukaha Beach Park, extending to a point 100 feet east
28	0252	Ponds West	Kalanianaole Avenue, mauka side, 100 feet between first two utility poles east of intersection with Banyan Way
29	0254	St. Joseph School West	Hualalai Street, north side, from the intersection of Ululani Street extending 80 feet south-west
30	0255	Ka Waena Lapaau	Komohana Street, east side, from the southern driveway entrance to Ka Waena Lapaau Medical Facility, extending to a point 100 feet south

	Stop #	Name	Description
31	0256	Hilo High School (adjust existing stop)	Waianuenue Avenue, both sides, from a point beginning at the signalized entrance of Hilo Intermediate School extending to a point 100 feet north-east
32	0257	Hilo Intermediate School	Same as 0257
33	0258	Hilo Library West	Already in code
34	0260	Kalakaua Park East	Already in code
35	0261	Kalakaua Park West	Waianuenue Avenue, beginning from intersection with Kinoole Street, extending to a point 80 feet north-east
36	0270	Hihio	Kaumana Drive, beginning from the intersection with Private Road, just west of Terrace Drive, extending to a point 80 feet west
37	0271	Ainako West	The whole property frontage is driveway entrance. Placement not specified. Need to measure after construction.
38	0275	Gilbert Carvalho Park West	Waianuenue Avenue, beginning at the driveway entrance to Gilbert Carvalho Park, extending to a point 100 feet east
39	0277	KTA West	Puainako Street, beginning at a point 40 feet from the driveway entrance to Ginger Patch Market and Deli, to a point 100 feet east
40	0278	KTA East	Puainako Street, 90 feet between driveway entrance to Hawaii Mamaki Tea Plantation and west entrance to KTA Shopping Center
41	0282	Hilo Public Golf Course	Haihai Street, north side, beginning at a point 62 feet west of eastern entrance to Hilo Municipal Golf Course, extending to a point 100 feet west
42	0283	Kapaka	Haihai Street, north side, 60 feet between driveways fronting 660 Haihai Street
43	0284	Ainaola	Haihai Steet, north side, fronting 868 Haihai Street beginning from the driveway at east end of property, extending to a point 80 feet west
44	0288	Life Care Center	Kawailani Avenue, directly across from the driveway entrance to the Hilo Life Care Center, 50 feet in either direction
45	0401	Honokaa Hospital North	Not a preferred alternative, but recommended for Community College if selected
46	0403	Honokaa Park (preferred Alternative)	Lehua Street, beginning from the driveway to the rear entrance of Honokaa Hospital extending to a point 80 feet south

	Stop #	Name	Description
47	0404	Blane's Drive-In East	Mamane Street, beginning at the front steps of United Methodist Church extending 40 feet in either direction
48	0405	Blane's Drive-In West	Multiple alternatives. Needs to be incorporated into the Hawaii County Code once selected.
49	0406	Honokaa HS East	Mamane Street, south side, starting from the intersection with Pakalana Street extending west 100 feet
50	0407	Honokaa HS West	Mamane Street, north side, beginning from the driveway entrance of the Waimea Medical Association, extending to a point 80 feet west
51	0502	Junction 250 West	Hwy 270, north side, beginning at a point 100 feet east of intersection with Hwy 250, extending to a point 100 feet east
52	0503	Kohala Town Center East	Mahukona-Hawi Road, south side, the 90 feet between driveways fronting Kohala Town Center
53	0504	Kohala Town Center West	Mahukona-Hawi Road, north side, beginning at a point 90 feet from the intersection with Hospital Road, extending to a point 100 feet west
54	0505	Ainakea North	Ainakea Drive, west side, beginning from the intersection of Kolonahe Street extending to a point 100 feet north
55	0506	Ainakea South	Ainakea Drive, east side, beginning from a point 50 feet north of the driveway entrance of existing Ainakea Senior Residence extending to a point 100 feet north
56	0610	Waimea Elementary East	Hwy 19, from the front steps of Waimea Elementary school extending to a point 100 feet west
57	0619	HPA Village East	Hwy 19, from the east property line of address 65-2171 extending to a point 100 feet west
58	0620	HPA Village West	Hwy 19, from a point 25 feet west of the driveway entrance to HPA Village Campus to a point 100 feet west
59	0623	HPA Main Campus East	Hwy 19, at junction 250, description needs to be written once a final location is chosen
60	0624	HPA Main Campus West	Hwy 19, at junction 250, description needs to be written once a final location is chosen
61	0701	Kona Airport	Kona Airport, from the crosswalk fronting Ellison S. Onizuka Space Center to a point 100 feet north
62	0702	Kuakini & Palani West	Not currently on scheduled route, incorporate stop as system expands
63	0703	Kuakini & Palani East	Not currently on scheduled route, incorporate stop as system expands

	Stop #	Name	Description
64	0704	Kona Seaside Shopping Mall	Alii Drive, from the south east driveway entrance to the Kona Seaside Shopping Mall to a point 80 feet north
65	0705	King Kamehameha Kona Beach	Alii Drive from the intersection of Kaahumanu Place to a point 100 feet north
66	0706	Kona Bay (Lakina N)	Alii Drive, existing loading zone fronting Koa Reality
67	0707	Kona Bay (Lakina S)	Alii Drive, makai side, from the crosswalk at the intersection with Lakana Drive to a point 100 feet north
68	0708	Uncle Billy's South	Alii Drive, both sides, from the crosswalk at the intersection with Hualalai Road to a point 100 feet north
69	0709	Uncle Billy's North	Same as 0708
70	0710	Kona Target North	Makala Boulevard, east side, from the crosswalk at the entrance to the Target Store to a point 100 feet north
71	0711	Kona Target South	Makala Boulevard, west side, from the crosswalk across from the entrance to the Target Store to a point 100 feet south
72	0732	Coconut Grove Market	Alii Drive 70 foot designated pull out area approximately 200 feet north of Kahakai Road
73	0733	Kaiwi St	Not currently on scheduled route, incorporate stop as system expands
74	0734	Kekuaokalani Gym	Not currently on scheduled route, incorporate stop as system expands
75	0735	Lanihau Center South	Palani Road, west side, beginning at a point 15 feet south of the entrance to Palani Shopping Center, extending to a point 100 feet south
76	0736	Lanihau Center North	Palani Road, east side, beginning at the entrance to Palani Shopping Center, extending to a point 100 feet north
77	0742	Kainaliu Kona South	Hwy 11, 75 feet of existing loading zone, fronting Oshima's Drugstore (address: 17-7400)
78	0743	Kainaliu Kona North	Hwy 11, from the driveway entrance on north side of building at address 79-7407, to a point 80 feet south
79	0801	Hookena Elementary North	Hwy 11, east side, across from Hookena Elementary, 100 foot paved pull off area
80	0802	Hookena Elementary South	Hwy 11, West side, beginning at a the crosswalk in front of Hookena Elementary extending to a point 75 feet north
81	0806	Honaunau Post Office	Need a Hawaii County Code description if stop is placed at this location
82	0807	Keoki's	Hwy 11, makai side, beginning from utility pole 116000 at Spirit Gas Station continuing to a 60 feet north

	Stop #	Name	Description
83	0808	Honaunau Elementary	Hwy 11, 100 feet fronting Honaunau Elementary
84	0809	Yano Hall North	Already in code
85	0810	Yano Hall South	Hwy 11, beginning at a point 60 feet north of Kinue Road intersection, to a point 80 feet north
86	0902	Pahala Town Center	On Pikake Street
87	0904	Naalehu School South	Hwy 11
88	0906	Naalehu Civic Center East	Hwy 11, from a point 60 feet north of the utility pole at the south end of the Naalehu theatre property to a point 100 feet north
89	0907	Naalehu Civic Center West	Hwy 11, from mile marker 46 to a point 100 feet south

NOTE: The descriptions included as part of Table 1 are draft. Measurements and locations should be verified before adoption into the Hawaii County Code.

Section 2.0 Americans with Disabilities Act (ADA) Compliance for Bus Stops

Compliance with Federal Law requires that official bus stops be ADA compliant:

Bus Stop Pad
Open surface with 8 x 5 foot firm, flat, slip resistant surface, accessible by 3 foot wide path. Ideally, high-volume stops should have clear pedestrian access from both bus doors, if applicable.

Sidewalks
36 inch wide, clear, stable, firm, and slip-resistant surface that is graded for proper run off control is required for pedestrian access to a bus stop. If a region is lacking in pedestrian amenities, the transit association, in conjunction with local municipalities or developers, must provide a pedestrian path to the nearest intersection.

Curb Cuts
Although the pedestrian access for the majority of Hawaii County is at grade, curb cuts are required at intersections with curbing or any abrupt change in grade.

ADA issues for non-essential amenities:

Route Signs
If a pictogram is used, it must be accompanied by raised characters and Braille. Signs need to be mounted with a centerline 60 inches from ground. It is recommended that every stop with a sign have an updatable schedule for each unique stop.

Shelters
36 inch wide clear, stable, firm, and slip-resistant surface
30 x 48 inch of clear floor space is required for enclosed shelters

ADA Recommended Stops
Table 2 on the next page describes recommended ADA compliance for the Hawaii County Code recommended sites not currently in compliance.

Table 2: Recommended ADA features at Stops

	Stop #	Name	Bus Stop Pad	Sidewalk	Curb Cut
1	0121	Pahoa High and Inter North	X	X	X
2	0217	Hilo Medical Center	X	X	X
3	0221	Kulaimano Elderly Housing	X		
4	0240	HCC East	X	X	X
5	0241	HCC West	X	X	X
6	0242	Bank of Hawaii West	X		
7	0247	Banyan Resorts Stop 4	X	X	X
8	0248	Leleiwi Beach Park	X		
9	0250	Keaukaha Beach Park			
10	0252	Ponds West	X		
11	0255	Ka Waena Lapaau	X		
12	0270	Hihio			
13	0283	Kapaka	X		
14	0284	Ainaola	X		
15	0288	Life Care Center	X		
16	0401	Honokaa Hospital North	X	X	
17	0403	Honokaa Park	X	X	
18	0405	Blane's Drive-In West	X	X	X
19	0502	Junction 250 West	X		
20	0503	Kohala Town Center East	X		
21	0504	Kohala Town Center West	X		
22	0505	Ainakea North	X		
23	0506	Ainakea South	X		
24	0701	Kona Airport	X		
25	0702	Kaukini & Palani West	X		
26	0703	Kaukini & Palani East	X		
27	0704	Kona Seaside Shopping Mall	X		
28	0705	King Kamehameha Kona Beach	X		
29	0732	Coconut Grove Market	X		
30	0734	Kekuaokalani Gym	X	X	X
31	0735	Lanihau Center South	X		
32	0736	Lanihau Center North	X		
33	0808	Honaunau Elementary		X	

NOTE: Amenities addressed as part of pull-out design are covered in Section 3 of this document.

Section 3.0 Criteria for Bus Pullouts

This section describes the bus stop sites which would benefit from bus pullouts as a means to mitigate safety issues. There are 14 such stops (see Table 3) within Hawaii County; all of which are recommended for incorporation into the Hawaii County Code discussed in Chapter 2.

Generally bus pullouts are reserved for 3 scenarios:

- Speed zones greater than 45 mph
- Where more than 35 people use the bus in a single day
- Where there is a significant safety concern

Table 3: Recommended Sites for Bus Pullouts

	Stop #	Name	Rational
1	0110	Mt View Aloha Gas Station North (2 directional pullout alternative)	Ideal location. Will eliminate need for second stop and highway crossing
2	0115	Kilauea General Store South (2 directional pullout alternative)	Open area, good conditions, eliminates the need for a second stop across the street that may have narrow right-of-way
3	0120	Pahoa High and Inter South	Plenty of room on either side of the street. Safer for students
4	0121	Pahoa High and Inter North	
5	0217	Hilo Medical Center	Anticipated that hospital stop will require longer stopping time and adequate space is available.
6	0278	KTA East	Stop has a 16 foot shoulder, plenty of space for pullout
7	0619	HPA Village East	School stop with adequate shoulder width
8	0620	HPA Village West	
9	0623	HPA Main Campus East	Stop for school children located on dangerous highway curve.
10	0624	HPA Main Campus West	
11	0801	Hookena Elementary North	School stop with adequate shoulder width
12	0802	Hookena Elementary South	
13	0806	Honaunau Post Office (location requires further evaluation)	Recommended the counter purchase property and turn it into a “drop-off” or “park-n-ride” location
14	0808	Honaunau Elementary	Good conditions for pullout area, creates safer stop for school children.

Section 4.0 Bus Stop Amenities

During the second phase of field work, each priority location was evaluated for eight different amenities. Once existing conditions were recorded, recommendations were made for necessary improvements, taking into consideration the surround area and anticipated usage at each location. These are shown in the "Data Base of Priority Stops," a companion report to this document.

Signage
Clearly visible signage is the most basic necessity of any bus stop, and is recommended at every proposed bus stop location. Limited signage exists within the current system. The majority of the existing signs were found in the District of South Hilo. It is recommended that even the existing signs be updated with larger signs having clear and simple graphics. It is also recommended that each sign have a simple and updatable schedule giving precise time of buses stopping at each location.

Informational Display
Although Information regarding Hawaii County Mass Transit Agency operations is becoming more easily accessible through the internet and expanding transit operations, it is still recommended to provide informational kiosks at high-volume and tourist stops islandwide.

Benches
A bench for waiting passengers is recommended at every stop where it is physically possible. Benches should be placed at least six feet from the traffic lane of the adjacent street.

Bus Pad
Bus Pads are reinforced concrete pads used to handle the additional load, along with the wear and tear of paved surfaces created by buses at bus stop locations, most often in conjunction with bus pullouts. Bus Pads can be incorporated when streets are resurfaced.

Lighting
Lighting plays a role in a bus stop's perceived safety. Every effort has been taken to make use of existing street lighting to fulfill this need. Where additional lighting is necessary or passenger safety is of concern, lighting fixtures can be incorporated into the proposed bus stop design. Solar powered lighting is recommended to eliminate the need for utility connectivity and make use of an easily available renewable energy source.

Shelters
Shelters are desirable features. Priority should be given to stops with more than 25 riders a day, where a wheel chair lift is used frequently, and near senior housing centers. If funding is available, stops in new high volume activity centers and consolidated stops should have shelters.

General provisions when considering shelter construction include:

- Maintain five feet of unobstructed pedestrian pathway,
- Shelters generally require a 9 to 11 foot setback from the curb, and
- In instances of limited space, a shelter can be constructed up to 25 feet from the bus stop location.

"Adopt-a-Stop" is a program used in other cities that could be instituted in Hawaii County. Adopt-a-Stop should be sought where the opportunity is present for MTA to work with business owners who can assume the responsibility for cost and maintenance of a bus stop.

The final design of the bus stop shelter should also respond to the environmental demands of the site, such as sun, wind, and precipitation. Panel placement, shelter orientation, and materials types that are easily maintained and provide maximum comfort to riders should be selected. Also, enclosed shelters should be constructed of materials that allow clear unobstructed visibility of patrons waiting inside, and vice versa.

Refuse
Although waste receptacles are necessary to reduce littering, removal services is a very costly endeavor on the part of the MTA. This amenity is recommended primarily at Adopt-a-Stops where a trash can is primarily a service to the adjacent business owners.

Other popular programs exist such as "Keep-a-Can" in Portland, OR. Individuals are able to take ownership of their local transit system by volunteering to empty and service a trash can in their neighborhood. In return the transit association would provide an attractive, industrial strength can, liner, and recycling container.

Crosswalks
Crosswalks are a very important feature for pedestrian access to and from a bus stop. In the field study existing crosswalks were noted, and although not necessarily a part of this study, observations were noted in regions where an additional crosswalk was a logical safety or convenience improvement. As a general provision, bus stops should be located 15 feet from crosswalks when possible. In all cases, a crosswalk should be available where a set of stops serves locations on different sides of the street. A breakdown of the advantages and disadvantages of each amenity can be found in Attachments 2 and 3.

Security

Security, which is as much a perceptual issue as it is a physical one, plays a significant role on the comfort of riders. Graffiti and trash should be regularly removed. Direct surveillance from adjacent land users and traffic should be sought where ever possible. When landscaping, use low growing shrubs. Finally, avoid locations where there is an opportunity for concealment.

Section 5.0 Stop Placement

Bus stops placement locations are chosen based on multiple of factors. Safety, for both passengers and vehicles, is the number one consideration. Stop locations should be easily accessible by surrounding neighborhoods and transit generators. Also, placement is chosen by locations where improvements in safety, convenience, and/or reduced trip time.

Ideally, stops are placed at intersections for a number of reasons:

- To reduce walking time
- Intersection crossings are generally safer
- To be closer to ADA amenities like curb ramps, which generally only appear at intersections.

When bus stops are placed they should be evaluated based on their relationship to the nearest intersection, being categorized as nearside, farside, or midblock, in proximity. Each location type has its own advantages and disadvantages. Table 4 outlines the main characteristics from each.

Table 4: Farside, Nearside, & Midblock Locations

	Advantages	Disadvantages
Farside	▪ Minimize conflict between right turning vehicles and buses ▪ Provides additional right turning capacity by making curb lane available for traffic ▪ Minimizes sight distance problems on approaches to intersections. ▪ Encourages pedestrians to cross behind the bus. ▪ Creates shorter deceleration distances for buses since the bus can use the intersection to decelerate. ▪ Results in bus drivers being able to take advantage of the gaps in traffic flow that are created at signalized intersections.	▪ May result in the intersections being blocked during peak periods by stopping buses. ▪ May obscure sight distance for crossing vehicles ▪ May increase sight distance problems for crossing pedestrians ▪ Can cause a bus to stop farside after stopping for a red light ▪ Could result in traffic queued into intersection when a bus is stopped in travel lane
Nearside	▪ Minimize interference when traffic is heavy on the farside of the intersection ▪ Allows passengers to access buses closest to crosswalk ▪ Results in the width of the intersection being available for the driver to pull away from the curb ▪ Eliminates the potential for double stopping ▪ Allows passengers to board and alight while the bus is stopped at a red light ▪ Provides driver with the opportunity for driver to look for oncoming traffic, including other buses with potential passengers	▪ Increases conflict with right turning vehicles ▪ May result in stopped buses obscuring curbside traffic control devices and crossing pedestrians ▪ May cause sight distance to be obscured for cross vehicles stopped to the right of bus ▪ May block the through lane during peak period with queuing buses ▪ Increases sight distance problems for crossing pedestrians
Midblock	▪ Minimizes sight distance problems for vehicles and pedestrians ▪ May result in passenger waiting areas experiencing less pedestrian congestion	▪ Requires additional distance for no-parking restrictions ▪ Encourage patrons to cross street at midblock (jaywalking) ▪ Increases walking distance for patrons crossing at intersections

Source: TCRP Report 19 - Chapter 3

Farside placement is generally the preferred alternative. They tend to cause fewer traffic delays and are safer, by blocking fewer traffic movements and sight lines. Farside placement also eliminates the danger of other drivers making illegal right turns in front of the bus, and allows for shorter pullout distance by using the intersection as part of the approach.

Section 6 Summary

In this multi-step study, SSFM has examined every bus route and every stop. Using field examinations, we have recommended 224 priority stops. Of these, 89 stops should be included in the Hawaii County Code and made ADA compliant. Table 5 summarizes bus stop numbers determined for Hawaii County.

Table 5: Summary of Bus Stops in Hawaii County

Final Statistics – Islandwide	
Existing Stops Identified	575
Stops Field Surveyed	253
Priority Stops	224
Hawaii County Code Recommendations	89
County Code stops requiring ADA improvements	38
Bus Pullouts recommended	14

Attached as part of this document are:

- Bus Stop Guidelines 2002, Tri-Met - Chapter 3, The Bus Stop
- TCRP Report 19 - Chapter 3, Curb-Side Factors
- TCRP Report 19 - Chapter 4, Street-Side Factors

ATTACHMENT 1

Bus Stop Guidelines 2002
Tri-Met - Chapter 3
The Bus Stop

Bus Stops Guidelines 2002

TRIMET

October 2002

Acknowledgements

Bus Stop Guidelines Committee:

Ben Baldwin, Planner, Bus Stops – Project Oversight, Contributor
Myleen Richardson, Planner/Analyst – Editor, Contributor
Angie Corbin, Maintenance Supervisor, FM – Contributor, Document Review
Phil Selinger, Director of Project Planning – Contributor, Document Review
Alan Lehto, Manager Corridor Planning– Contributor, Document Review
Young Park, Manager of Capital Projects – Contributor, Document Review
Yalawnda Anderson, Engineer – Contributor, Document Review
Pete Taylor, Trainer – Document Review
Diana Anderson, Information Development Coordinator – Document Review
Elizabeth Davidson, Community Relations Specialist – Document Review
Warren Schlegel and Debbie Huntington, Graphics – Final Document Format, Production

Questions and comments pertaining to the contents of this report can be sent to:

Young Park, Manager of Capital Projects
parky@trimet.org

Table of Contents

Executive Summary

The public's first impression of Tri-Met and its services is the bus stop. It is important that bus stops are easily identifiable, safe, accessible, and a comfortable place to wait for the bus. These guidelines provide a framework for maintaining and developing bus stops. They promote consistency for good design and the provision of bus stop amenities, making stops easier to identify and better matched to their use, location and potential for attracting riders. Through a series of development programs, Tri-Met seeks to make bus stops a positive contribution to the community streetscape and a place where riders can obtain transit related information and are encouraged to use the provided services.

The guidelines identify and encourage partnerships with the community and property owners. Tri-Met is working with communities to improve access to bus stops, including sidewalks, safe street crossings, accessible curb ramps and bicycle lanes. The quality of the streetscape is critical to the success of the bus stop development program.

The purpose of this document is to:

1) Identify the elements of the Tri-Met bus stop,
2) Set guidelines for the design of bus stops and the placement of bus stop amenities, and
3) Describe the process for managing and developing bus stops at Tri-Met.

This document will also act as the basis for CIP development to justify and support project goals.

The Bus Stops Guidelines document contains seven major sections, each of which is summarized below.

- **Introduction**: This section looks at the various goals that govern the development and implementation of bus stop projects within Tri-Met. The section also provides a snapshot of the current on-street inventory throughout the system and looks at some of the challenges that Tri-Met are being faced with. The section concludes by identifying the short and long term goals of the Bus Stops Section.
- **The Bus Stop**: This section looks at the guidelines maintained by Tri-Met to maximize the effectiveness of its bus service. This section defines preferred designs for bus stop location, layout, amenities and applying transit-preferential street treatments.
- **Program Partnerships**: Bus stops as public spaces are as much a part of a community as streets, pathways, parks and plazas. This section explores ways in which Tri-Met encourages jurisdictions, neighborhood associations and citizens to recognize the value bus stops play in the community and looks for ways to build partnerships with these entities to enhance bus stops.
- **Bus Stop Development Projects**: Tri-Met initiates capital projects to make significant improvements to route efficiency, on-street and bus stop safety, accessibility and comfort. This section describes some projects Tri-Met is currently implementing, which provide and / or improve amenities within existing transit services.
- **Maintenance Standards**: This section discusses the maintenance standards Tri-Met utilizes to keep the service area safe and clean.
- **Organizational Support**: Primary responsibility and accountability for bus stops – their design, placement, shelters and other amenities – lies with the Capital Projects Management section of the Project Planning Department. This nine person section works closely with other Tri-Met departments to provide for the regular maintenance and management of bus stops as well as implementation of bus stop development programs. This section provides a brief description of the Section's positions, responsibilities and the interdepartmental support needed to manage bus stops.
- **Program Support**: This section identifies ways to finance and maintain bus stop program initiatives that help offset program costs.

Bus Stops Guidelines 2002

I. Introduction

The public's first impression of TriMet and its services is the bus stop. It is important that bus stops are easily identifiable, safe, accessible, and a comfortable place to wait for the bus. These guidelines provide a framework for maintaining and developing bus stops. They promote consistency for good design and the provision of bus stop amenities, making stops easier to identify and better matched to their use, location and potential for attracting riders. Through a series of development programs, TriMet seeks to make bus stops a positive contribution to the community streetscape and a place where riders can obtain transit related information and are encouraged to use the provided services. The guidelines identify and encourage partnerships with the community and property owners. TriMet is working with communities to improve access to bus stops, including sidewalks, safe street crossings, accessible curb ramps and bicycle lanes. The quality of the streetscape is critical to the success of the bus stop development program.

The purpose of this document is threefold: 1) to identify the elements of the TriMet bus stop, 2) to set guidelines for the design of bus stops and the placement of bus stop amenities, and 3) to describe the process for managing and developing bus stops at TriMet. Through explanations and diagrams, this document provides the tools needed to plan bus stops and associated amenities within the TriMet service area.

Bus Stops Program Goals:

- A *basic bus stop* should consist of an accessible, paved area and easily identifiable signage. Bus stop shelters and other amenities shall be provided consistent with a set of bus stop development criteria.
- Bus stops should be placed to *assure customer convenience and provide for the safety* of pedestrians and vehicles. Stops shall be visible, near crosswalks and well lit.
- Bus stops should be *clearly and consistently identifiable with up-to-date information* for riders about services at the bus stop.
- TriMet should solicit *community input* for all bus stop installations and changes, and respond promptly to inquiries and complaints from customers and bus stop neighbors.
- The design of bus stops shall be *sensitive to the community setting* and may incorporate features that identify the stop with the community (such as art, bus stop naming or inclusion of a community bulletin board).
- Where reasonable, bus stops should be *accessible*. Americans with Disabilities Act (ADA) considerations will be given top priority in the siting and design of new and existing bus stops.
- Bus stops shall *be located in support of institutions* and with clients having special needs, large employers and community centers.
- Bus stops will be spaced to *maximize the efficient operation* of transit service while not requiring riders to walk more than a quarter mile to the bus stop.
- TriMet will work with local jurisdictions, communities, and land developers to *construct sidewalk connections* to bus stops. Regional planning targets, new or sustained transit service and bus stop investments will be used to encourage those improvements.
- Bus stops shall be *well maintained* and free of trash and vandalism. TriMet will seek partnerships that share responsibility for maintaining bus stops.
- Damaged or worn out bus stop features shall be *repaired or replaced* in a timely manner.
- TriMet will seek to *offset the cost of installing and maintaining bus stop amenities* through a bus shelter and bus bench advertising program.

II. Bus Stops Program Year 2001 Status Report

A. Bus Stop Statistics Snapshot

General Information

• Service Area	592 square miles
• Jurisdictions in the service area	30
• Bus Stops	8189
○ Major transit points[1]	>150

Bus Stop Elements and Amenities

Poles[2]	**8127**
Shelters	**888**
• Ad shelters	44
Trash cans	**535**
Benches	**1786**
• Basic (used in shelters)	800
• Premium	37
• Ad	949
Informational Displays	**277**
• Bus Catcher Information Display	229
• BCID Transit Tubes	25
• BCID Small Pole Mounts	23
Lighting (stops with nearby lighting)	58%
Pavement[3]	
• Curbcut near landing	46%
• Sidewalk at stop	70%
• Front landing paved	64%
• Rear landing paved	57%

An example of how to interpret the pavement data would be: 46% of stops have a curbcut nearby.

Data is current as of January 31, 2001.

[1] This includes major transit points, transit centers, and stops in the downtown bus mall.
[2] Currently, TriMet uses square tube poles. Previously, round, 2" poles were used. Please note that some jurisdictions also use these pole types.
[3] There is not a total number presented, as stops can have any combination of the items listed. For example, the sidewalk may be the pavement for the front and back landings, and would be counted for each category.

B. Limitations

Not all TriMet bus stops are consistent with the goals listed in the preceding section. In some instances bus stops are defined by the underdeveloped corridors or roads they serve. Where roadways lack underground drainage and pedestrian systems or are constrained by natural terrain, TriMet cannot effectively improve impacted bus stops without making significant street and sidewalk enhancements, removing or reducing the number of stops or moving service. These issues may be best addressed by a coordinated effort between TriMet and the jurisdictions charged with maintaining and upgrading the roadway system.

- Approximately 32% of TriMet bus stops suffer from lack of pavement or have interrupted or no sidewalk connection to a community pedestrian network. Crosswalks may be few and far between.
- Using the boarding criteria described in Section III of this document, approximately 500 eligible stops do not have shelters, though some may have other forms of shelter from buildings, bridges or awnings.
- Not all bus stops are easily identifiable due to: 1) inconsistent placement, 2) incomplete customer information on bus stop signs, 3) signs that blend into the streetscape, and/or 4) one-sided signs.
- Only those bus stops that have a trash can and/or shelter are cleaned on a regular basis.

Bus stop inconsistencies, as measured against the guidelines contained in this report, will be identified and mapped and will be the basis for development of a capital improvement program that can be directly considered as part of the annual capital budget development process. The existing bus stop management database with its detailed bus stop descriptions together with boarding counts from the Bus Dispatch System (BDS) will facilitate identification of bus stop specific inconsistencies. TriMet will also be working with Metro and jurisdictions to map deficiencies in the pedestrian network that make it difficult and unsafe to access bus stops. Intergovernmental agreements must be developed to promote joint development of bus stops and the pedestrian network.

C. Priorities

The following are bus stop management priorities, which are either reflected in Winter 2001 programs or anticipated in future programs:

- Improve underdeveloped stops where 1) supporting infrastructure exists, 2) it is physically feasible, and 3) it is fiscally responsible. Improvements start with pavement and access upgrades, followed by shelters (100 shelters / year) and other customer amenities.
- Improve customer information through expansion of existing methods and implementation of innovative new methods. Examples include shelter and pole-mounted printed information and electronic real-time (Transit Tracker) displays.
- Replace all bus stop signage with signs that are readily distinguished, even in active streetscapes, and to be equally identified from both directions. Locate bus stops, signs and amenities consistent with guidelines and equitably among all communities served by TriMet.
- Evaluate all sites for bus stop amenities placement. Place shelters where it is feasible, where existing protection is unavailable (i.e., no awnings, etc.), and according to TriMet guidelines.
- Work with jurisdictions to identify deficiencies in the pedestrian network. Establish priorities based on pedestrian safety and existing and potential transit use. Develop strategies to work with property owners to improve the pedestrian connectivity to bus stops, where viable.

- Pursue agreements with jurisdictions and public utility agencies to facilitate placement of shelters, benches, lighting and trashcans.
- Secure resources or partnerships that target improved and consistent maintenance of *all* bus stops. This includes cleaning stops on a regular basis, not just those with bus shelters, and keeping stops free of graffiti and litter.
- Find revenue-generating opportunities through the use of ad shelters, ad benches, and similar programs.
- Maintain and expand public outreach programs and find more effective ways to solicit, process and respond to community and customer input.
- Improve operating efficiencies through bus stop spacing that is consistent with these guidelines.

III. The Bus Stop

It is impossible to force every bus stop to conform to a standard. However, TriMet maintains guidelines to maximize the effectiveness of its bus service. These guidelines define preferred designs for bus stop location, layout, amenities and applying transit-preferential street treatments. The most important of many considerations are listed in this document.

A. Stop Location and Spacing (New Stops, Moves and Consolidations)

Approach

Stop location and spacing will always depend on individual circumstances. However, one must weigh the options and choose based on well-understood criteria. Generally TriMet expects riders to walk up to a quarter-mile to reach the stop.

When determining new bus stop locations proceed as if placing stops for the first time. If an existing stop does not fit into the process listed below, there must be a very compelling reason to retain it (e.g., if significant investment has already been made at the stop, or if there is heavy use by riders who are elderly or disabled *and* a new location would clearly degrade service for those riders). A stop should remain in service as designed for at least 5-10 years.

Tools

Choices for stop location will determine access to: pedestrian crossings; transfer lines; major transit generators; and general neighborhood employment and activity areas.

What to do

Preferred bus stop locations are determined in the following sequence:

- *Transfer Locations*: All intersections with other bus lines/MAX (light rail).
- *Designated Crossings:* Stops at signalized intersections with safe pedestrian crossings (aim for spacing of 780 feet).
- *Other Major Stops:* Major transit trip generators (at closest intersection with crosswalk, where available).
- Locations based on stop spacing:
  - *Dense areas* (22 or more units/acre): Aim for 3 blocks/780 feet. Less than that is only appropriate in special circumstances on a stop-by-stop basis or for safety. For non-residential or employment areas use an equivalent 56 persons/acre. Included in "dense areas" should be regional designated centers: Regional Centers, Town Centers, and Main Streets.
  - *Medium to low density* areas (4 to 22 units/acre): 4 blocks/1,000 feet. Less than that only for special circumstances on stop-by-stop basis or for safety.

How to determine levels of density

1. The standards must be adjusted to account for the difference between net and gross acreage. Taking an average of 25% of gross acreage used for such things as right-of-way (calculated for three representative neighborhoods in Portland – Lents, Arbor Lodge, and Multnomah), 22 units/acre becomes approximately 16 units/total acre (including right-of-way).
2. Mixed use, commercial and industrial areas should also be included by using a conversion to identify the number of people per acre (employees for employment areas and residents for residential areas). Using an average of just over 2.5 persons per household (1990-97 average – Metro data), this means:
   - Dense areas = 41 or more persons/acre
   - Medium to low density = 8 to 41 persons/acre
   - Low to rural density = less than 8 persons/acre
3. Future growth needs to be accounted for as well, and can be determined by looking at zoning and regional growth projections.

For more information, please contact Metro.

- *Low to rural density areas* (below 4 units/acre or 10 persons/acre): As needed based on above considerations. No more frequent than every 1,000 feet.

Bus stop spacing will continue to be governed by a combination of density and subjective issues such as neighborhood demographics, available alternatives, safety, public input and efficient bus operations. It is intended that this process be objective, but also flexible enough to respond to unique needs and circumstances.

As programs or requests for bus stop changes call for the review of specific bus stops, these spacing criteria will be considered. Even key bus stops may require adjustment (e.g., nearside to farside placement). Long term user and operating benefits will be weighed against project costs and neighborhood/rider objections to proposed changes.

Pages 7 and 8 show examples of stop locations for areas of dense development and areas of lower density development.

What to consider

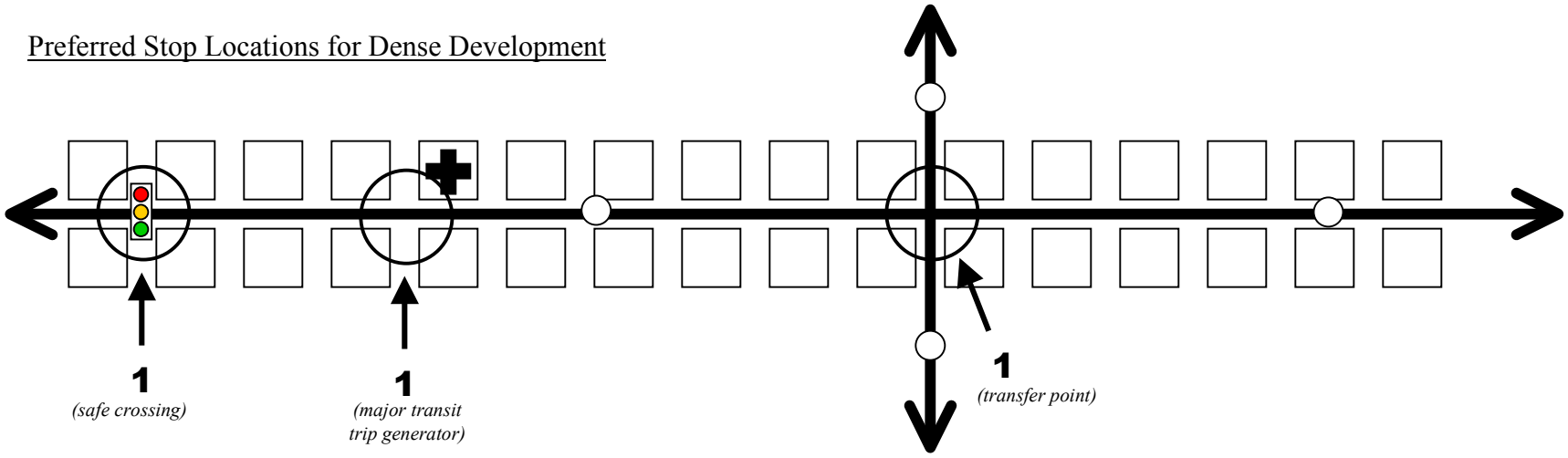
The following is a checklist of the most important considerations:

- ❑ Safety
  - Waiting, boarding and alighting must be safe
  - Access to a safe street crossing/crosswalk
  - Provide adequate sight distance, i.e., provide visibility between bus driver and waiting riders
- ❑ Service quality tradeoffs – fewer stops mean the following:
  - Faster service
  - More potential for amenities at each stop
  - May require a longer walk from/to origin/destination
- ❑ Stops must be suitable for bus operations
  - Safe access into and out of bus stop location (no parking)
  - Provide bus operators with adequate view of street and pedestrian areas
  - Provide adequate sight distance for autos before bus stop, so drivers are aware the bus is stopped
- ❑ Possible impacts on traffic safety and traffic delay
- ❑ Input and review by the public and by neighborhood and business associations
- ❑ Pedestrian safety to and from the stop and at the bus stop
- ❑ Accessible for all
  - Minimize slope
  - If necessary, construct 5’ x 8’ concrete pad at stop
  - Check for curb ramps at intersection and on surrounding streets
- ❑ Maximize accessibility to neighborhood or major generators
  - Preference for intersections at streets that connect into surrounding neighborhood
  - At major transit generators, locate the stop near pedestrian access to the generator, preferably at signal
  - Look at pedestrian pathways (formal and informal), not just streets
- ❑ Stops should be paired, at same intersection when possible
- ❑ Ensure compatibility with adjacent properties
- ❑ Do not move existing stops for trash, noise, and/or nuisance. Instead, seek ways to address the problem directly.

Diagram 1

Initially, plan stops at safe crossings, transfer points, and major transit generators

Preferred Stop Locations for Dense Development



Preferred Stop Locations for Low-Mid Density Development

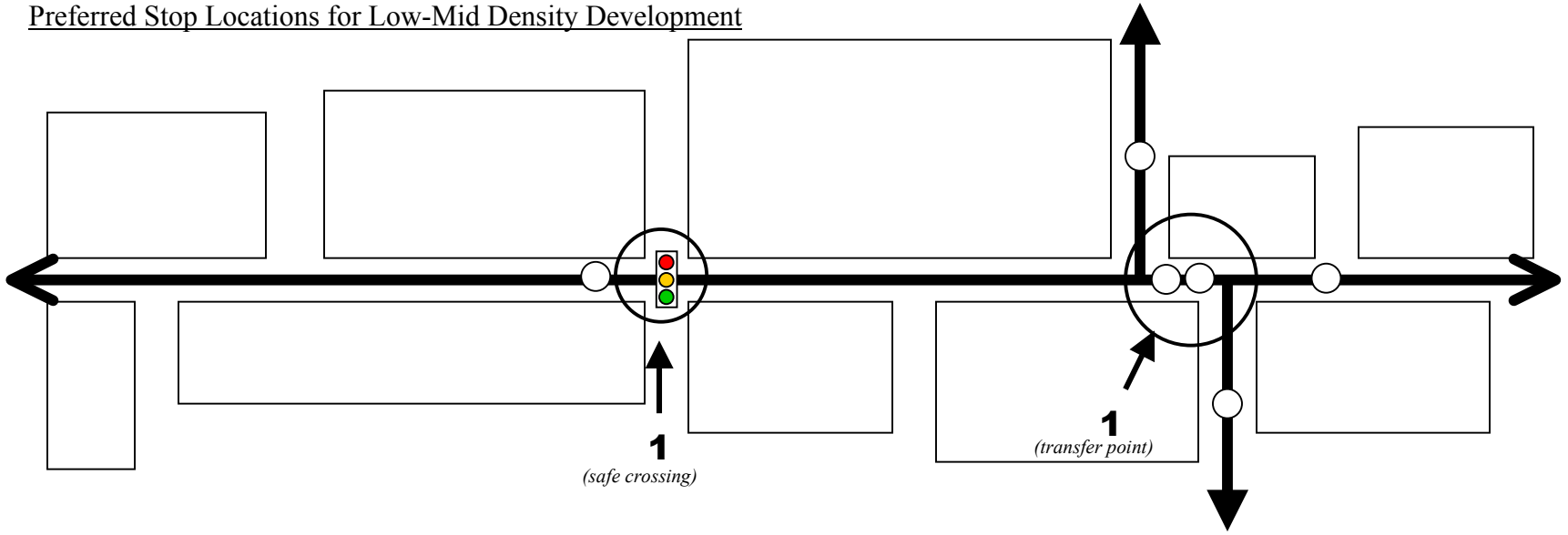
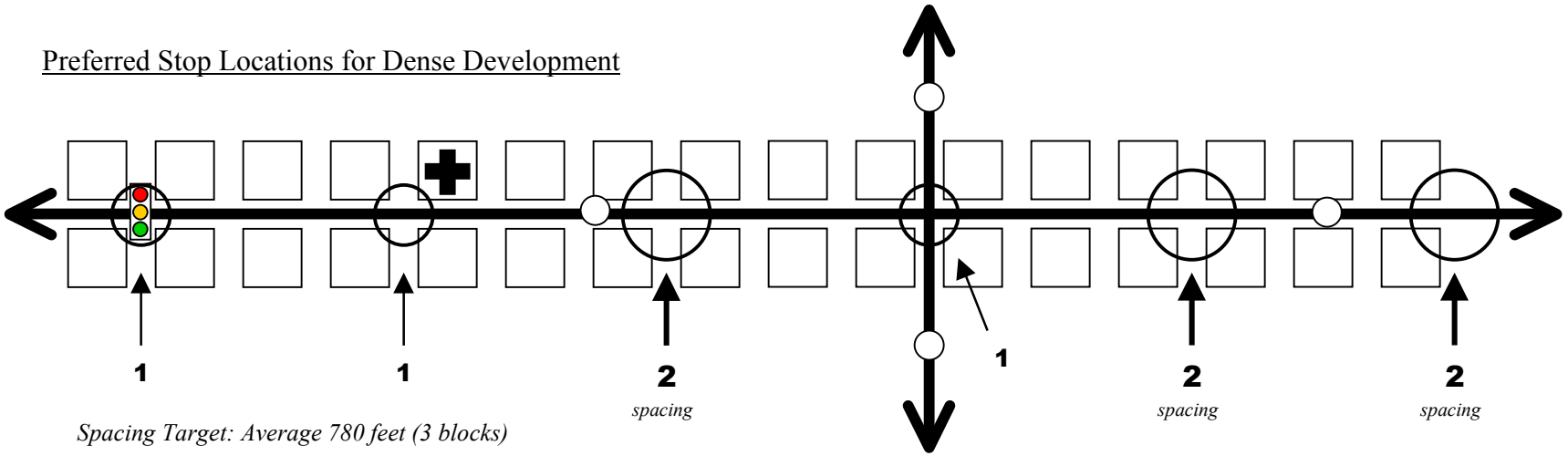


Diagram 2

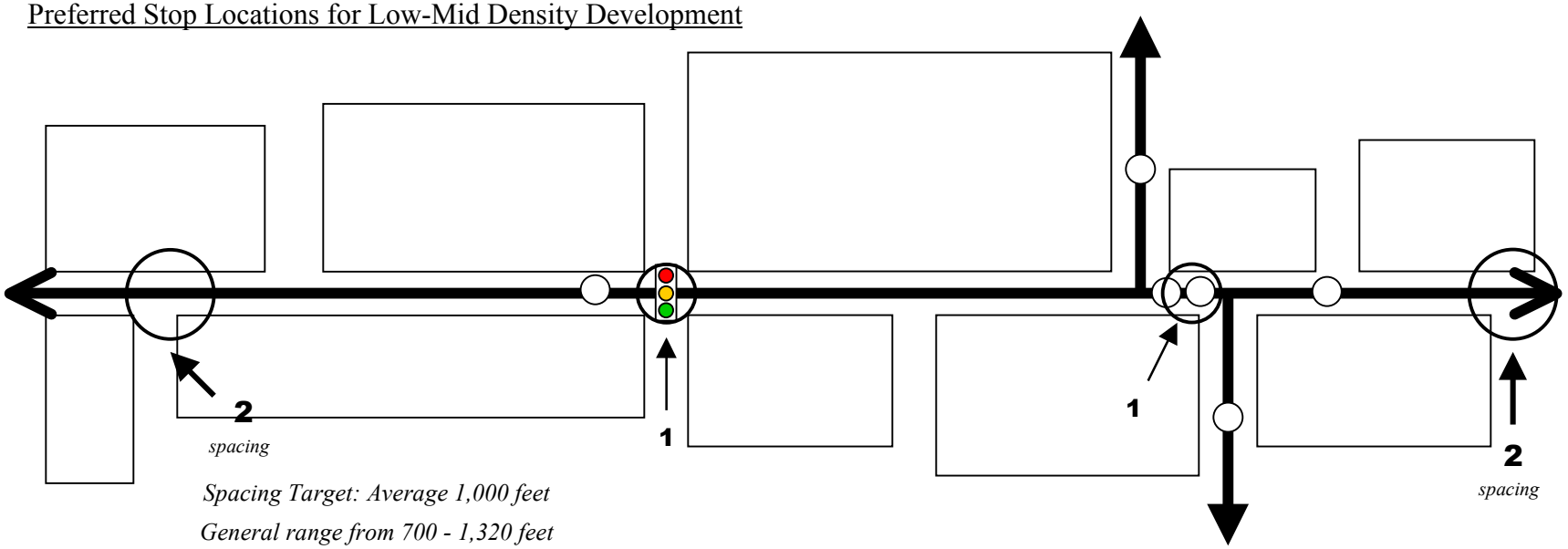
Then plan stops at intersections that are spaced appropriately between the initial stops.

Preferred Stop Locations for Dense Development



Spacing Target: Average 780 feet (3 blocks)
General range from 600 - 1,000 feet

Preferred Stop Locations for Low-Mid Density Development



Spacing Target: Average 1,000 feet
General range from 700 - 1,320 feet

B. Stop Placement

Approach

Stops are placed at locations:

- that are safe for passengers and vehicles,
- that may be easily accessed by the surrounding neighborhood, major transit generators and/or intersecting transit services, and
- where improvements in safety, convenience and/or reduced trip times outweigh negative impacts.

Tools

The placement of the bus stop in relation to intersection: farside; nearside; midblock; off-street. Please see Appendix C. Additional Stop and Zone Materials, Diagram 1 for illustrations.

What to do

Table 1. Stop Placement

Situation	Preferred Placement
Any signalized intersection where bus can stop out of travel lane	Farside
If bus turns at intersection	Farside
Intersection with many right turns	Farside
Complex intersections with multi-phase signals or dual turn lanes	Farside
If nearside curb extension prevents autos from trying to turn right in front of bus	Nearside
If two or more consecutive stops have signals	Alternate nearside and farside (starting nearside) to maximize advantage from timed signals
If obvious, heavy single-direction transfer activity	One nearside; one farside to eliminate crossing required to transfer
If blocks are too long to have all stops at intersections	Midblock
Major transit generators not served by stops at intersections	Midblock
Midblock pedestrian-crossing combined with midblock pedestrian access into block	Midblock
Transit center	Off-street
Major transit generator that cannot be served by on-street stop, or where ridership gain will far outweigh inconvenience to passengers already on-board	Off-street

Stops are at intersections because:

- walking distances amongst origins, destinations and stops are reduced for customers,
- street crossings are legal at intersections,
- street crossings are generally safer at intersections, and
- curb ramps and other benefits of accessibility are generally located only at intersections.

Placing stops farside of the intersection is preferred in most cases for signalized intersections because they result in:

- fewer traffic delays and better safety – bus clears intersection blocking fewer movements and sight lines,
- better pedestrian and auto sight distances,

- fewer conflicts between buses and pedestrians (i.e., no pedestrians trying to cross in front of bus – where passing autos cannot see them),
- greater bus maneuvering area,
- more effective priority signal treatments,
- eliminating the danger of cars turning right in front of buses (as happens nearside), and
- minimized parking restrictions necessary to get bus to curb (shorter bus zones because buses use the intersection as part of approach to zone).

What to consider

Every site will present a unique set of issues. The following is a checklist of the most important considerations:

- Travel time delays
  - Farside allows signal treatments to work most effectively
  - Alternate placement nearside-farside if signals occur at every stop
- Safety
  - Waiting, boarding and alighting must be safe
  - Steer riders toward safe street crossings
  - Watch for other pedestrians
  - Consider impacts on other traffic
  - Provide adequate sight distance, i.e., provide visibility for bus driver and waiting riders
- Service quality tradeoffs – fewer stops mean
  - Faster and more efficient service
  - More potential for amenities at each stop
  - Longer walk distance to stops for some
- Stops must be suitable for bus operations
- Impacts on traffic
- Accessible for all
  - Slope – no more than 2% for level surfaces, 8% for ramps
  - If necessary, construct 5' x 8' concrete pad at stop
  - Check for curb ramps at intersection and on surrounding streets
- Ensure compatibility with adjacent properties

C. Stop Elements, Amenities, and Customer Information

Approach

Use elements that clearly define the bus stop for patrons, operators, pedestrians, and motorists. Provide amenities that will invite ridership by making riders comfortable and confident in the service. Do this in locations and at a level that is appropriate to the ridership and budget. Place amenities and elements of stops in configurations that maximize:

1. Safety
2. Visibility
3. Comfort

Customer information is designed to:

Show the way – Provide easy identification of every bus stop. This is achieved through colors, shapes and symbols that are consistent but unique within the streetscape.

Provide basic service information – Provide basic route information on every bus stop sign that includes the route number, direction of travel, major stops along the way and the fare zone.

Provide expanded information at targeted stops – Use visual and tactile tools, provide more detailed schedule information and maps at targeted stops.

Use artistic elements to welcome patrons and neighbors – Art can help create a sense of place, neighborhood ownership and comfort.

Tools

Bus stop elements:

- **Pole and bus stop sign** – *Required*, identifies the bus stop. TriMet bus stop signs are used at all district bus stops. Historically, these signs have been placed on any number of existing poles, columns, light standards and the occasional tree or bus shelter. This is a past practice that TriMet is attempting to phase out. At new or moved stops, TriMet signage is placed on dedicated TriMet poles; other jurisdictional signage identifying the bus stop zone may also be placed upon a TriMet bus stop pole.

  Poles should be placed two feet from the curb with informational signs flag-mounted away from the street *or* poles placed behind the sidewalk and informational signs flag-mounted towards the street. In both cases the sign should be oriented towards the sidewalk for pedestrian visibility. Farside pole and sign placements should be a minimum of 50' clear of existing pedestrian crossings. Nearside pole and sign placements at signalized or controlled intersections should be setback 15' to 25' from pedestrian crossings. Nearside pole and sign placements at uncontrolled intersections may be placed as close as one foot from a crosswalk. Pole placement must be carefully planned to ensure that all bus stop elements work as designed, that all bus operators know exactly where to stop, and that all patrons know exactly where to board. *Proper placement and installation is critical to bus stop operation*. Shapes and colors of TriMet signs and poles will help identify the bus stop. Please see Appendix A. Construction Specifications, Sheet 27 for sign and pole installation specifications.

- **ADA landing pad** – *Preferred*. Required at new and existing stops, stops with moderate or better ridership (minimum 20 daily boardings) and stops with any lift activity; preferred at all bus stops.

  TriMet defines an ADA landing pad as a clear, level landing area a minimum of 5'x 8' (10' x 8' is ideal) located adjacent to the TriMet bus stop sign. At new construction sites TriMet requires ADA pads to be a minimum of 8'x 8'. Construction of ADA pads is pursued at locations where a connection to a pedestrian pathway is possible. Please refer to Appendix A. Construction Specifications, Sheets 1, 5, & 16 for concrete specifications.

- **Rear landing pad** – *Preferred*. In addition to an ADA accessible landing pad to access the front door of buses, TriMet prefers to have an additional landing pad at the rear door. The rear door landing pad should be considered when more than eight (8) daily passenger alightings exist in addition to criteria that warrants an ADA landing pad.

  Rear landing pads must be accompanied by a front door ADA landing area. This landing area must also be clear of obstacles and at least 4'x 6'. At new construction sites a rearlanding pad should always be pursued, but is not required.

- **Bus zone –** *When necessary*. At bus stops where accessibility improvements are planned, and parking is available, bus zones, no parking areas (NPAs) or other parking control options should be placed. TriMet cannot guarantee bus stop accessibility unless the bus has a clear path to the curb.
  For additional information, please see Section III, Part E Roadway Treatments.

Bus stop amenities:

- **Shelter –** *Optional*. TriMet continues to use ridership figures as the primary criterion for determining shelter placement warrants. Yet several additional criteria are also considered when ridership figures do not support shelter placement.

- Preferred for stops with 35 or more boardings per weekday
- Infrequent service – minimum of 30 daily boardings on routes where peak headways are greater than fifteen minutes
- Lift usage – minimum of 15 weekday boardings and 4% lift usage
- Proximity to senior housing and a minimum of 20 daily boardings
- Shelters funded and maintained by others
- Development of large new activity centers adjacent to transit where ridership is projected to meet criteria
- Consolidated bus stops – combined ridership totals increase likelihood of shelter placement

If a bus stop meets TriMet's shelter criteria it *may* be considered for bus shelter placement. Meeting these criteria *does not* guarantee shelter installation. Existing site conditions and pedestrian infrastructure, public right-of-way availability, accessibility and safety issues, and other concerns must be reviewed and addressed before future bus shelter placements are confirmed.

Bus shelter placement and orientation should follow the layout options shown in Diagrams 3 and 4. In instances where none of the suggested layouts apply or are feasible, the following must be maintained:

- Five feet of pedestrian passby, including clearance between poles, hydrants and other obstacles.
- ADA landing pad adjacent to sign and outside of shelter.
- Clear pathway from the ADA waiting area inside the shelter to the ADA landing pad.
- Clear pathway from the rear door landing area to the pedestrian path.

A variety of bus shelter shapes and sizes are available to address site restrictions and opportunities, and ridership needs. Please see Table 2 for descriptions.

Table 2. Shelter Types

Shelter Type	Dimensions (in feet)	Minimum Required Setback (from curb, in feet)	Minimum Daily Boardings	Other
B	8.5 x 4.5 x 8	11	35	Basic and most common shelter; sited in business and retail districts, residential neighborhoods, industrial and manufacturing areas, etc.
A	8.5 x 2.5 x 8	9	35	Narrow version of B shelter; pursued when a B shelter is warranted but right-of-way is limited.
BX	12 x 4.5 x 8	11	60	Longer version of B shelter; option at stops with strong usage.
AX	12 x 2.5 x 8	9	60	Rarely used; a possibility at stops with strong usage and limited setback.
BB	16 x 4.5 x 8	11	90	Double length shelter; only used at stops with significant ridership and likely only at activity centers.
AA	16 x 2.5 x 8	9	90	Rarely used; narrower version of BB.
High Capacity	Varies	Varies	>200	Special shelters for extremely high usage areas e.g., transit centers, light rail stations and high transfer points.
Awning	Varies	Not applicable	Not applicable	Protection provided by businesses…

The specifications for TriMet's current bus shelters as well as shelter pad specifications can be found in Appendices B. Stop Amenities and C. Construction Specifications, Sheets 1-4, 17-20, & 23. Also, refer to Section VI, for shelter maintenance information.

- **Seating –** *Optional*. Since TriMet has several seating options, bench placement can be considered at any stop where:
  - Accessibility is provided
  - Placement does not compromise safety (it is too close to the street, causes a tripping hazard, etc.)
  - Placement does not compromise accessibility (bench partially blocks the sidewalk, infringes on the ADA or rear landing pad, etc.)
  - Ad bench placement is allowed

Benches can generally be sited like bus shelters; however, they should not be placed closer than three-and-a-half feet from the curb or six feet from the curb when a travel lane exists immediately adjacent to the curb. The same clearance requirements placed on shelters apply here. Benches should be oriented towards the street or the direction of the approaching bus. Table 3 describes current seating options.

Table 3. Seating Types

Type of Seat		Length (in feet)	Criteria for Placement	Notes
Standard	Shelter Bench	4.0	N/A	Placed in TriMet shelters.
	Premium Bench	6.5	Minimum of 25 daily boardings; appropriate surroundings	Often placed in business and retail districts where shelters are not appropriate.
	Ad Bench	~6.0	Will be considered at any stop lacking amenities if in a safe location.	Placed for ad exposure or at TriMet's request.
Specialized	Flip Seat	N/A	Minimum of 20 daily boardings; appropriate site	Very space efficient, reserved for special situations.
	Simme Seat	N/A	Minimum of 20 daily boardings	Mounted on bus stop pole, appropriate where there are curb tight sidewalks (pole placed behind sidewalk).

- **Trash can –** *Optional*. Trash cans are placed in areas of high ridership, transfer locations and places where the potential for accumulating trash is apparent (near fast food restaurants, convenience stores and places where windblown trash collects). They are also placed at stops by request. Placement must not infringe upon the ADA pad or pedestrian pathway. It must not compromise direct access between the ADA waiting area and the ADA landing pad or access between either ADA area and the sidewalk.

- **Lighting** – *Optional*. Currently several options exist. The existing environment usually dictates which option to use. TriMet pursues both overhead lighting oriented towards the bus stop boarding area and bus shelter lighting. The current goal is to provide 1.5 – 2 foot candles of light around the bus stop area.

Customer information:

- **Printed Information –** *Optional*. Several choices of bus catcher information displays (BCID) are available to display schedule information at bus stops. Large (2' x 4') units are mounted in shelters. Transit tubes and smaller framed units are attached to TriMet bus stop poles. Braille

discs provide stop identification for visually impaired patrons. Placement criteria for these and other information tools are determined by TriMet's Information Development Department (IDP). For specific placement criteria, please refer to Table 4.

- **Transit Tracker –** *Optional*. Displays in shelters that provide real time bus arrival information. The Transit Tracker siting criteria are intended to be independently applicable to:
  - the entire system;
  - an area of emphasis (e.g., the Interstate Corridor, or a major activity center); or
  - one route.

  Primary Criteria (stop-level):
  - Relatively high boardings (actual or projected)
  - High transfer rate
  - Relatively low service frequency
  - Poor on-time performance and/or poor headway adherence
  - Not at end of line

  Secondary Criteria (stop-level):
  - A bus shelter is available
  - Electricity is available
  - Three or fewer routes served
  - Partnership opportunities exist

Note: The idea behind the low service frequency is that TT seems more valuable in situations where transit service is less frequent. With frequent service, a passenger may not be as concerned about how long they must wait, and the value of knowing exactly when the bus will arrive may not be as great as in situations with less frequency. Also, these criteria are not intended to be applied conjunctively, but rather they have different weights, are scored in total, and are used primarily for ranking purposes. For example, a site having high boardings but low transfers scores lower than another site with the same number of boardings but with more transfers

Table 4. Customer Information Tools

Information Tools	Function	Where
Stop design consistency, unique shape and color of sign & pole	Identification	All stops
Bus stop sign	Basic service information and orientation	All stops
BCID units	Schedule, route map	Stops with bus shelters or on TriMet poles (at locations with high ridership, transfer points, transit centers, transit generators and in some cases to promote new service).
Braille discs (the status of this program needs to be reviewed)	Tactile bus stop identification for visually impaired patrons	On TriMet poles
Transit Tracker	Automated bus arrival times	Stops with bus shelters (focused at locations with high ridership, transfers)
Bus stop art	Connection to community, creating sense of place	Stops near neighborhood nodes, pedestrian activity

What TriMet wants to accomplish

TriMet places bus stop elements, amenities and customer information to:

- provide safe, level landing pads for front and rear doors (front door pad must be ADA compliant);

- make waiting customers visible to the bus operator and vice versa;
- minimize maneuvering difficulty for riders with wheelchairs and other ADA mobility devices;
- make all parts of the transit experience as comfortable and convenient as possible, given financial resources;
- keep accessible through-path on sidewalk;
- provide a clear and consistent on-street image;
- ensure that TriMet poles and signs are readily visible to patrons, pedestrians, bus operators, and motorists;
- provide basic information to orient bus patrons; and
- provide targeted information that enhances the riding experience.

Things to consider

Every site will present a unique list of issues. The following is a checklist of the most important considerations:

For elements and amenities:

- ❑ Visibility of passengers to operators, and vice versa
- ❑ Accessible for all
  - Slope
  - Minimum 5' x 8' ADA concrete pad at stop
- ❑ Safety
  - Waiting, boarding and alighting must be safe
  - Provide adequate sight distance, i.e., provide visibility between bus driver and waiting riders
- ❑ Stops must be suitable for bus operations
- ❑ Ridership and lift usage
- ❑ Elderly housing, hospitals and compelling land uses can lower minimum criteria for amenities
- ❑ Clear sight lines for pedestrians and traffic
- ❑ Ensure compatibility with adjacent properties
- ❑ Avoid private property when possible
- ❑ Consider possible partnerships with private landowners and businesses (e.g., awnings, Adopt-A-Stop, etc.) when needed
- ❑ Minimize conflict with trees and other nearby features
- ❑ Cost
  - Initial capital and installation cost
  - Long-term maintenance cost
  - Replacement cost

For customer information, also consider:

- ❑ Patron usage
- ❑ Transfer locations
- ❑ Service frequency
- ❑ Schedule reliability
- ❑ Special needs
- ❑ Labor availability
- ❑ Stop location on route

Table 5. Bus Stop Classification

Stop Type	Underdeveloped	Basic	Level 1	Level 2	Level 3
Use/Stop Type Designation Criteria	Poor, or lack of, supporting land uses; few or no boarding rides; closely spaced with another stop	All stops meeting spacing/siting criteria	High use stops (35 BR+ / day); significant employer program participant; apartments; institutions; hospitals; shopping centers; major business; minor park & ride lots (shared use); stops with significant usage by riders who are disabled or elderly	Major stops (200+ BR / day); transit mall; major park & ride lot (TriMet dedicated); all transfer points; stops with active lift or ramp usage	Bus Rapid Transit service; transit centers; high volume park & rides; major transfer hubs
TriMet Managed Bus Stop Features (*Any combination of the stated features*)	No pavement; inadequate shoulder; visibility blocked; poor lighting; insufficient ADA clearances; undue exposure to weather/ traffic; shared pole; one sided visibility	Pavement meets ADA clearances; bus stop sign on dedicated pole	*Preceding features plus:* Standard (A or B) shelter (larger if justified); lighting (utility pole or shelter); BCID in shelter; trash can; free standing bench; pad for rear door, when physically possible	*Preceding features plus:* 16' or high capacity shelter; BCID or transit tracker; trash can; bike rack; public telephone (dial out only); free standing bench; art work	*Preceding features plus:* "Station" style shelter; free standing bench(s); bike lockers, lids or other long-term storage; operator building and restroom as needed; ticket vending machine; artwork element
Externally Managed Features (*Any combination of the stated features*)	No clear, safe pedestrian access; no logical, safe street crossing; unsafe topography; standing water; unpleasant site conditions	Safe street crossing (corner, ADA ramps); sidewalk or safe shoulder access	*Preceding features plus:* sidewalk connections; curb extensions; crosswalks	*Preceding features plus*: art enhancements (TriMet or community); community bulletin board; newspaper vending bins	*Preceding features plus these possible features:* concession or nearby shop(s); landscaping (low maintenance); public restroom; U.S. mail box

D. Bus Stop Layouts and Design

In the past, bus stops were designed on a stop-by-stop basis leading to a wide variety of layouts and an inconsistent message to TriMet patrons and operators. Successful bus stops are designed to link to other transportation modes, existing or planned. Accommodating sidewalk systems is critical to assuring the safe and accessible transport of TriMet patrons between the origin/ destination and the bus stop.

Following this section, bus stop layout diagrams are presented. They are designed to respond to existing conditions and incorporate only basic amenities. The diagrams are also intended to clearly indicate where buses stop, and where patrons wait and board. All examples assume that an accessible pedestrian system is already in place.

Stop elements and amenities covered in the diagrams:

- TriMet pole and bus stop sign – Required. The pole/sign is the cornerstone of all bus stops. Its placement must be considered carefully.
- Bus stop landing area – An ADA landing area is required by federal and state law for all new stops. Optimally, TriMet will provide a safe landing area for all bus doors. The ADA landing area must be placed adjacent to the bus stop sign whenever possible.
- Bus zone or no parking area – Required where parking might otherwise block the bus's ability to pull to the curb. The bus must get to the curb to provide accessible entry. Eliminating parking at the stop accomplishes that goal. Curb extensions and other expensive solutions are discussed in Section III, Part E Roadway Treatments.
- Bus shelter and shelter pad – Optional. Shelter from the elements makes the transit experience more pleasant. The shelter's placement, and its orientation to other elements are critical.
- Trash can – Optional. Placement is often an afterthought. When placement is planned, trash cans should be incorporated in the bus stop design.

Stop elements and amenities not covered in the diagrams:

- Curb ramps – The following layouts assume curb ramps are present. If they are missing, TriMet or the local jurisdiction will install at least one when constructing other improvements.
- Lights and other amenities – Great enhancements, but not covered in these diagrams. These are optional elements.
- Bus zone and no parking area signage – Every jurisdiction does it differently. One to four poles are possible. These are too variable to show in a diagram successfully.
- Service information – Important, but not critical to stop layout because the information is usually attached to a bus shelter or bus stop pole.
- Trees, fire hydrants, mailboxes, driveways, power poles, etc. – Continue to be accommodated on a stop-by-stop basis.

Standard clearance requirements at *all* stops:

- Sidewalk clearance – Maintain minimum five feet of sidewalk clearance
- Accessible pathway – Minimum five foot wide path between shelter and any utility objects
- Road clearance – Minimum two foot clearance between shelter and edge of curb (extra care must be taken because newer vehicles have longer tail-swing)
- Building clearance – Minimum 12" from buildings, fences, and other structures to allow room for maintenance
- ADA landing area – Minimum 5' x 8' "clear and level surface" at curb for lift or ramp operation

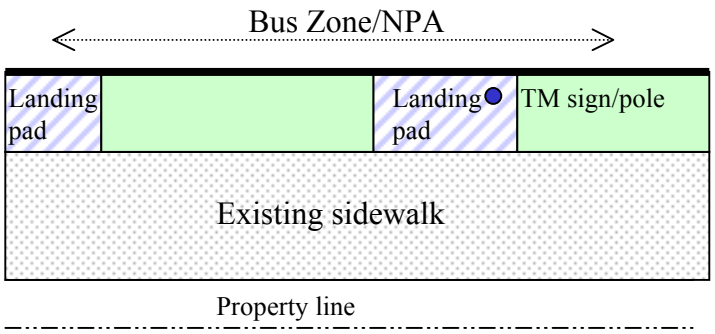
Requirements for *all* stops with shelters:

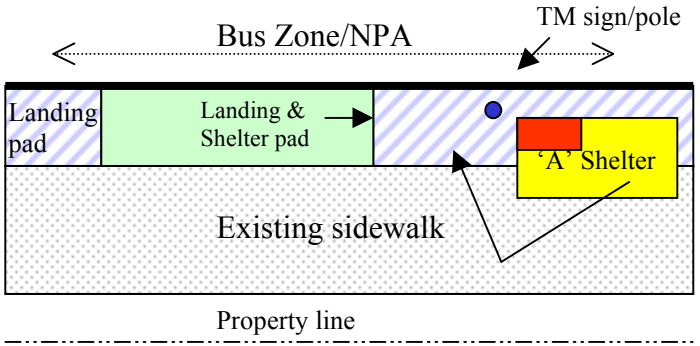
- ADA waiting area in shelters – Minimum 2'6" x 4' space must be kept clear for mandatory waiting area to accommodate mobility devices.
- Visibility – Shelters must not block motorists' or pedestrians' line of sight
- Relation to bus stop – Shelter should be within a compact space, close to landing area for access to bus (generally within 25').

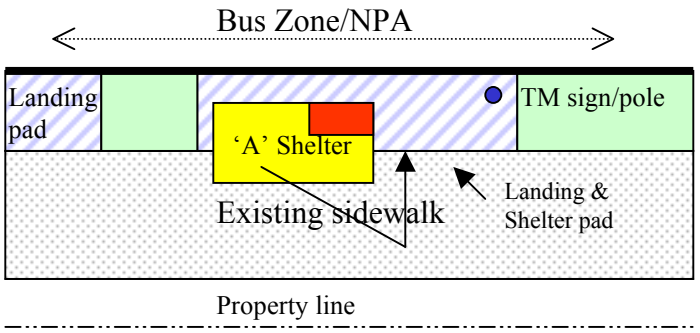
Diagram 3

Bus stop design: Sidewalks with furnishing zones

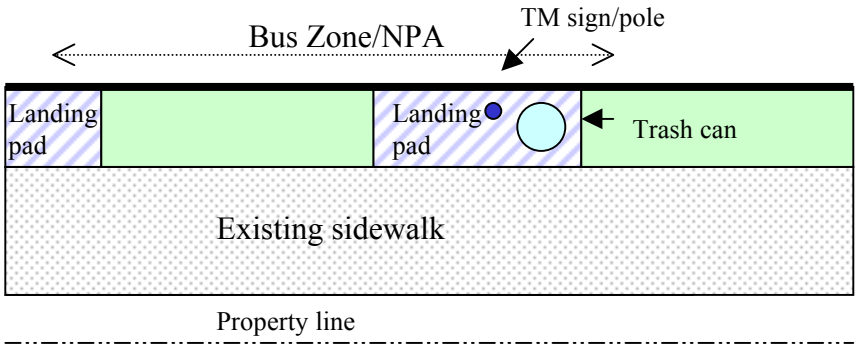
Basic

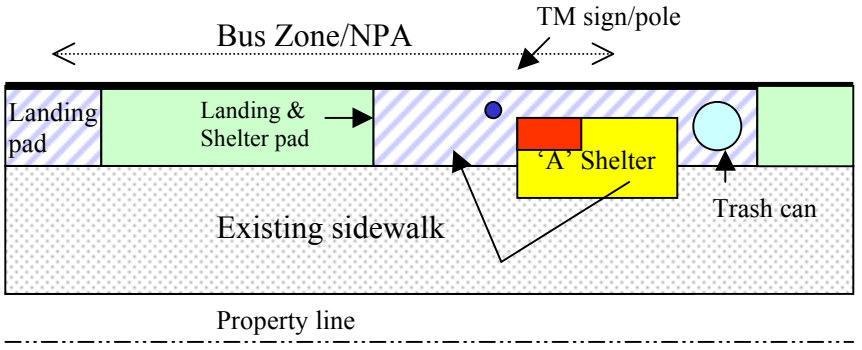






Expanded





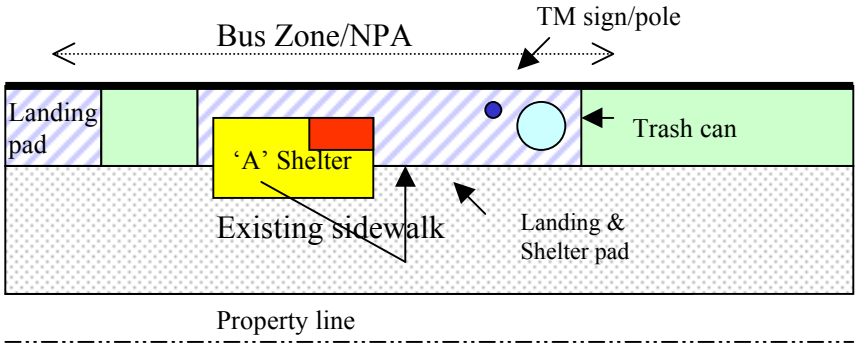
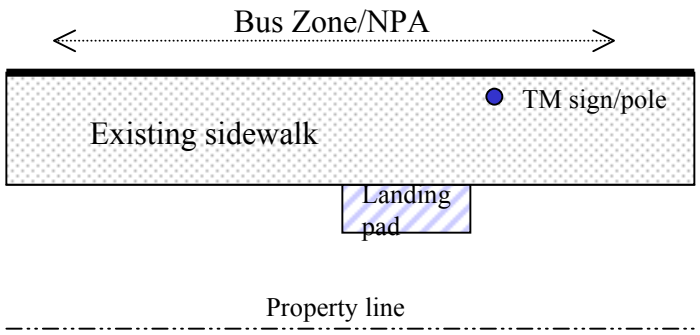
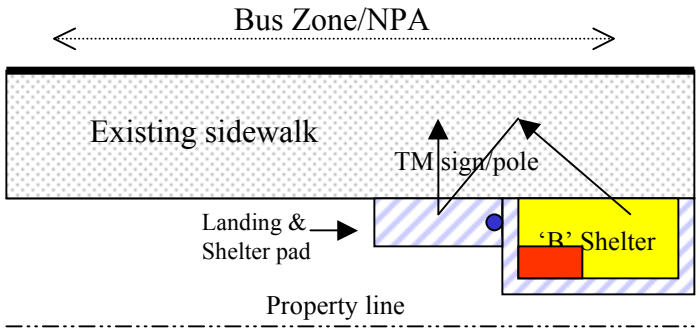


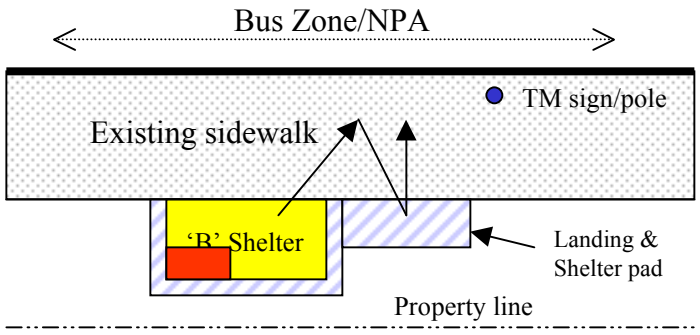
Diagram 4

Bus stop design: Sidewalks without furnishing zones

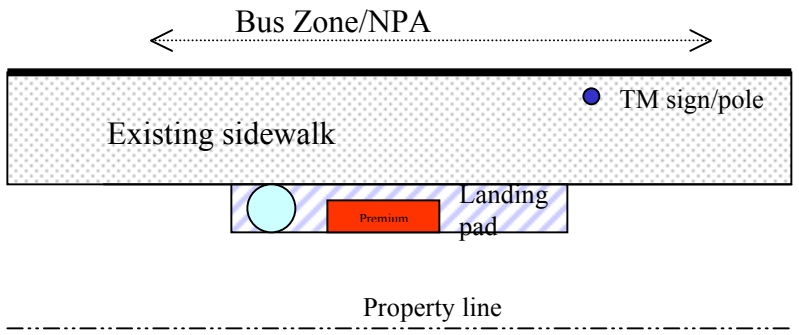
Basic

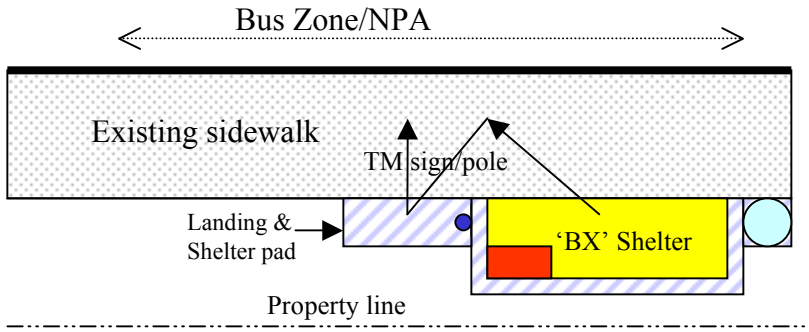


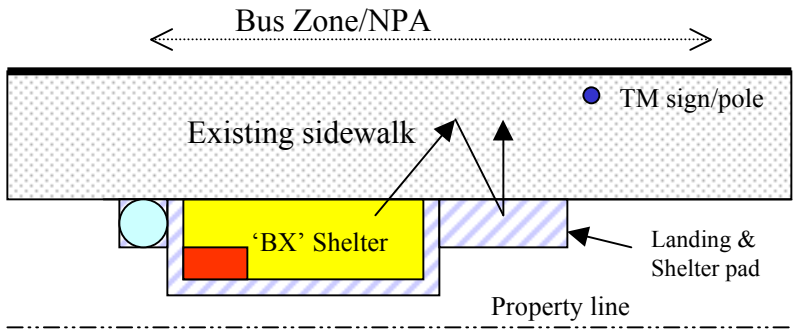




Expanded







E. Roadway Treatments

Approach

Change management or structure of roadway to improve transit efficiency and accessibility. Focus on locations or corridors with the highest delays and/or those that create the most variability in on-time performance. Consider ridership and lift usage at stops.

Tools

1. Bus zones or other parking restrictions

A bus stop is not considered accessible unless the bus can reach the curb. Bus zones, no parking areas (NPAs) and other parking restrictions are often necessary to assure access. Bus zones or NPAs are required when:

- it is determined that a stop must be accessible.
- parking is allowed at the stop.
- there is not justification for a curb extension, stop move or stop deletion.
- buses lay over.

Nearside (NS) Bus Zones - preferred length is 80' measured from the bus stop sign. In extreme circumstances NS bus zones can be shortened to 60', however buses may not be able to clear the travel lane. At signalized intersections the bus should stop a minimum of 15' from the pedestrian crossing so that approaching drivers will be able to see pedestrians using the crosswalk. The area between crosswalk and bus stop must also prohibit parking.

Farside (FS) Bus Zones – preferred length is 80' measured from the crosswalk. In all instances the rear of the bus must clear the crosswalk. Farside zones can be shortened to 60', however buses may not be able to clear the travel lane.

Midblock (AT or OP) Bus Zones – preferred length is 90' measured from the bus stop sign. A minimum length for midblock zones is determined on a site-by-site basis. These zones are infrequently used, but are found on "super-blocks" often opposite of 'T' intersections in high-density areas and along mid- and lower density area roadways with few intersections.

Bus zones must be clearly marked – since parking control is provided by jurisdictions, so is the signage and marking requirements, resulting in several variations. Generally bus zones are marked by a front zone sign/pole, and a rear zone sign/pole. At farside zones, bus stop markers are often used to indicate where the bus should stop (to allow enough space to pullout). An NPA sign/pole may be added at the front of a bus zone to clearly define ambiguous frontage (i.e., between a zone and a driveway, or a zone and a fire hydrant). The City of Portland applies yellow tape to the curb tops in bus zones to further define the space.

Please refer to Appendix C. Additional Stop and Zone Materials, Diagrams 2 & 3 for technical specifications, incorporating driveways, etc.

2. Curb extensions incorporating transit stops

Curb extensions are a popular roadway treatment often used in streetscape improvement plans. For best effect, extensions are placed along a corridor in series of two or four to an intersection. Under this scenario the extensions improve pedestrian connections by shortening street crossing distances, and improving sight angles for pedestrians and motorists. For transit, curb extensions have several benefits. They:

- provide buses with access to the curb from the travel lane without deviation (no pulling in or merging) thereby reducing dwell time.

- can reduce nearside stop turning conflicts on two lane roads by blocking through traffic.
- provide patron waiting and boarding areas separated from pedestrian movements on sidewalks.
- provide room for stop amenities or other streetscape features.
- visually designate a street as a pedestrian friendly transit corridor.

Designing/building curb extensions that work well with transit is not an easy task. Designers must battle with the competing cross slopes of the existing roadway and sidewalks, consider drainage and relocate sewer grates. As a result, few extensions actually provide a landing area that allows low floor bus ramps to deploy at an ADA acceptable slope.

Following are the general requirements for transit stop curb extensions:

- Transit curb extensions should be paired with a pedestrian or transit curb extension across the travel street.
- Curb extensions must be clearly marked/designated to improve their visibility to motorists.
- Extensions must provide a minimum 32' of curb line free of ramps, wings and curb returns. At farside extensions, the bus must be clear of the crosswalk, requiring a minimum of 42' of clear curb line.
- A 6'x 8' clear space must be defined at front and rear door locations (door locations should be indicated by curb tape or paint).
- Bus shelters, poles, trees, benches, trash cans and other amenities must be placed a minimum of three-and-a-half feet clear of the curb face.
- Placement of curb extensions, whether nearside, farside, at signalized or non-signalized intersections must be made on a case-by-case basis. Generally, nearside curb extensions are preferred at non-signalized intersections.

Technical information for curb extensions can be found in Appendix A. Construction Specifications, Sheet 24, and Appendix C. Additional Stop and Zone Materials, Diagram 4.

3. Bus pullouts and bus pads

A bus pullout's primary function is to move buses out of travel lanes where they might impede traffic flow. Although there are scenarios where this is a valuable function, TriMet does not actively pursue the placement of bus pullouts at regular bus stops because it reduces the efficiency of transit service. TriMet will consider accepting pullouts:

- at bus layovers (where buses park for several minutes)
- at selected bus stops on roads with at least two of the following:
    - posted speed limit at or above 45 mph
    - ridership above 35 daily boardings (or six (6) daily lift boardings)
    - potential safety issues

Concrete bus pads are often incorporated in pullout designs but are also used at curbside bus stops. Bus pads are considered on a case-by-case basis but are generally found at stops with frequent service, significant ridership, or where heavy bus braking and acceleration is necessary.

Technical information for pullouts and pads can be found in Appendix A. Construction Specifications, Sheets 25 & 26, and Appendix C. Additional Stop and Zone Materials, Diagram 5.

4. "Except Bus" signage, queue jump signals and bus only lanes

These treatments should be pursued on major trunk routes, crosstown routes or any high frequency bus routes with significant traffic delays during peak periods. "Except Bus"

signage is the most common treatment where a nearside bus stop at a signalized intersection uses a right turn pocket. Queue jump signals are used in conjunction with an "except bus" queue jump lane (especially when there is no farside lane) to provide safe merging into traffic lane. Bus only lanes provide exclusive right-of-way to bypass congestion, but are only used when adequate right-of-way is available.

What to do

Each treatment has differing effectiveness based on the individual circumstances. Detailed analysis of such issues as traffic volume, ridership, safety, right-of-way, and delay to transit are required. The City of Portland's Transit Preferential Streets Program Sourcebook (June 1997), developed with TriMet participation, and TriMet's Streamline project guidelines contain more information on these tools.

Things to consider

Every site will present a unique list of issues. Use the following as a checklist of the most important considerations:

- ❑ Pedestrian safety
- ❑ Traffic safety
- ❑ Transit operation safety
- ❑ Schedule reliability
- ❑ Transit travel time and speeds
- ❑ Impact on traffic
- ❑ Costs/Benefits

F. Bus Stop Access

It is essential that bus riders have safe access to their bus stop. Walking on narrow roadway shoulders, through mud or puddles, or through ditches is unacceptable to most bus riders and is often unsafe. TriMet does not hold responsibility for construction or maintenance of sidewalks or curb ramps, but TriMet can leverage their construction through partnerships with jurisdictions and property owners or solicitation of regional funding for their construction. The pedestrian network is not only essential for transit access, but benefits the community and the region by encouraging walking for local travel.

TriMet must work with Metro and local jurisdictions to identify deficiencies in the pedestrian network using geographic information system (GIS) tools and then assign priorities for a pedestrian network development program. Some key considerations would include:

- Direct, paved, ADA compliant walk connections between any moderate-to-dense neighborhood or business center and transit stops. These should be on at least one side of the street.
- Pedestrian connections need to be continuous, with a safe crosswalk where sidewalks must shift from one side of the street to another. Driveways need to be limited and well lit for pedestrian safety.
- Designated and protected pedestrian crosswalks across arterial streets, no further apart than three blocks or 780 feet.
- Street lighting, particularly at street crossings.
- ADA compliant curb ramps at each intersection.
- Sidewalks need to be in good repair and free of trip hazards.
- Sidewalks and bus stops will be coordinated to provide ADA clearances and amenities of mutual benefit to both pedestrians and bus riders.

TriMet will support efforts to secure funding for pedestrian network development including Federal programs and their local allocation, designation of improvement districts or assignment of local Traffic Impact Fees (TIF) or other local tax mechanisms.

IV. Program Partnerships

A. Citizen Involvement

Bus stops as public spaces are as much a part of a community as streets, pathways, parks and plazas. TriMet encourages communities and citizens to recognize their value and to build a sense of ownership. TriMet, in partnership with Stop Oregon Litter and Vandalism (SOLV), promotes several ways for citizens to participate in the care of their local stops.

Adopt-A-Stop – A customer agrees to pick up the litter, clean the stop amenities and report any items needing repair in exchange for gloves, cleaning supplies and a steady supply of bus tickets.

Keep-A-Can – If trash is an issue at a particular stop, customers or local businesses can sponsor a trash can. Under the program, volunteers agree to empty and provide service for a trash can. In return, TriMet will provide an attractive, industrial strength can, liner, and soda can recycling container for the stop.

TriMet also offers other programs that do not relate directly to bus stops but give citizens the opportunity to support the public transit system. Details on transit, safety advocacy or any other TriMet opportunity are available through TriMet's Customer Service Department.

B. Development Review

1. Background

TriMet has been conducting development review on transit-adjacent development for over six years. This review process has fostered strong relationships with local jurisdictions, while helping to facilitate better designs for new development. The review process enables TriMet to be involved early enough in the process to influence the land use and infrastructure designs being proposed. Including transit improvements as part of new development helps to mitigate for transportation impacts and allows the cost of these amenities to be shared by developers. In the end, these partnerships stretch resources and create a more comprehensive transit system.

2. Improving stop placement

With an emphasis on bus stop improvement and support, TriMet primarily reviews development projects located directly on transit routes. For significant projects, stop spacing, location and usage along the adjacent route segment are analyzed to determine whether stop relocation or adjustment would facilitate: a) better access to transit, b) patron and pedestrian safety, c) transit operational efficiency, or d) traffic safety. If appropriate, modifications to roadway and frontage design, signalization, pedestrian pathways and street or parking lot crossings will be considered.

3. Private sector purchasing amenities, joining SOLV, adopting stops

Depending on the size and nature of the development or development action, TriMet may request improvements to adjacent bus stops. If frontage improvements are planned TriMet will request the addition of an ADA landing pad and a rear door landing pad at stops that lack them. If ridership potential exists, TriMet may request that a developer provide a bus shelter, a bench or other bus stop amenities as warranted. In some instances, developers may want to provide a bus shelter where only limited ridership is projected (e.g., to satisfy a condition of approval or to receive an exemption from certain conditions of approval). In this scenario, TriMet asks developers to take an active role in caring for the stop by joining SOLV, adopting the stop, sponsoring a trash can or agreeing to regularly clean the stop.

4. Private sector designing transit stops and plazas

Some jurisdictions are asking developers and their architects to incorporate transit stops into their projects' designs. Building and frontage themes are replicated at the bus stop, creating transit plazas that visually relate to the project. Awnings, columns, pedestals, shelters, benches and

public art provided by developers are not standard TriMet issue, therefore, their care becomes the individual property owner's responsibility (TriMet still provides and maintains signage and customer information).

C. Public Partnerships

1. Responding to the Regional Transportation Plan (RTP)

The 2040 Framework presents a vision for livability for the Portland metropolitan area. It defines the Portland and Vancouver city centers which are surrounded by regional centers, town centers, station areas and main streets, all of which have levels of urban density that call for concentrated transit services. The plan also calls for an extensive transit network that serves all communities with various forms of transit - from light rail transit to local neighborhood buses.

The RTP is the 5-year plan that responds to the transportation vision introduced in the 2040 Framework. The RTP, last adopted in 2000, is specific about both the levels of transit services to be provided and the mode split targets for communities to use transit and other alternative modes of travel. Jurisdictions, thus, must adopt Transportation Systems Plans (TSPs), which demonstrate the means by which they expect to achieve the mode split targets.

TriMet is a necessary partner in both the formulation and execution of these plans. Jurisdictions and TriMet must work together to define transit priority corridors, traffic management tools and streetscape improvements that will encourage reduced reliance on the single-occupant vehicle. This partnership is also critical to encourage land uses along transit corridors (Transit Oriented Development or TOD) that take advantage of the public investment in transit services.

2. TriMet partners to improve other jurisdictions projects

TriMet Project Planning staff is available to provide support for jurisdictional planning efforts that have transportation elements. Town center plans, corridor development, streetscape improvement plans, street-widening projects, traffic calming plans and TSP development are a few examples of planning and implementation efforts that can benefit from TriMet input. Jurisdictional plans that recognize, coordinate with or incorporate TriMet service and capital improvement plans will likely result in better transportation and transit products.

3. Jurisdictions partner with TriMet to improve transit projects

Project Planning also invites key jurisdictional staff to be part of TriMet project teams. Their support and input is critical to the success of TriMet projects as well. The cooperation amongst jurisdictional partners influences key planning decisions, facilitates key design elements, promotes simplified permitting and improves interagency communication.

4. Improving coordination through IGAs and MOUs

Intergovernmental Agreements (IGA) and Memorandums of Understanding (MOU) are documents that recognize project and program partnerships. TriMet and the City of Portland have developed several IGAs that have greatly improved TriMet's ability to provide accessibility and comfort to neighborhood bus stops. For example, a carriage walk agreement between Project Planning and the Bureau of Maintenance has allowed the agencies to coordinate bus stop accessibility improvements, like ADA landing pads and curb ramps, with the city's own efforts to upgrade the pedestrian infrastructure with curb ramps and accessible sidewalks. A bus shelter siting agreement has allowed TriMet and the City to simplify the siting and permitting process, putting amenities on the street more quickly. TriMet continues to pursue agreements like these with its regional partners to make better and more efficient use of available funding, and to provide timely, coordinated projects.

V. Bus Stop Development Projects

TriMet initiates capital projects to make significant improvements to route efficiency, on street and bus stop safety, accessibility and comfort. TriMet utilizes the tools and methodology introduced in these guidelines to provide an improved product that integrates with existing transit service.

Following are recent or current capital projects, their intent and their effect.

Low Floor Bus

Low Floor Bus 1996-2010

INITIATED: 1996 with the purchase of TriMet's first low floor buses and the commitment to replace all high floor buses by 2010.

COMPLETED: Ongoing –will be completed when every bus line utilizing low floor buses has received low floor bus wayside improvements.

STATUS 2002: Lines 4, 8, 15, 19, 33, 54, 56, 72 and 75 have received wayside improvements.

PRIMARY GOAL: To significantly improve patron accessibility and safety at bus stops at impacted stops on appropriate routes.

TARGET: Functional accessibility at 70% of selected route's bus stops. ADA accessibility at 50% of selected route's bus stops.

PRIMARY TOOLS:
1. Bus stop relocation, consolidation and removal
2. Bus zones and parking restrictions
3. Curb ramps
4. ADA and rear landing pads
5. New poles and signs
6. Limited amenities (benches, shelters and trash cans)

Streamline

Streamline 1999-2005

INITIATED: 1999 with the release of the 99/00 Capital budget.

COMPLETED: Ongoing – currently five lines have been selected to receive Streamline treatment.

STATUS 2002: Lines 4, 72 and 12 are in the process of receiving Streamline improvements.

PRIMARY GOAL: To improve bus service reliability and reduce travel time while also improving patron safety, accessibility and comfort on selected routes.

TARGETS: Reduce travel time to significantly impact riders' perception of timesavings. Reduce resources necessary to operate service at current frequency.

PRIMARY TOOLS:
1. Traffic signal transit priority treatments
2. Roadway treatments (bus only lanes, queue jump and bypass lanes, curb extensions, turning radius improvements, lane adjustments etc.)
3. Bus stop relocation, consolidation and removal
4. Bus zones and parking restrictions
5. Curb ramps
6. ADA and rear door pads
7. New poles and signs
8. Amenities improvements -benches, shelters, trash cans, lighting
9. Route simplification

Bus Shelter Expansion

Bus Shelter Expansion 2000

INITIATED: 2000 with a public announcement of the placement of 100 new bus shelters during FY 2000/2001.

COMPLETED: Ongoing – current plan to continue until 500 new shelters have been placed.

STATUS 2002: Underway–will site, permit, construct pads for and place shelters at 100 new sites by July 2002.

PRIMARY GOAL: To improve patron comfort at bus stops currently lacking shelter. Upgrading accessibility if needed.

TARGET: Meet primary goal.

PRIMARY TOOLS:
1. Bus shelters
2. Bus shelter pads
3. Curb ramps
4. ADA and rear landing pads
5. New poles and signs
6. Bus zones and parking restrictions
7. Limited additional amenities (trash cans, lighting, BCIDs)

Bus Shelter Advertising

Bus Shelter Advertising Program

INITIATED: 1999-2000 with the permitting and placement of 50 ad shelters.

COMPLETED: Ongoing

STATUS 2002: Currently approaching 100 sites, permitting and siting on hold

PRIMARY GOAL: To offset the cost of improving, upgrading and maintaining first class bus stops and amenities programs.

TARGETS: Provide accessible, safe, lighted, covered bus stops at more locations.

PRIMARY TOOLS:
1. Amenities improvements -benches, shelters, trash cans, lighting, transit tracker
2. Bus shelter electrification
3. Potential enhanced cleaning and maintenance rotation
4. Bus stop relocation, consolidation and removal
5. Bus zones and parking restrictions
6. Curb ramps
7. ADA and rear door pads
8. New poles and signs

VI. Maintenance Guidelines

A. Introduction

On-street amenities provide an opportunity for increased transit use, improved efficiency of transit operations and capital improvements that enhance the communities in which they are located. Maintenance of these amenities accommodates the needs of passengers, transit operations and adjacent property owners.

The perception, utilization and public support for public transit are in large measure predicated on the condition in which transit amenities are maintained. Over 214,000 passengers use TriMet on a daily basis. Facilities Management intends to provide passenger areas that will not only make transit a pleasurable experience for them but also increase the number of riders using these amenities.

B. Goal

The goal is to provide TriMet's service district with consistent, high-quality bus stop and passenger facilities at all times.

C. Description of TriMet Maintained Amenities

TriMet bus stops include at minimum a bus stop sign with the following potential enhancements:

- Bus stop pole (TriMet owned)
- ADA landing pad
- Bus shelter and bench
- BCID
- Premium bench
- Trash can

D. Standards

Highest consideration shall be given to the safety, comfort and convenience of transit passengers. Impacts to the adjacent property owner(s) are also given consideration. All maintenance activities shall maximize safety and minimize disruption to the community, transit passengers and transit operations. TriMet's cleaning and maintenance of amenities shall be avoided during passenger rush hours. Vehicles shall not impede passenger boarding areas or impede normal traffic flow. All employees or contractors shall be professional and courteous at all times.

E. Routine Maintenance

The following standards shall be used by TriMet in evaluating maintenance services in order to provide a safe, clean and attractive passenger environment.

Definition of a clean bus stop:

- free from debris, e.g., cigarette butts, cups, newspapers, etc.
- free from foreign substances, e.g., gum, spills, food, etc.
- free from insects and weeds
- free from graffiti (written or etched)
- free from unauthorized stickers or posters

Definition of a well-maintained bus stop:

- overall passenger facilities in good repair
- areas and improvements are in good condition and all repairs are current
- all amenities (e.g., shelters, benches, trash receptacles) are properly installed to meet the requirements of city ordinances and Americans with Disabilities Act (ADA)
- furniture surfaces are in good condition, e.g., no rust, marring, scratches, etc.
- signage, walls, seating and kiosks are in good condition

- lighting in good working order at all times
- free from overhanging trees or brush

Guideline for repair & maintenance:

- Repairs are performed by both in-house employees and contractors.

Guidelines for cleaning:

- Pick-up trash and debris within a 15' radius of bus stop areas (blowers shall not be used).
- Remove graffiti, stickers and unauthorized signs and posters.
- Power wash all amenities with water. Using a ladder, clean the shelter roof inside and outside with a soft bristled brush until all dirt has been removed. Clean and flush gutters and drain holes of all debris. Clean the shelter frame, bench and windows (inside and outside) until all dirt has been removed using soft bristled brush and pressure washer. Dry windows with a squeegee so that no smears or streaks remain visible. Wipe benches completely dry after cleaning or graffiti removal to allow immediate customer use and to prevent claims for damaged clothing.

F. Emergency Cleaning

All emergency cleanings shall be completed within four (4) hours of notification, except broken glass, which shall be replaced within two (2) hours of notification.

G. Waste Disposal

Trash in and around shelters and stops gets collected and disposed of in various ways. Whenever possible, TriMet seeks sponsors to assist with the growing trash problem.

In most cases, TriMet provides the trash receptacle at a particular shelter. The sponsor collects and disposes of the trash as needed. A plaque on the trash can denotes the sponsor's name. TriMet maintains the trash can by providing the liner insert, and repairs and repaints (due to graffiti) on an as-needed basis.

For locations without sponsors, TriMet has its own in-house trash collection crew currently consisting of two (2) employees and one (1) trash dump truck. The crew follows a regular route schedule and also assists in emergency trash pick up as needed. When a sponsor neglects a trash can due to moving, vacation, etc., the crew assists until another sponsor is found.

Trash collected by TriMet is compacted in the dump truck and taken to a Metro collection site as needed. Metro currently provides vouchers to TriMet for no-cost disposal.

H. Anti-Litter and Graffiti Programs

TriMet partners with SOLV to provide anti-litter and graffiti programs, in addition to the regular maintenance routines described above. The SOLV program consists of three major components:

- Adopt-A-Stop: Please see Section IV, Part A Citizen Involvement.
- Keep-A-Can: Please see Section IV, Part A Citizen Involvement.
- First Step Youth Program: During the summer, SOLV and TriMet organize groups of at-risk students to clean up street litter and graffiti, focusing on TriMet transit corridors. TriMet provides group payment, supervision and transportation.

I. Bus Stop Amenities Replacement

Bus stop features are replaced as a result of accidents, vandalism or general wear over time. Regular maintenance will extend the life of bus shelters and other bus stop features, but their replacement is eventually required. The Capital Improvement Program (CIP) identifies the following criteria for the replacement of bus stop shelters:

- condition compromises customer safety
- exceeds a 15-year life cycle

- customer security is in some way compromised
- parts for repair and maintenance are no longer available
- the shelter is not in compliance with the Americans with Disabilities Act

A bus shelter replacement schedule is shown in Table 4 of the CIP.

Bus stop signs are similarly replaced if they pose a safety concern for bus riders; they have been damaged or vandalized; they impede movement in conflict with ADA guidelines or exceed an 8-year life cycle. Bus stop features may be in good condition beyond their expected life in which case replacement would be deferred. Signs, shelters and other amenities may be upgraded or moved to reflect changes in bus stop use or coordination with other development projects.

VII. Organizational Support

A. Capital Projects Management Section

Primary responsibility and accountability for bus stops – their design, placement, shelters and other amenities – lies with the Capital Projects Management Section of the Project Planning Department. This nine-person section works closely with other TriMet departments to provide for the regular maintenance and management of bus stops as well as implementation of bus stop development programs. Following is a brief description of the Section's positions and their responsibilities.

Programs Manager: Responsible for developing and implementing a 5-year Bus Stops Management and Development Plan, which includes negotiating agreements with each major jurisdiction. The Manager is also responsible for coordinating programs and managing the department and program budgets and contracts. The Capital Projects Management Section, including positions matrixed from other departments, report directly to the Programs Manager for bus stops program related activities.

Project Planner: Provides lead support for field checks and sign placement. The planner also conducts development reviews with respect to inclusion of bus stop facilities and coordinates programs with other jurisdictions, developers and other TriMet units. The planner prepares work orders, reviews Customer Service Inquiries (CSIs) and other requests associated with bus stops and shelters.

Project Planner: Works with the Programs Manager to develop and update the 5-year Bus Stops Management and Development Plan. Provides lead support for development and coordination of the Streamline Bus Improvement Program and other agency initiatives.

Project Planner: Works closely with all members of the section. This position conducts field investigations, prepares conceptual designs for bus stop improvements and identifies right-of-way and permit requirements for new or modified stops. The planner also manages the bicycle facility development program including expansion of lockers and racks.

Maintenance Supervisor: Assesses and manages the cleaning and repair needs and contracts and is responsible for quality control for these efforts. This position performs hands-on supervision of field maintenance personnel and conducts field checks for quality, accuracy and timeliness of services provided.

Engineer: Works closely with all members of the section but also reports to the Project Implementation Department within the Capital Projects and Facilities Division. Using TriMet and jurisdiction standards, the Engineer prepares design and construction drawings for all bus stop improvements. The Engineer orders utility checks, works with jurisdictions regarding joint construction or traffic management issues, establishes specifications for procurement contracts of bus stop shelters, signs and other amenities and oversees their installation.

Adopt A Stop Program Coordinator: This person monitors partnership agreements for the servicing of bus stops, shelters and trash receptacles and is a contract employee of SOLV. The coordinator develops, implements and coordinates all aspects of a special outreach program focusing on TriMet's bus routes.

Planner/Analyst: Responsible for building and maintaining TriMet's central bus stops database. This position is a significant resource for the planning, analysis and GIS mapping of bus stops and supporting information. The Planner/Analyst uses a Global Positioning System locator device to accurately locate bus stops within the geographic information system files. This person also prepares status and performance reports to track cleaning, repair, response to complaints and work orders.

Community Relations Specialist: Serve as a central point of contact for all external and internal communications pertaining to bus stop and P&R related inquiries. Working with the Section, this person tracks and responds to all CSI inquiries from the general public. This person also prepares mailings and notices for bus stop changes and sets up and supports community meetings pertaining to bus stop programs.

B. Interdepartmental Involvement

Overall responsibility for bus stops management resides with the Bus Stops Section. However, some issues require review and input from a broad cross-section of TriMet divisions.

- The **Service Planning Department**, in concert with the **Scheduling Department**, determines routes and the type of services to be provided along the routes. These have a direct bearing on the location and design of bus stops.

- The **Field Operations Supervisors** are in the best position to identify bus stop problems and operational concerns that influence bus stop placement. Road Supervisors request bus stop changes based on field observations and as required to accommodate construction projects or events that cause the realignment of service. They also temporarily reroute service when bus stops are affected by construction activities. Road Supervisors also receive customer comments in the course of their surveillance activities. Similarly, **Bus Operators** also pass on issues that they identify or comments from their bus riders.

- **Maintenance Technicians** in the Facilities Management Department repair and maintain stops and shelters. Maintenance technicians also receive customer comments in the course of their activities, which are managed within their group or passed to the Bus Stops Section.

- The **Information Development Department** of the Marketing and Customer Service Division prepares specifications for signage and information displays and determines locations for other customer information. The **Marketing Department** manages the shelter and bench advertising programs. Individual requests and needs for bus stop changes funnel through the **Customer Service Department** and are recorded in a Customer Service Inquiry database, which is accessed by the Bus Stops Management Section for research and response. Employer outreach efforts conducted by the **Marketing Department** provide input for program development.

- Corridor and route-specific projects, which may include bus stop improvements, are managed by the **Capital Projects Section** within the Project Planning Department.

- The **Land Development Section**, within the Project Planning Department, provides assistance with the coordination with public and private development and review of those projects.

- TriMet's **Committee on Accessible Transportation** (CAT) provides a very important consultative role in the management of bus stops. This committee comments on bus stop design guidelines and the development of standard bus stop features (e.g., bus stop shelter design). This perspective helps to assure compliance with the Americans with Disabilities Act and helps set priorities for bus stop development programs.

- In addition to the matrixed engineering support, other services are needed on a case-by-case basis from the **Project Implementation Department**. Project Implementation staff also provide information on construction and contract standards. The **CADD** section ensures drawings are properly prepared and updated.

- The **Public Art Program** also provides input for integrating art into bus stop design and in identifying opportunities for unique art projects associated with bus stops.

- Other groups are linked through the internal coordination plan and include **Safety**, **Training**, and **Real Property**.

C. Bus Stops Section Development Process

The processes for the development of bus stops may be summarized as follows:

Policy development process:

- Set vision and direction
- Establish standards and guidelines
- Establish priorities
- Identify funding needs and sources
- Determine ways to do business, e.g., partnerships

Plan development process:

- Develop Bus Stop Management Plan
  - 5-year plan (vision and needs with first year detail)
  - Include capital budget plus maintenance/operating costs
  - Include IGAs for each jurisdiction
- Perform outreach check
  - Interactive with plan development
- Solicit review - gain approvals
  - Key five inter-organizational linkages
  - Finance
  - Leadership Group
  - Board of Directors

Implementation plan process:

- Develop scope, schedule, budget for each program including outreach
- Identify resources (both funding and people)
- Determine needed contracts
- Identify and schedule needed permits
  - IGA requirements
  - Rights of way
  - Private property siting agreements/easements
- Permits centralized within the Bus Stop Section
- Coordinate and manage implementation
- Evaluate programs and processes

Construction:

- Develop field drawings for candidate sites, include digital pictures
- Prepare CADD drawings
- Consult with private property owners as required
- Determine and procure necessary permits
- Select contractor (on-call or bid)
- Inform Information Development (IDP), Facilities Management, and Marketing (advertising) of proposed changes
- Construction of site begins
  - Inspection and digital documentation is performed by the Bus Stops Engineer I
  - Notify Road Operations of completion
- Prepare and submit data updates

D. Operations and Maintenance

Road Operations and maintenance technicians provide daily information regarding bus stop and shelter conditions. Customers regularly request new bus stops and comment on bus stop conditions or issues. This information will funnel through the Customer Service group. Business and property owners identify specific issues with regard to bus stops and shelters located on or near their property. The bus stop maintenance process may be described as follows:

- Define maintenance standards per program plan
- Develop 5-year plan
    - Priorities
    - Timelines
    - Preventative/responsive budgets
    - Contract needs and other resources
- Implementation plan
    - Contract management
    - Quality control
    - Data
    - Tracking
- Evaluation
    - Inputs
        - Customer Service Inquiry (CSI) complaints [external feedback]
        - Emergency call outs
        - Standards being met
        - Internal feedback

Work order process:

- The Bus Stops Development Coordinator creates work orders based on a variety of sources/inputs:
    - Operations – Field Reports
    - Customer Service – CSIs
    - Maintenance – Field Reports
    - Other – Project Planning, other internal requests, etc.
- The work order goes directly to a single database system
    - Check the Location ID
    - Provide Road Operations notice of pending action(s)
    - Bundle work orders where possible – assign to maintenance staff or contractor
- Track work orders via the database/work order program
- Review and comments from Road Operations
- Quality control/inspection performed by Bus Stops Section
- The master data files are updated when the work order is closed

VIII. Program Support (Funding)

Approach
Identify innovative ways to finance and maintain bus stop program initiatives that help offset program costs.

Tools
Advertising—Advertising remains an effective and popular tool for offsetting various program costs. TriMet's most visible and successful advertising ventures may be the bus and MAX vehicle advertising programs; however, TriMet has also established or is pursuing advertising programs at bus stops and bus facilities:

- Ad shelters: An advertising component can be attached to a standard B shelter. This component allows for the placement of two 4' x 7' advertisements. Revenues accrue on a monthly basis and are directly dependent on the number of ads placed within the system.
- Ad benches: A basic transit bench with an advertising component attached to the back. Benches can be placed where a bus stop is located and where sufficient room exits. Revenues are dependent on the number of benches placed in the service area and are generated on a monthly basis.
- Other ad kiosks: There are additional advertising opportunities at bus stops and bus shelters. Advertising kiosks can be placed on telephones, sidewalks and on bus stop poles.

Partnerships—The use of non-profit or public agencies to assist in daily bus stop maintenance and graffiti removal can be an effective and cost saving tool. Current TriMet programs are:

- Anti-litter and graffiti programs: Please see Section IV, Part A Citizen Involvement and Section VI, Part H Anti-Litter and Graffiti Programs for more information.
- Public volunteers: TriMet works with local volunteers to identify safety hazards, potential improvements and maintenance deficiencies. Utilizing volunteers enables TriMet to improve the transit system with little or no cost incurred.
- Leveraging: The use of leveraging enables TriMet to add amenities in the system while reducing the long-term cost of project implementation. As an example, before transit improvements are made, TriMet searches for commitments from the community or local businesses to provide basic shelter maintenance and cleaning. If a commitment is made, TriMet can expedite the placement of these amenities.
- Jurisdictional/local programs: Grant opportunities targeting on-street or transit opportunities are available to jurisdictions. Transportation System Management grants, for example, can be used for bus stop and roadway improvements. TriMet can partner with jurisdictions to locate potential sites and provide design support for bus stop improvements.

Federal, State and local funding sources—Additional monies can be obtained through seeking out various Federal, State and local funding opportunities.

Cost efficiencies—TriMet actively looks for opportunities to save costs on the production, placement and installation of bus stops and amenities. Some useful opportunities are:

- Standardization: Providing consistencies in materials and supplies allows for bulk rate cost savings.
- Less expensive materials: Substantial cost savings can be realized by discovering less expensive materials that have similar aesthetics and durability (e.g., shelter glass).
- Development review: Please see Section IV, Part B Development Review.
- Joint development/pedestrian to transit programs: TriMet works in conjunction with local cities and jurisdictions on joint development projects. As a cost saving opportunity, TriMet and the jurisdiction assign various work responsibilities to the agency who can perform the task at a less expensive rate. For example, on several joint development projects with the City of Portland, TriMet has utilized the Bureau of Maintenance (BOM) to perform any

necessary construction work as TriMet performs other in-kind services. The BOM can perform infrastructure improvements at a much lower cost than TriMet can contract out for.

What to do

Each funding source and cost efficiency has a differing effectiveness based on individual circumstances. Therefore, each opportunity should be evaluated independently. Analysis could include:

- potential revenue gain versus capital investment
- feasibility of project implementation
- benefit to transit system

Things to consider

Every cost offsetting opportunity presents a unique list of issues. The following is a checklist of the most important considerations:

Advertising

- ❑ Placement limitations
- ❑ Capital investment (ad components, electrification) versus potential revenues gained
- ❑ Pedestrian safety
- ❑ ADA accessibility
- ❑ Aesthetic impact on environment
- ❑ Market feasibility
- ❑ Ad types

Partnerships

- ❑ Tradeoff costs
  - ▪ Contract monitoring commitments
  - ▪ Program requirements, commitments

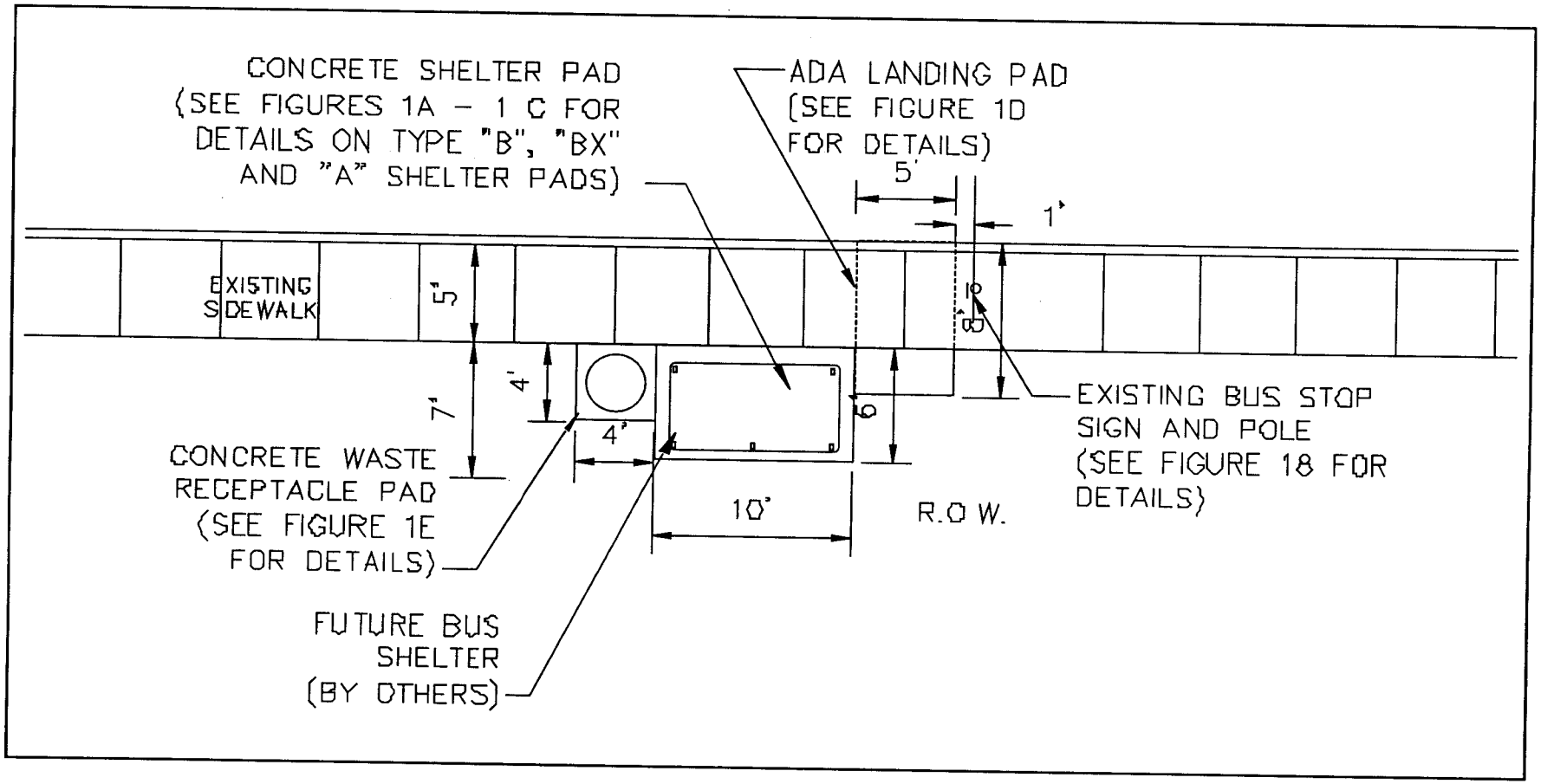
Federal, State and local funding sources

- ❑ Local match requirements
- ❑ Project implementation and feasibility

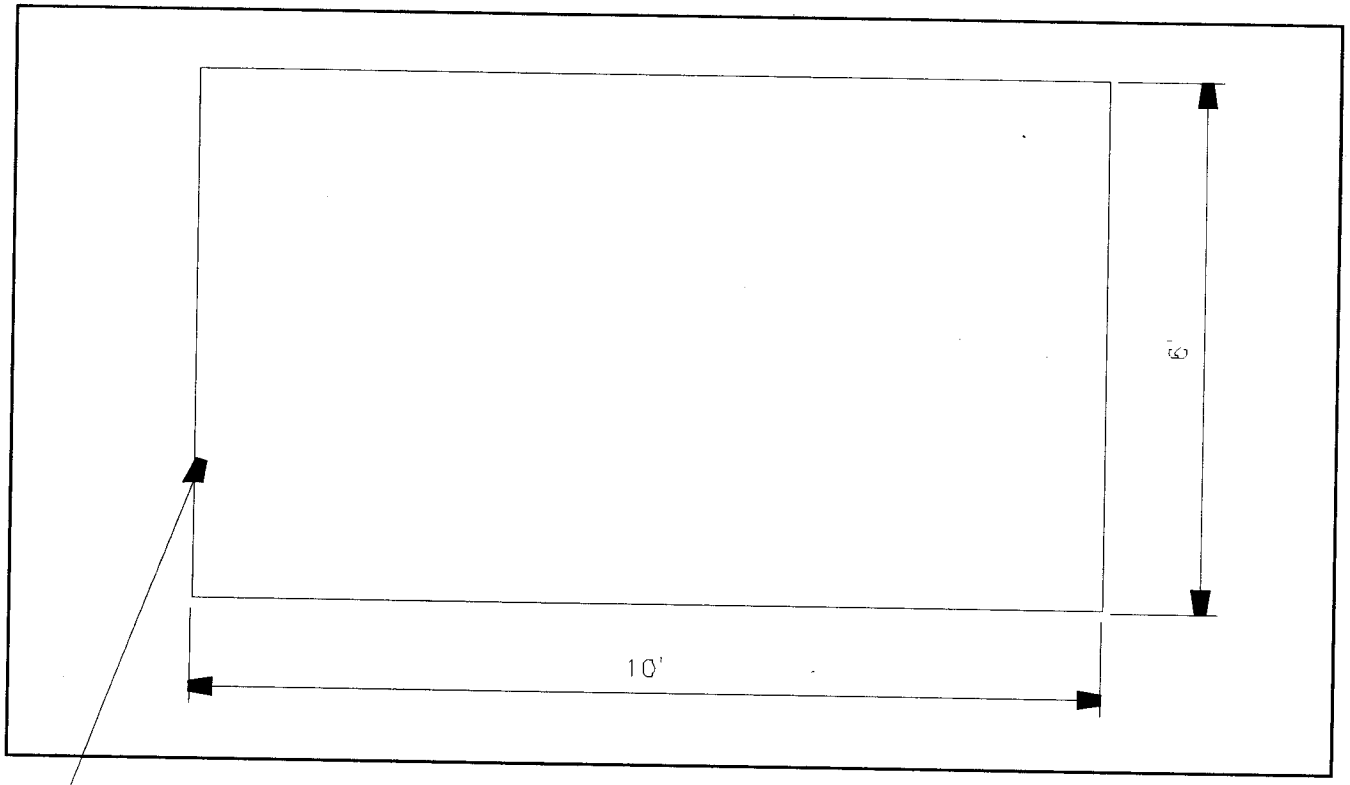
Cost efficiencies

- ❑ Public safety
- ❑ Increase in reliability
- ❑ Tradeoff costs

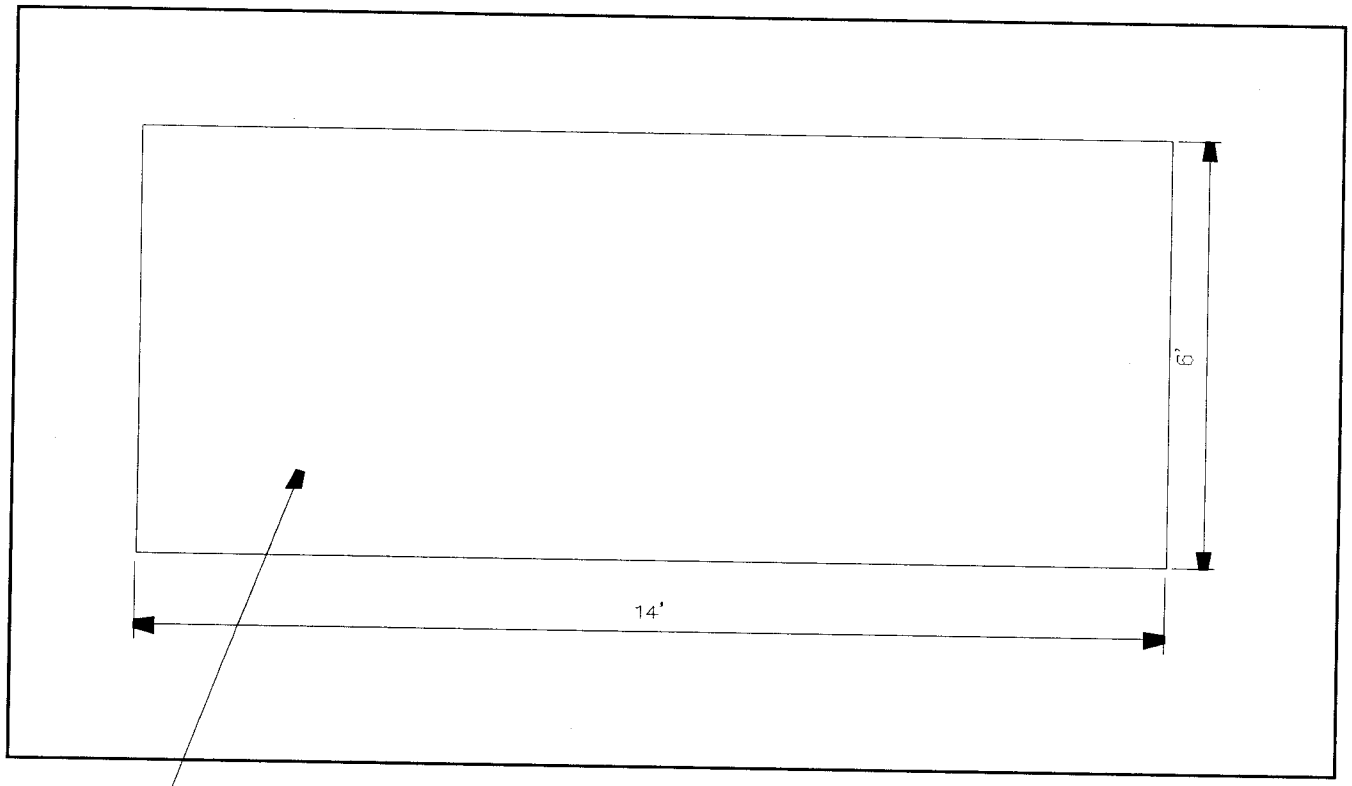
Attachment A
Table of Contents



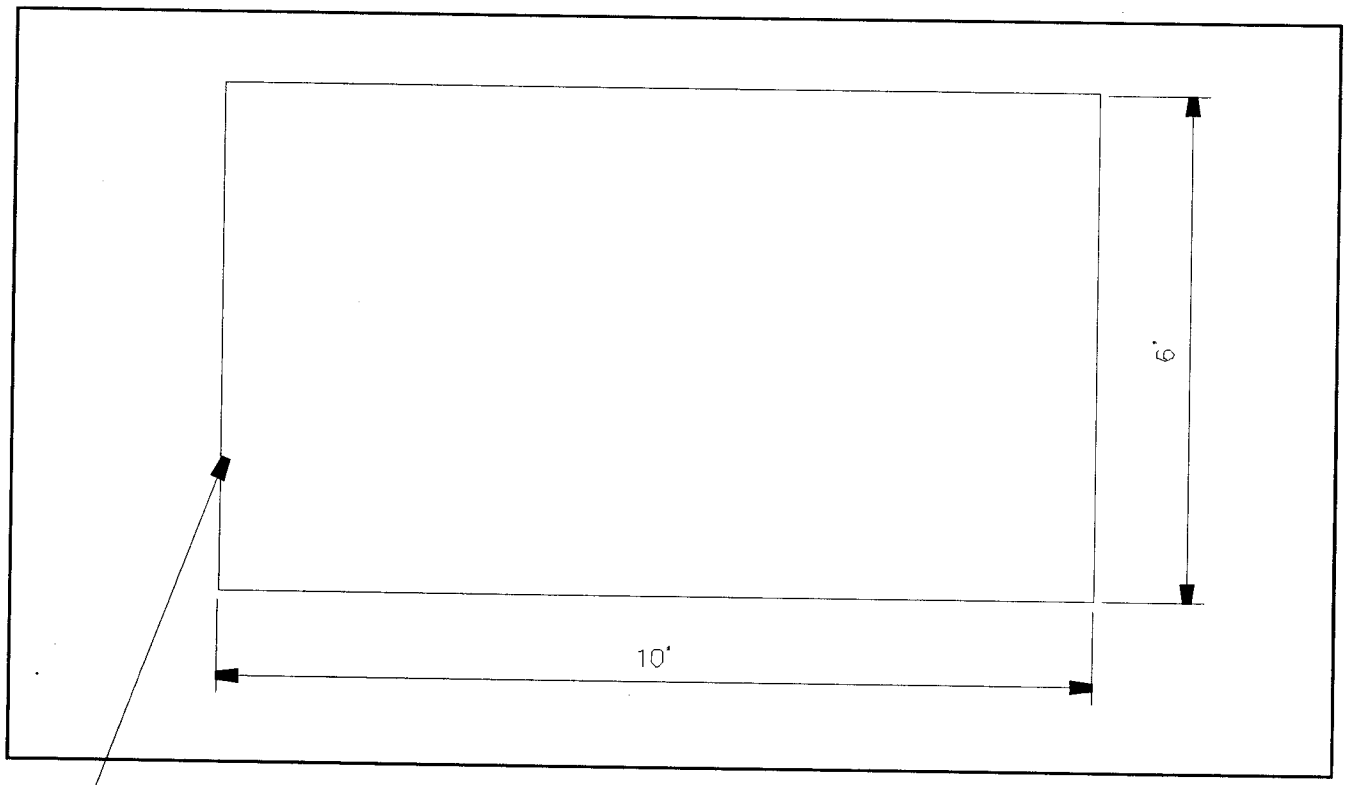
Shelter Pad/ADA Pad
Figure 1



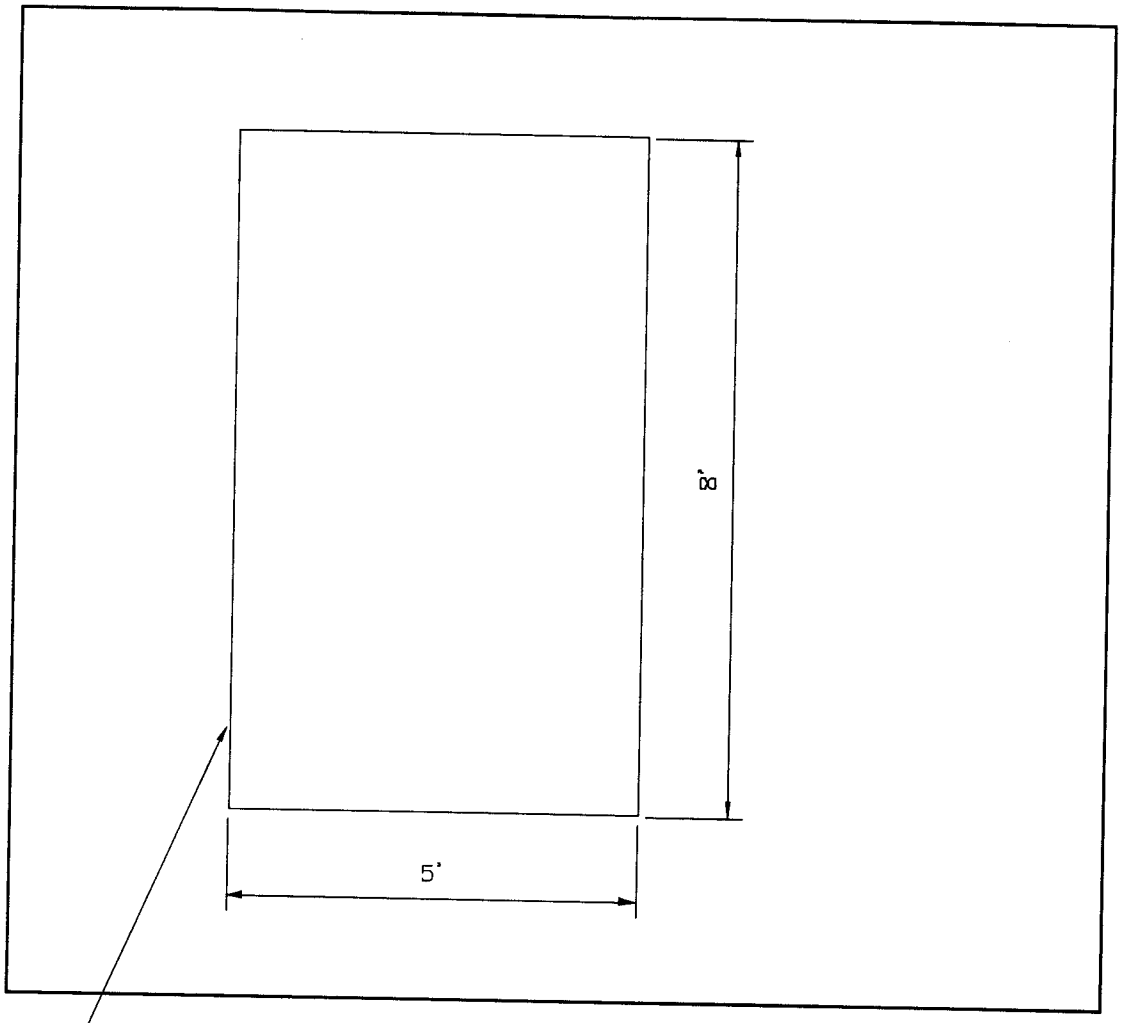
Type "B" Shelter Pad
Figure 2



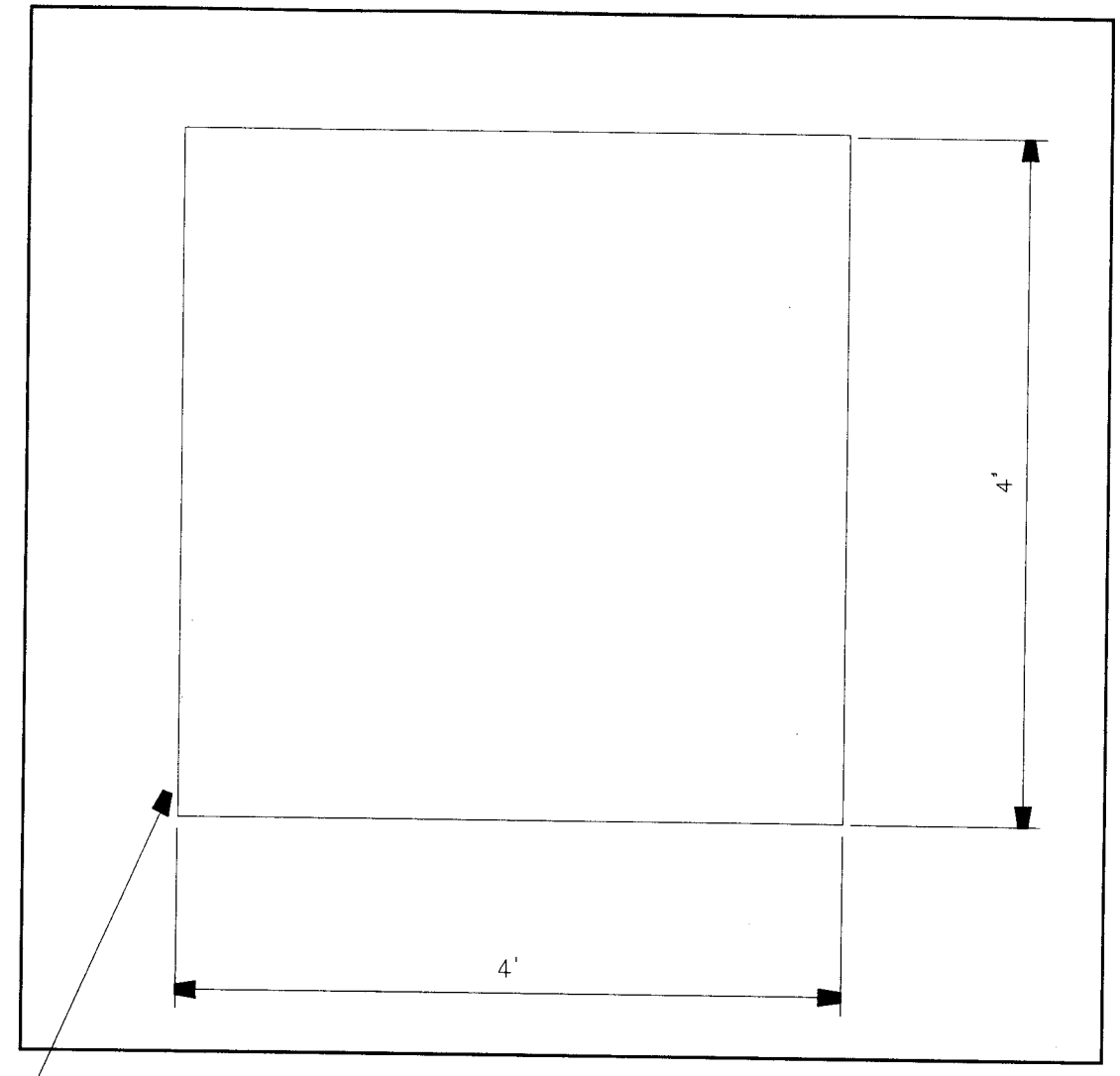
Type "BX" Shelter Pad
Figure 3



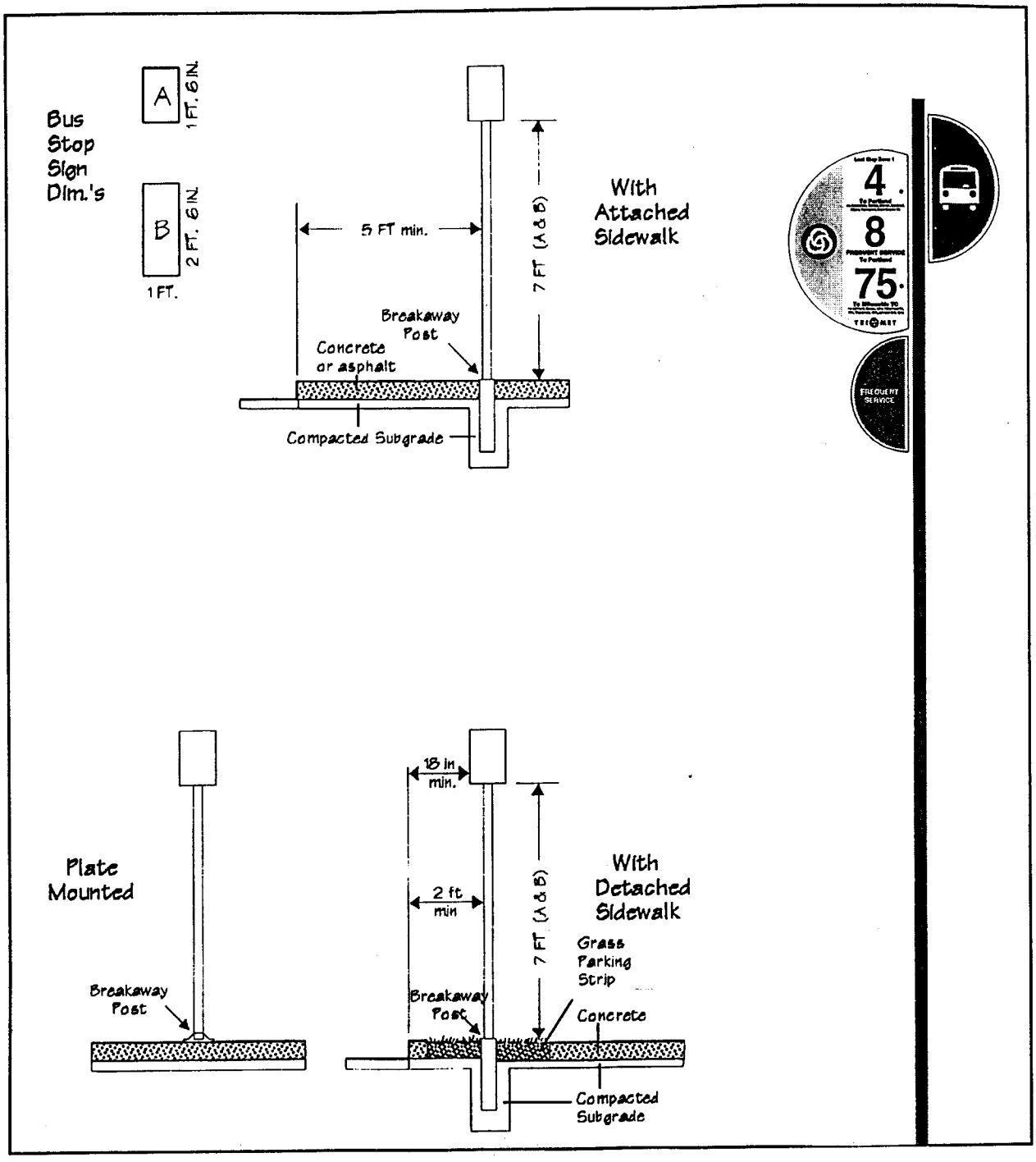
Type "A" Shelter Pad
Figure 4



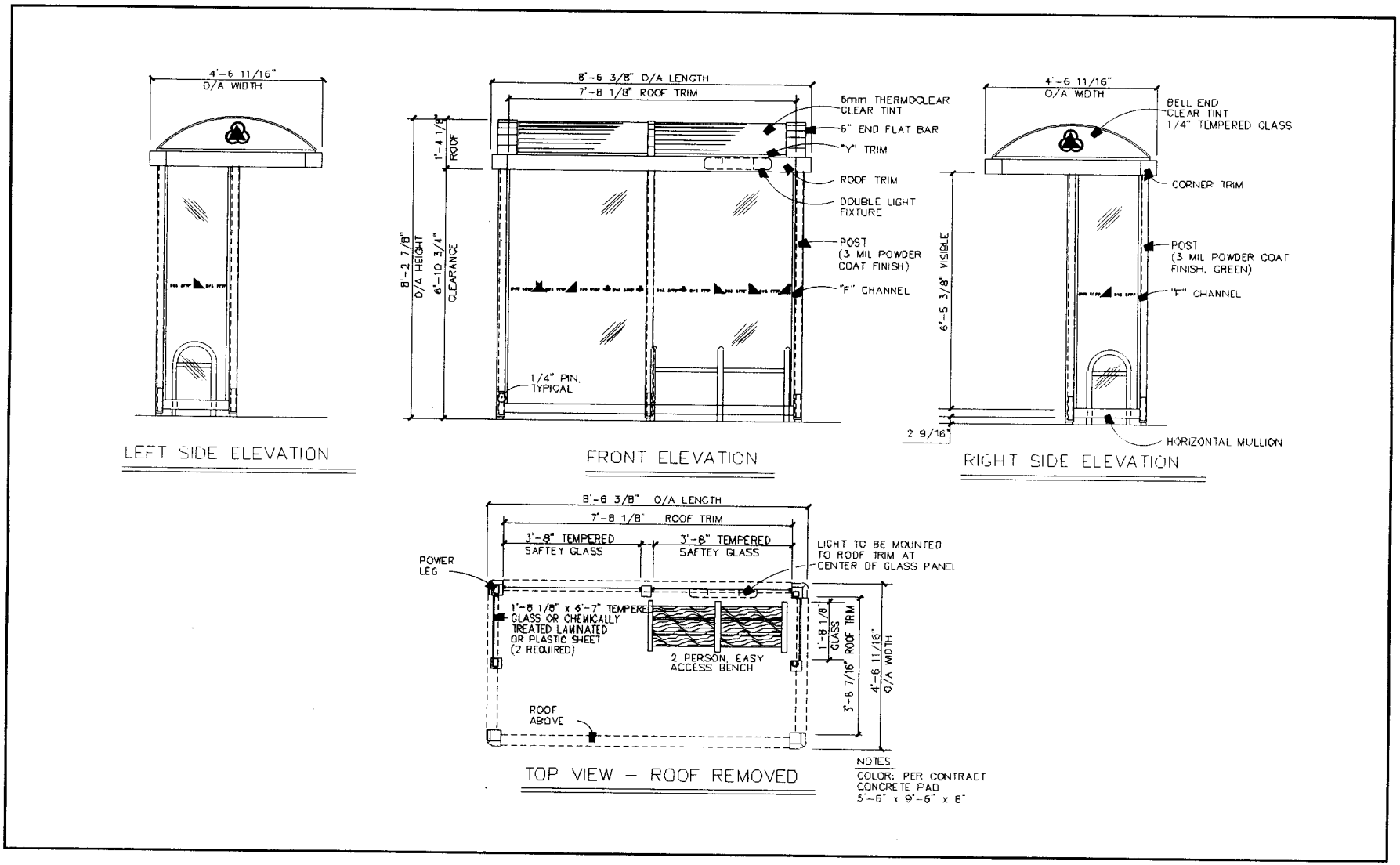
ADA Landing Pad
Figure 5



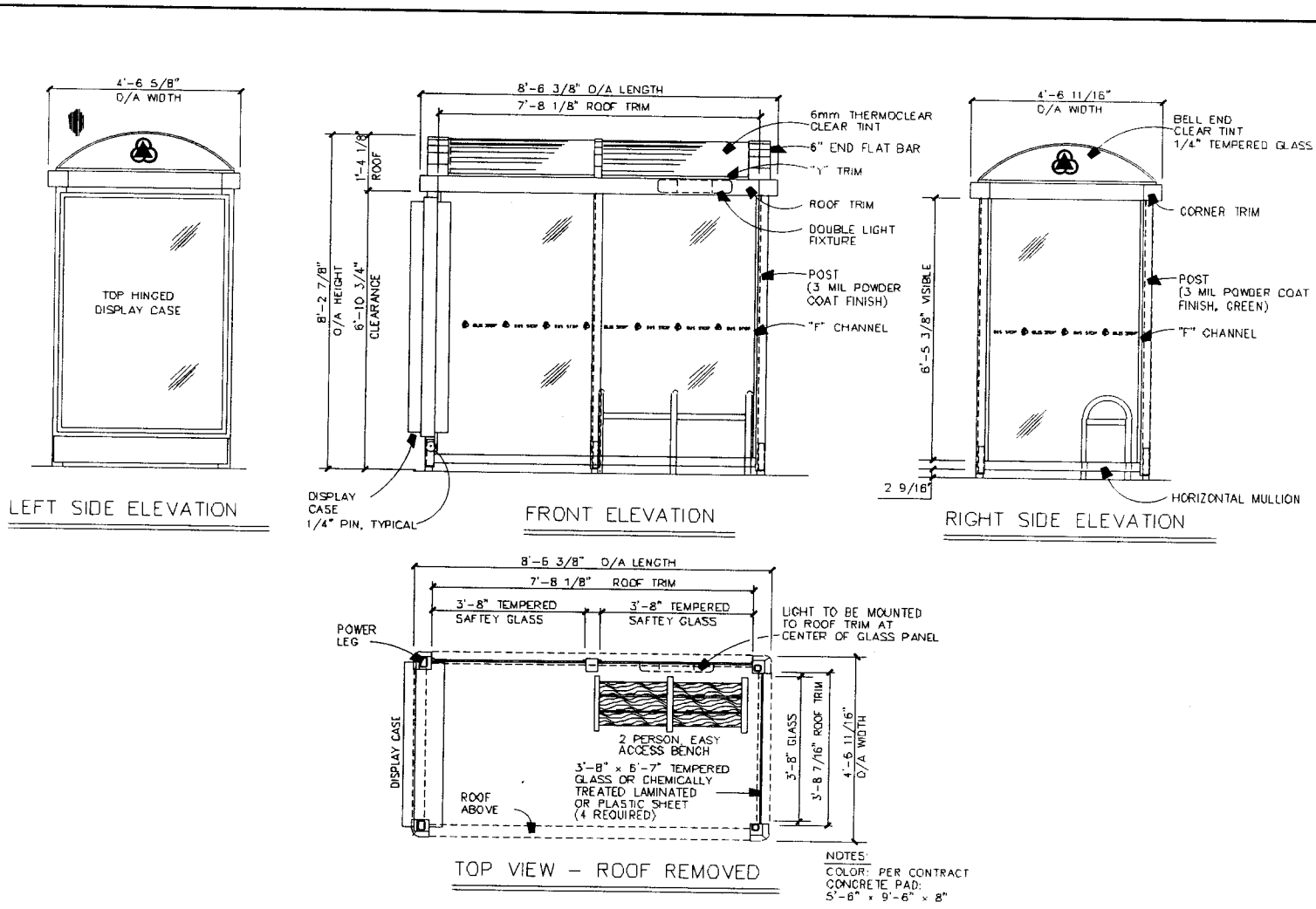
Waste Receptacle Pad
Figure 6



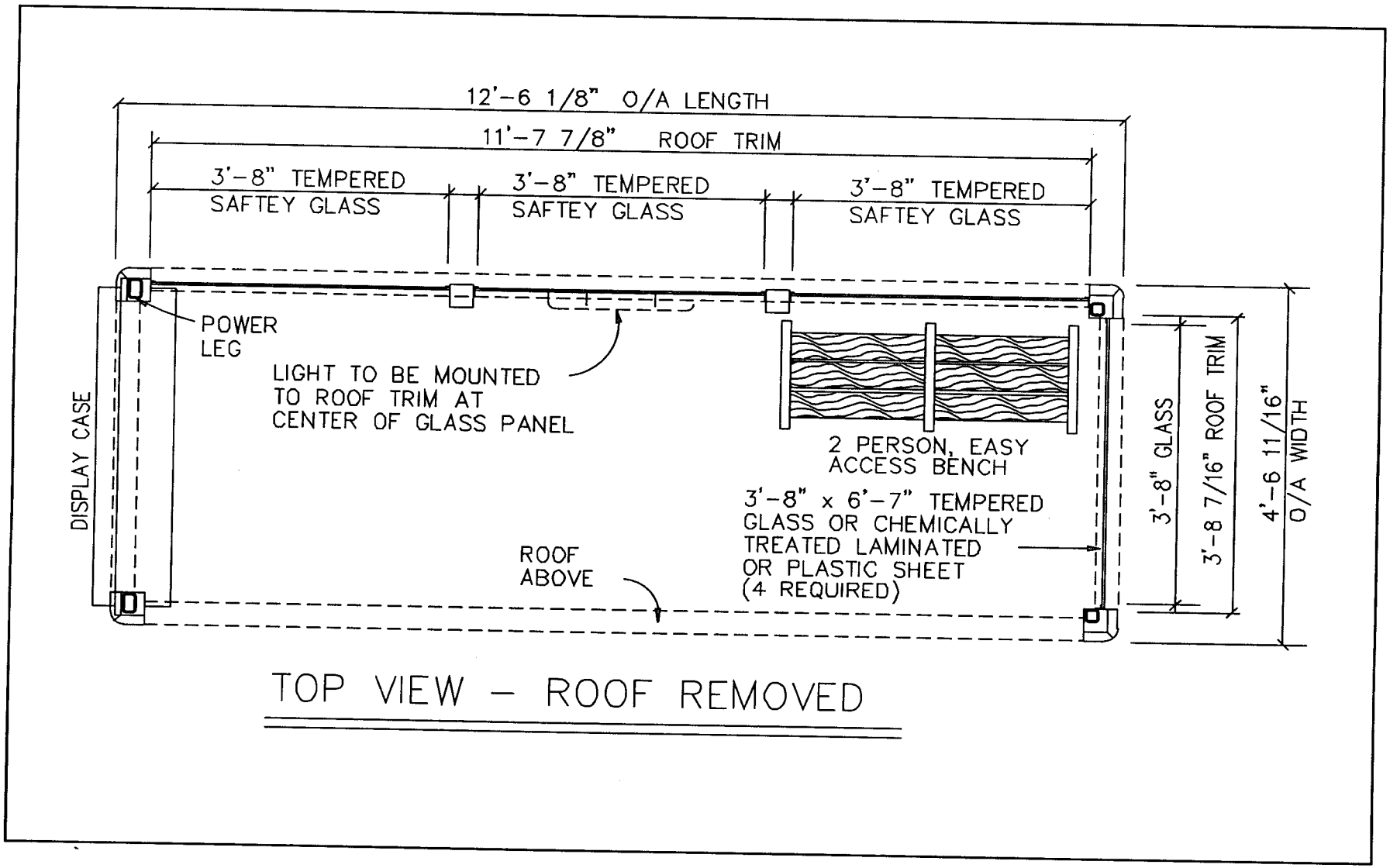
Bus Stop Sign Placement
Figure 7



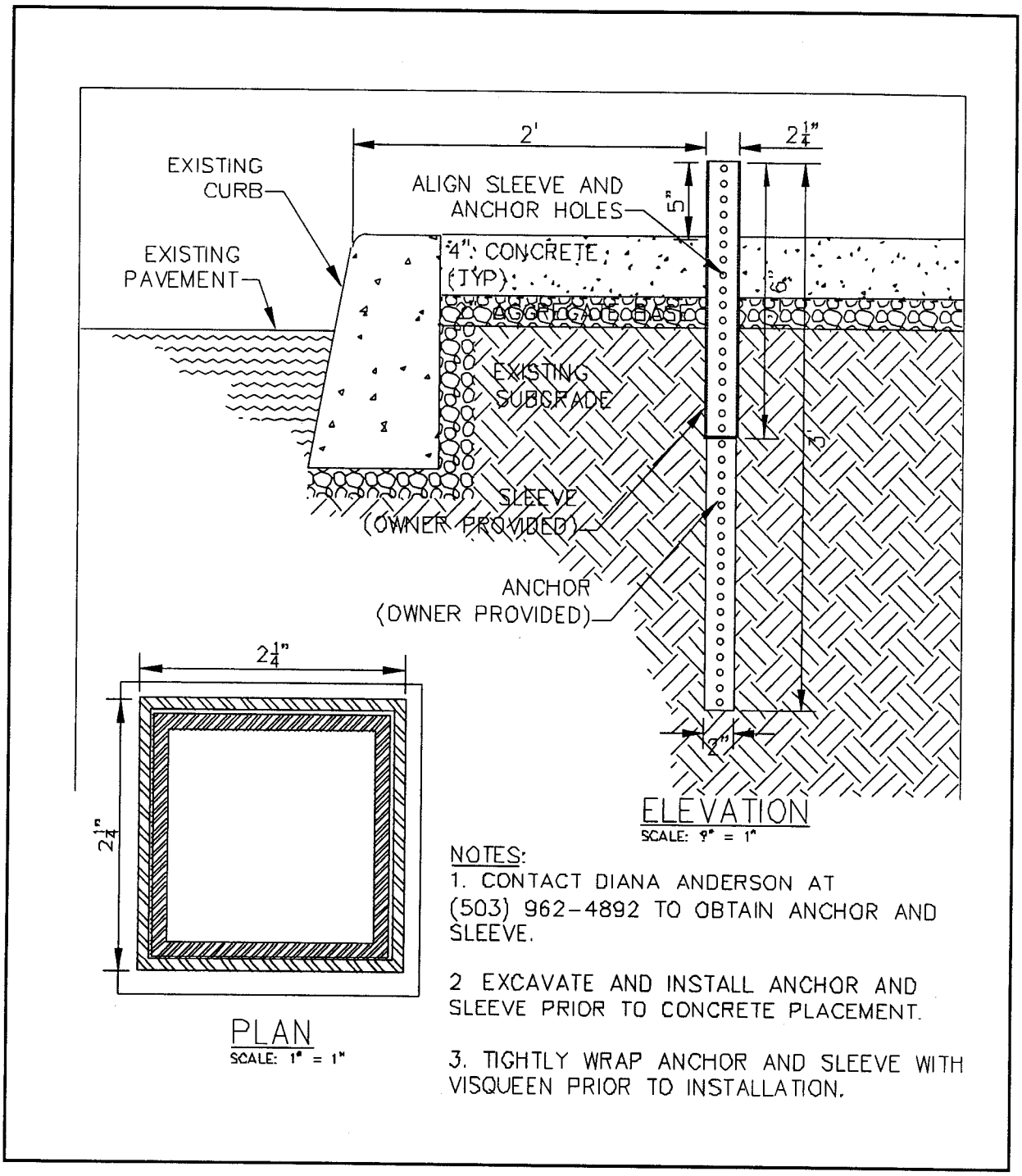
Type A Shelter Without Display
Figure 8



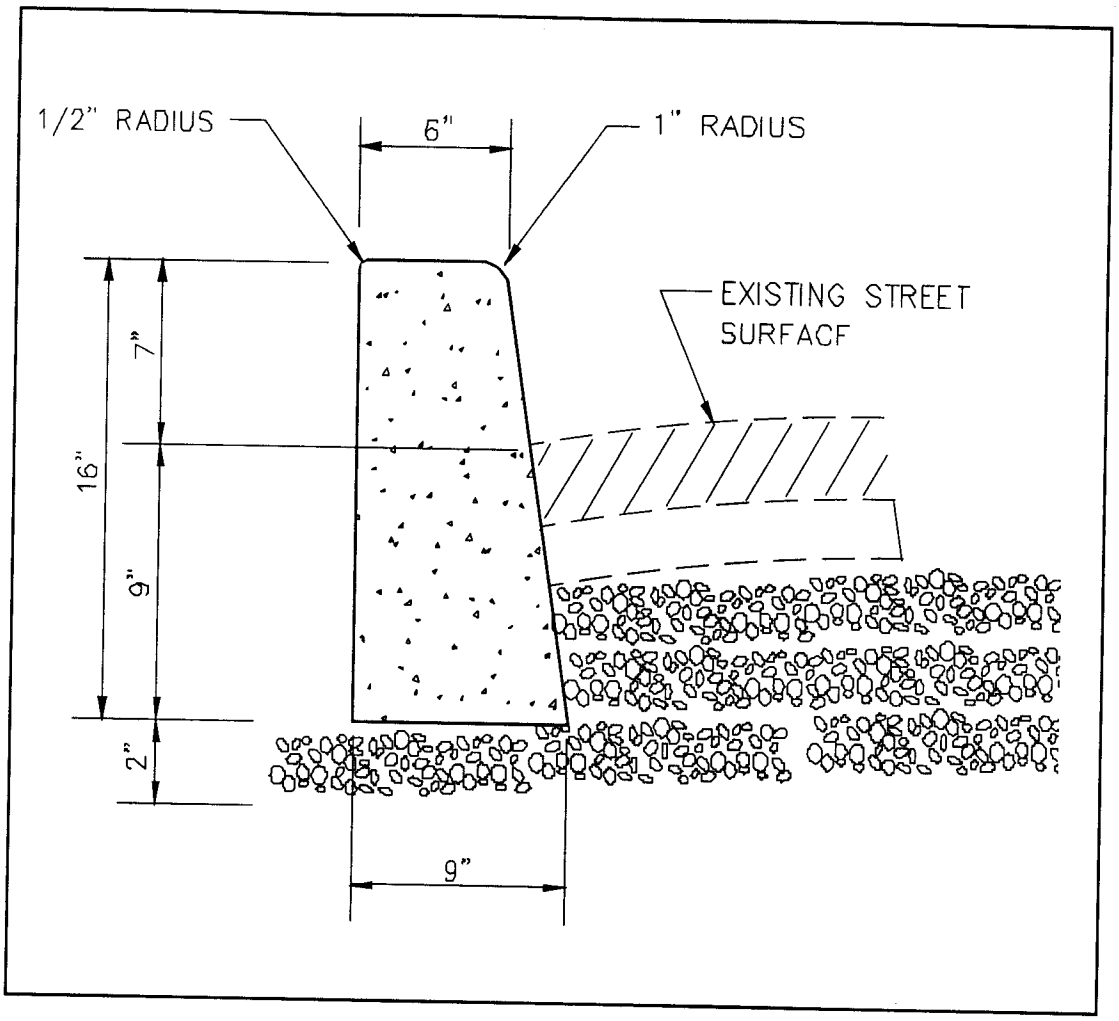
Type "B" Shelter With Display
Figure 9



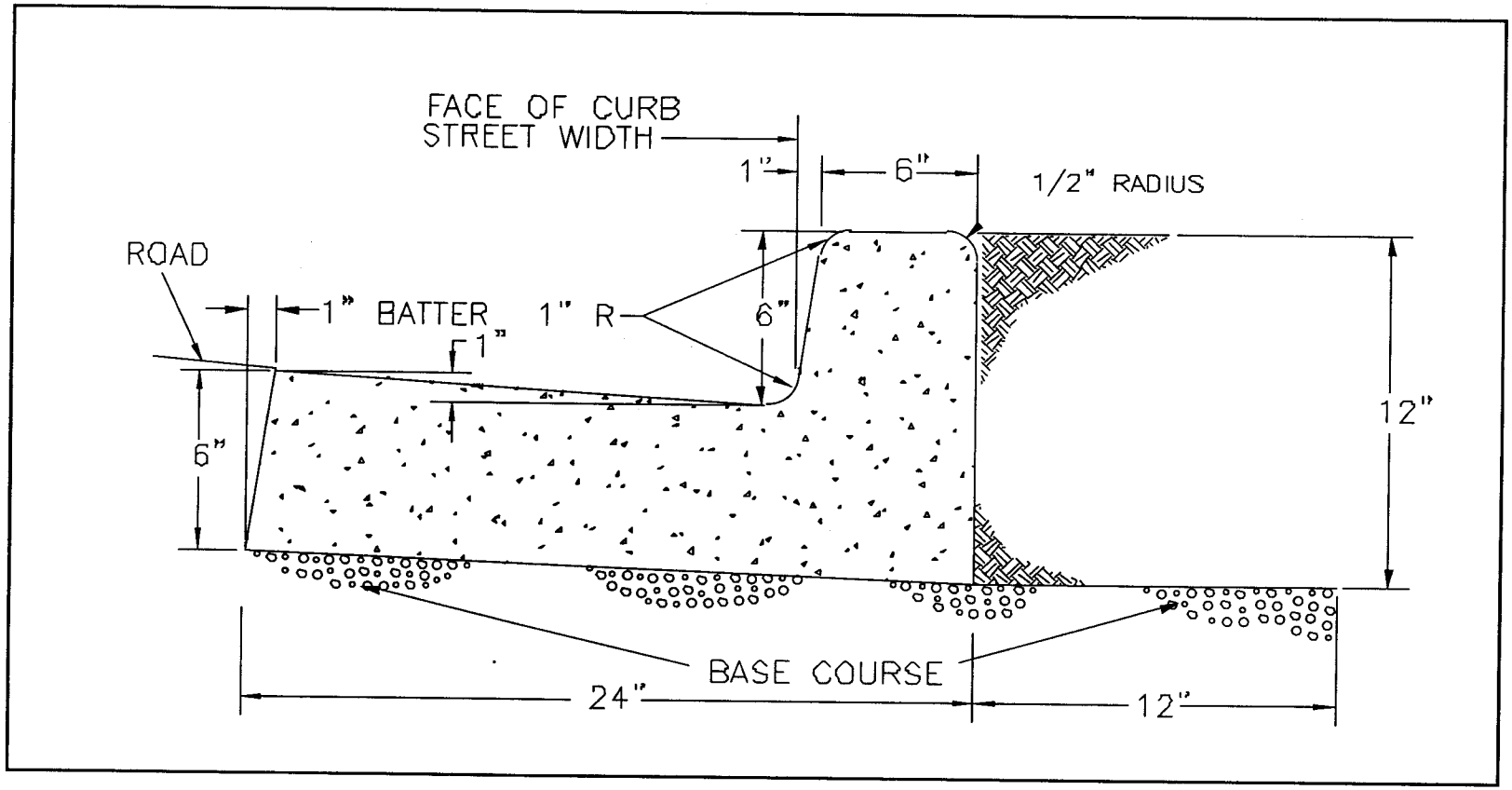
TType "BX" Shelter Without Display
Figure 10



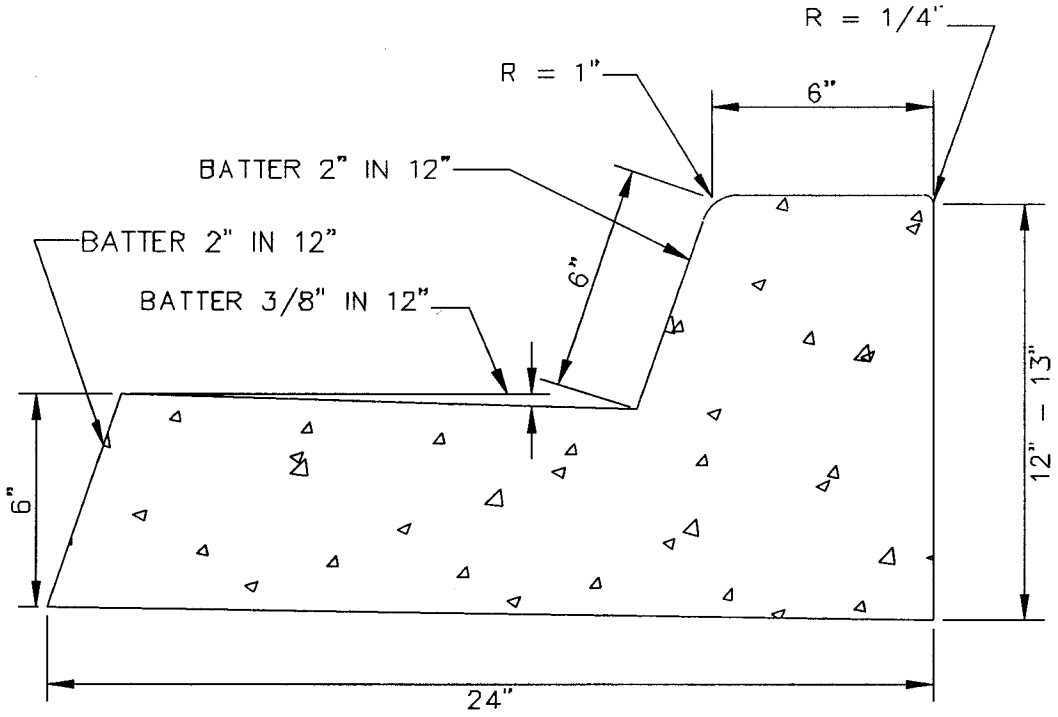
Pole Anchor & Sleeve
Figure 11



6" Curb
Figure 12



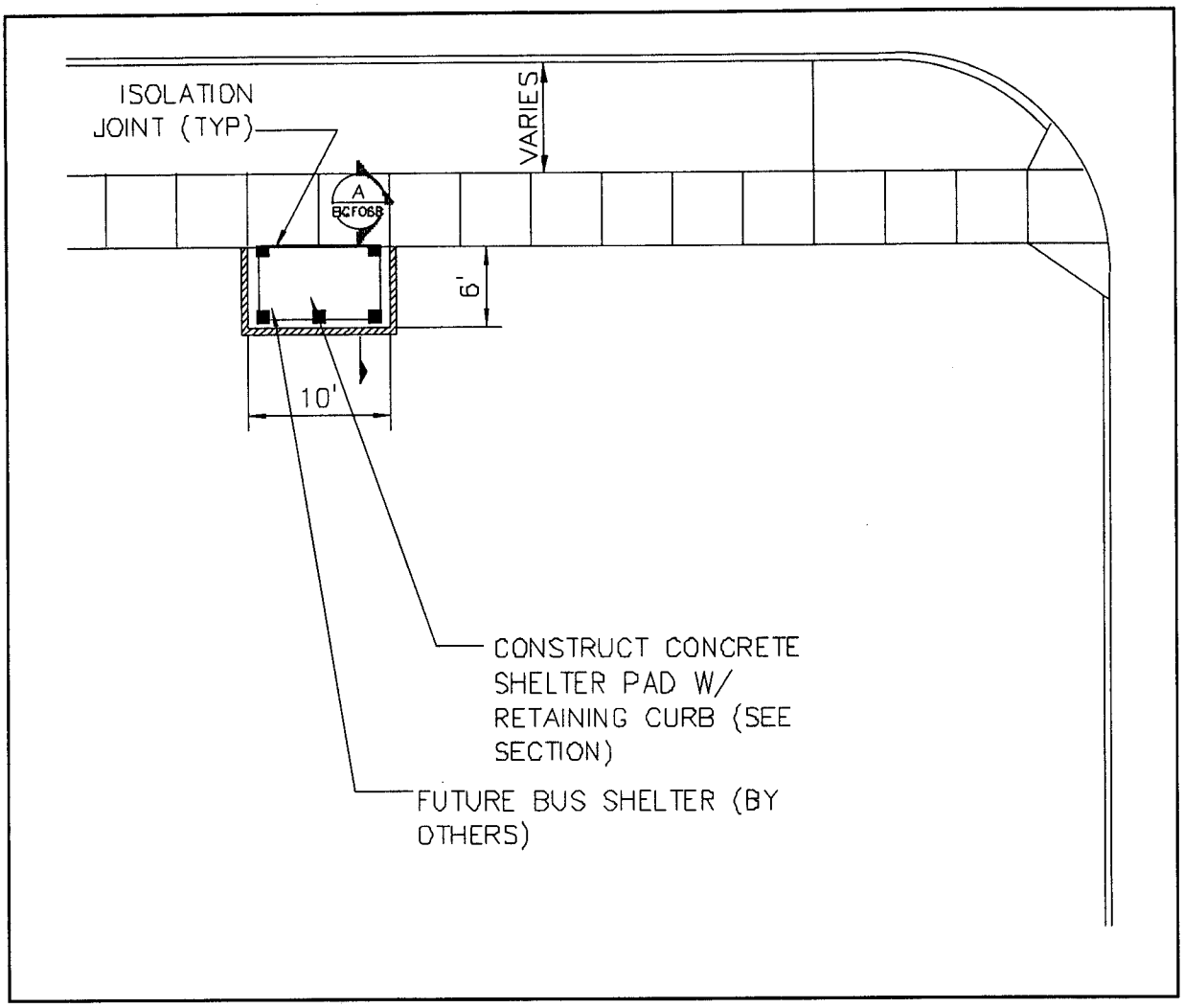
24" Curb & Gutter
Figure 13



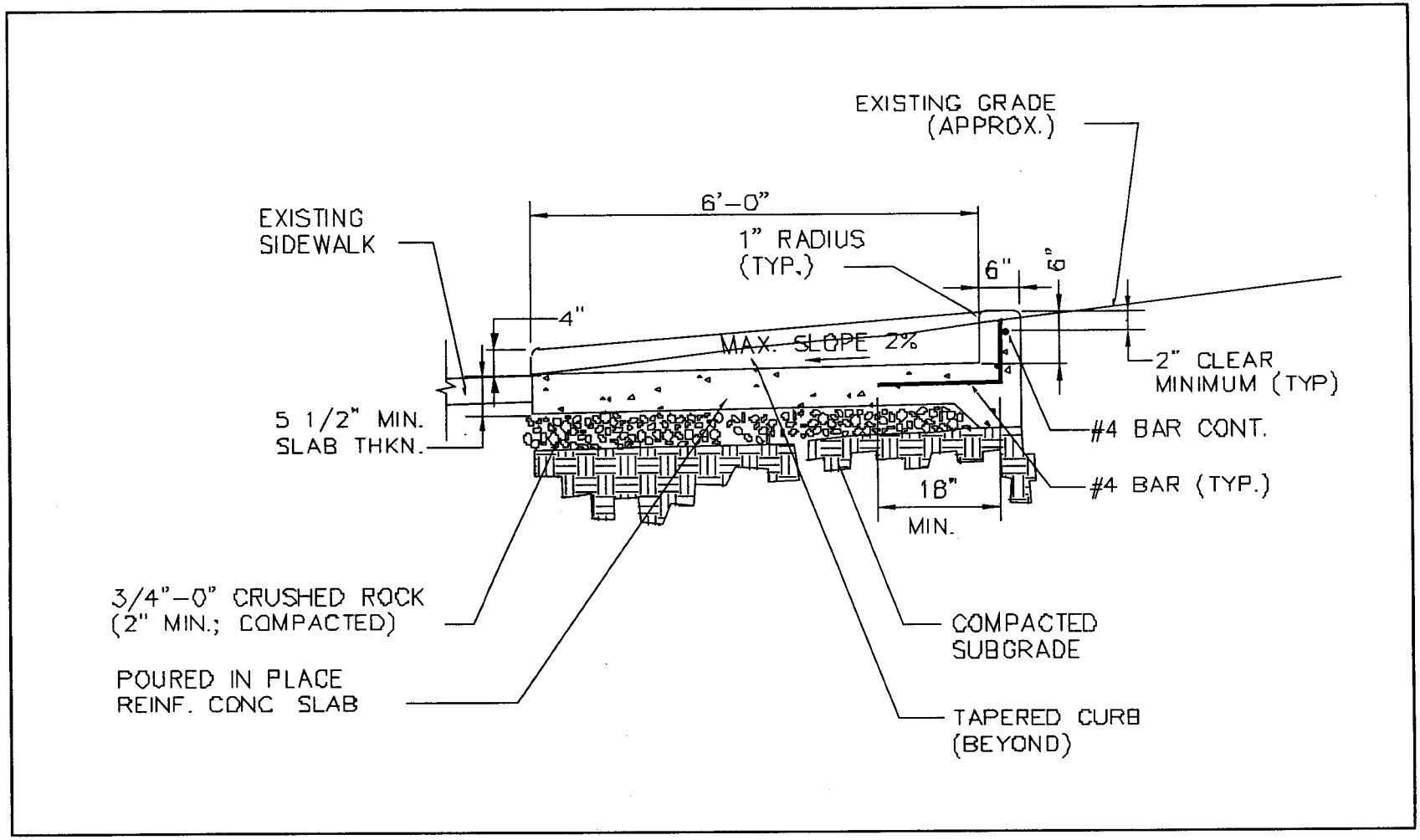
NOTES:

1. CURB TO BE CONSTRUCTED OF 3000 PSI (6.1 SACK) 2" – 4" SLUMP CONCRETE.
2. FOR COMMERCIAL/INDUSTRIAL AREAS USE 7" CURB EXPOSURE AND 13" TOTAL CURB HEIGHT.
3. TRANSVERSE CONTRACTION JOINTS TO BE CONSTRUCTED AT INTERVALS NOT TO EXCEED 12'.

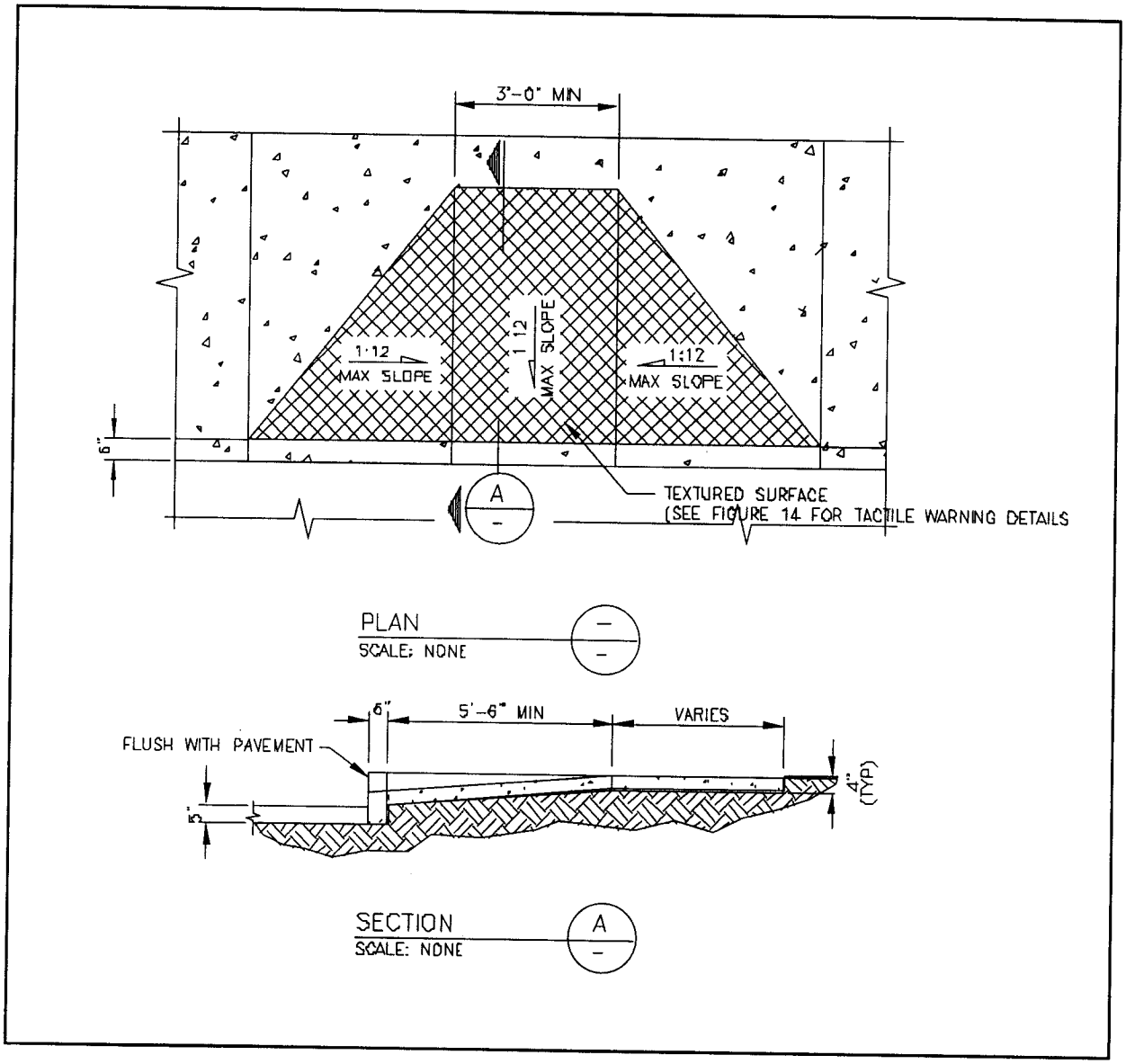
24" Combination Curb & Gutter
Figure 14



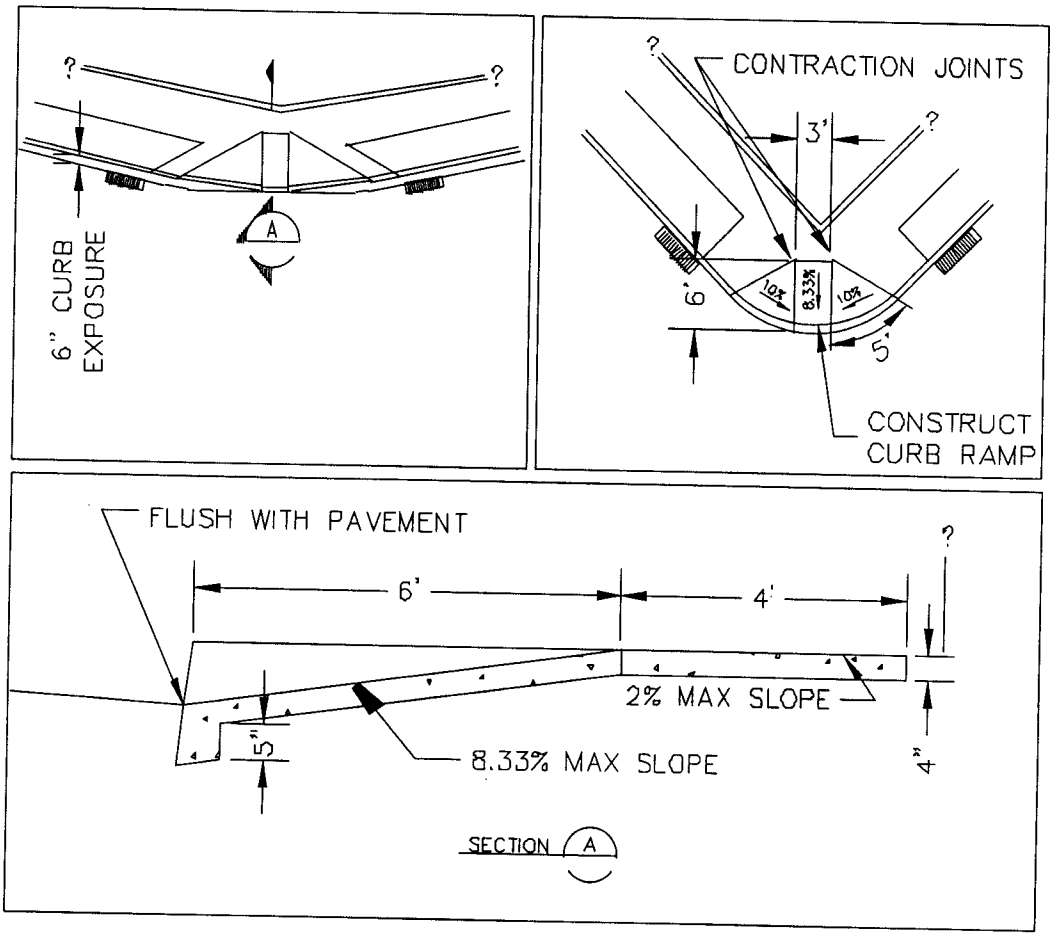
Retaining Curb
Figure 15



Retaining Curb
Figure 16



Curb Ramp
Figure 17



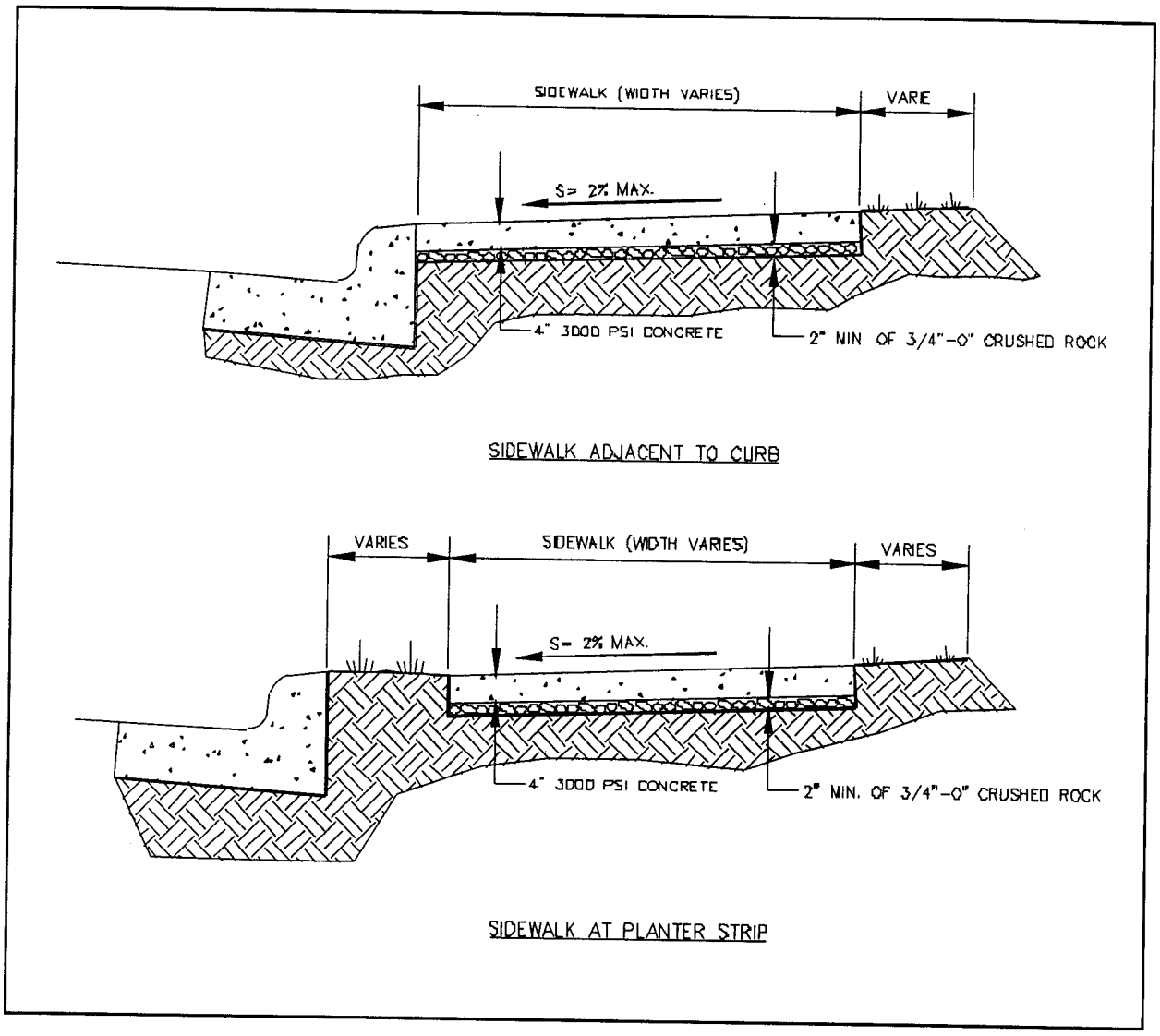
1. PROVIDE BROOM TEXTURE AND DIAMOND TEXTURE ON RAMP AS REQUIRED BY LOCAL JURISDICTION.

2. USE 3000 PSI CONCRETE WITH 2" TO 4" SLUMP.

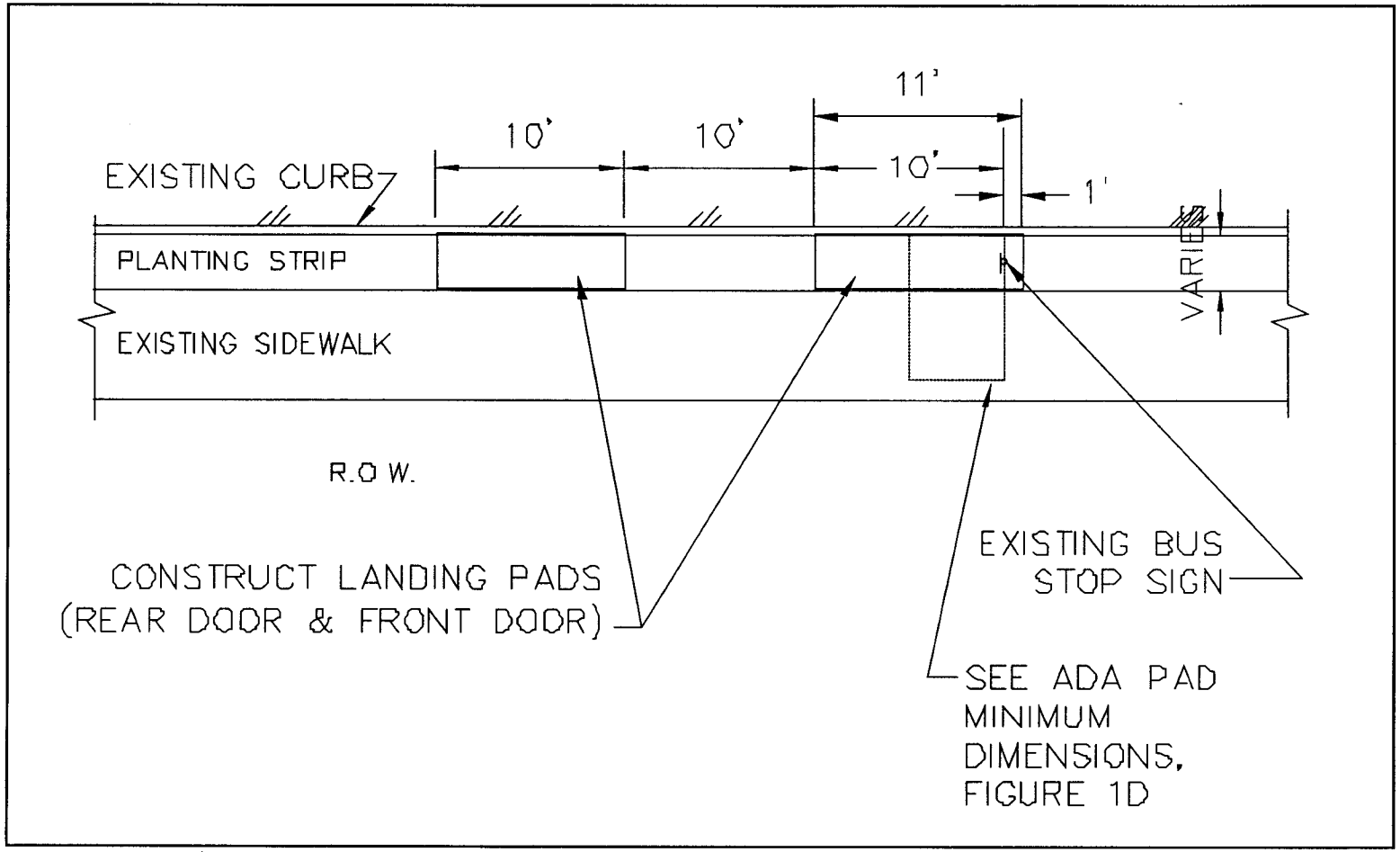
3. SAWCUT A MINIMUM OF 2' FROM CURBFACE AND REPLACE PAVEMENT SECTION WITH CLASS 'B' AC IN 2" LIFTS TO MATCH EXISTING.

4. PLACE CONTRACTION JOINTS AS SHOWN ABOVE

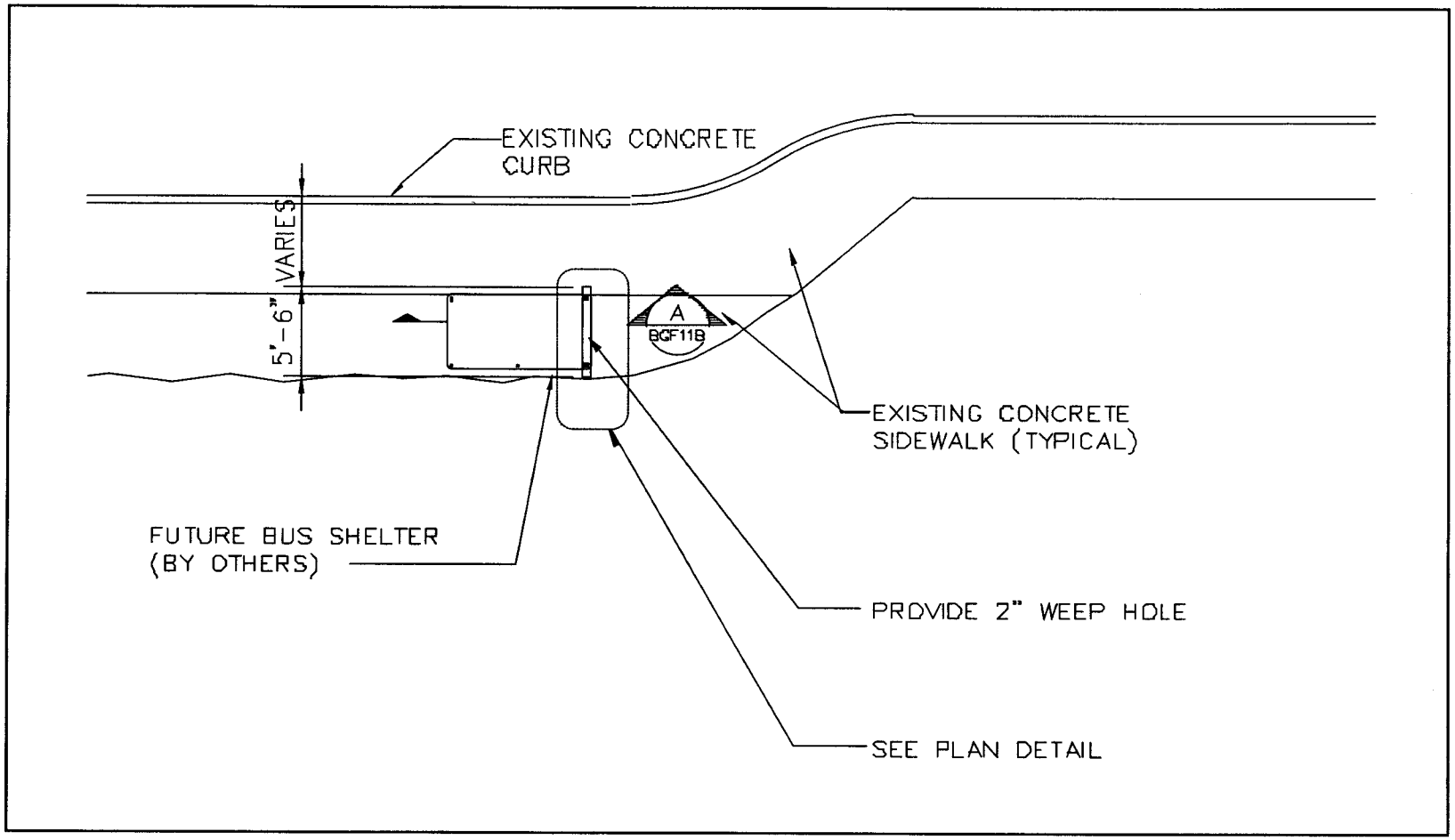
Diagonal Curb Ramp
Figure 18



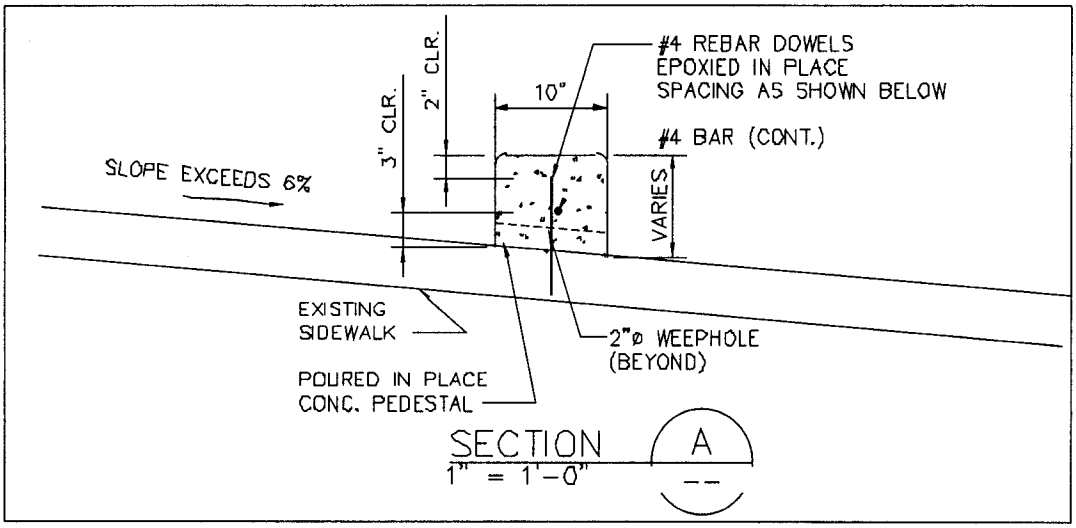
4" Sidewalk
Figure 19

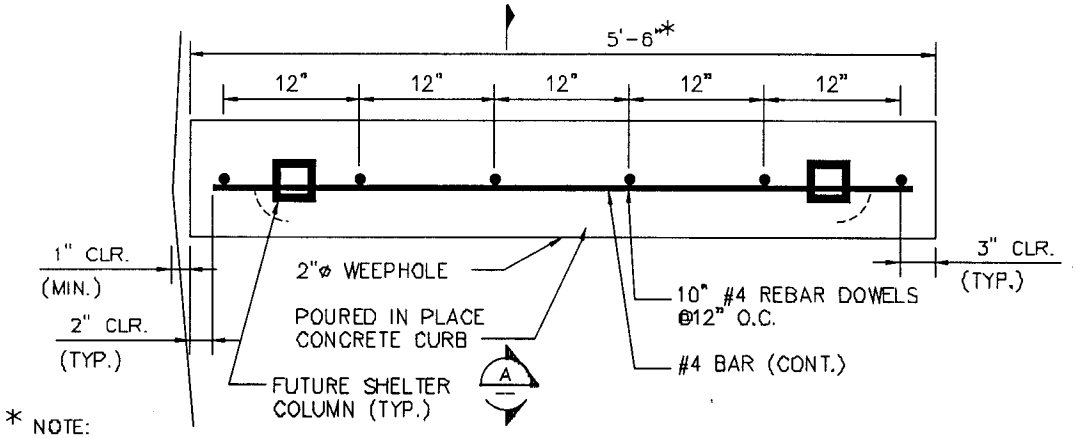


Front & Rear Door Landing Pads
Figure 20



Leveling Pedestal
Figure 21

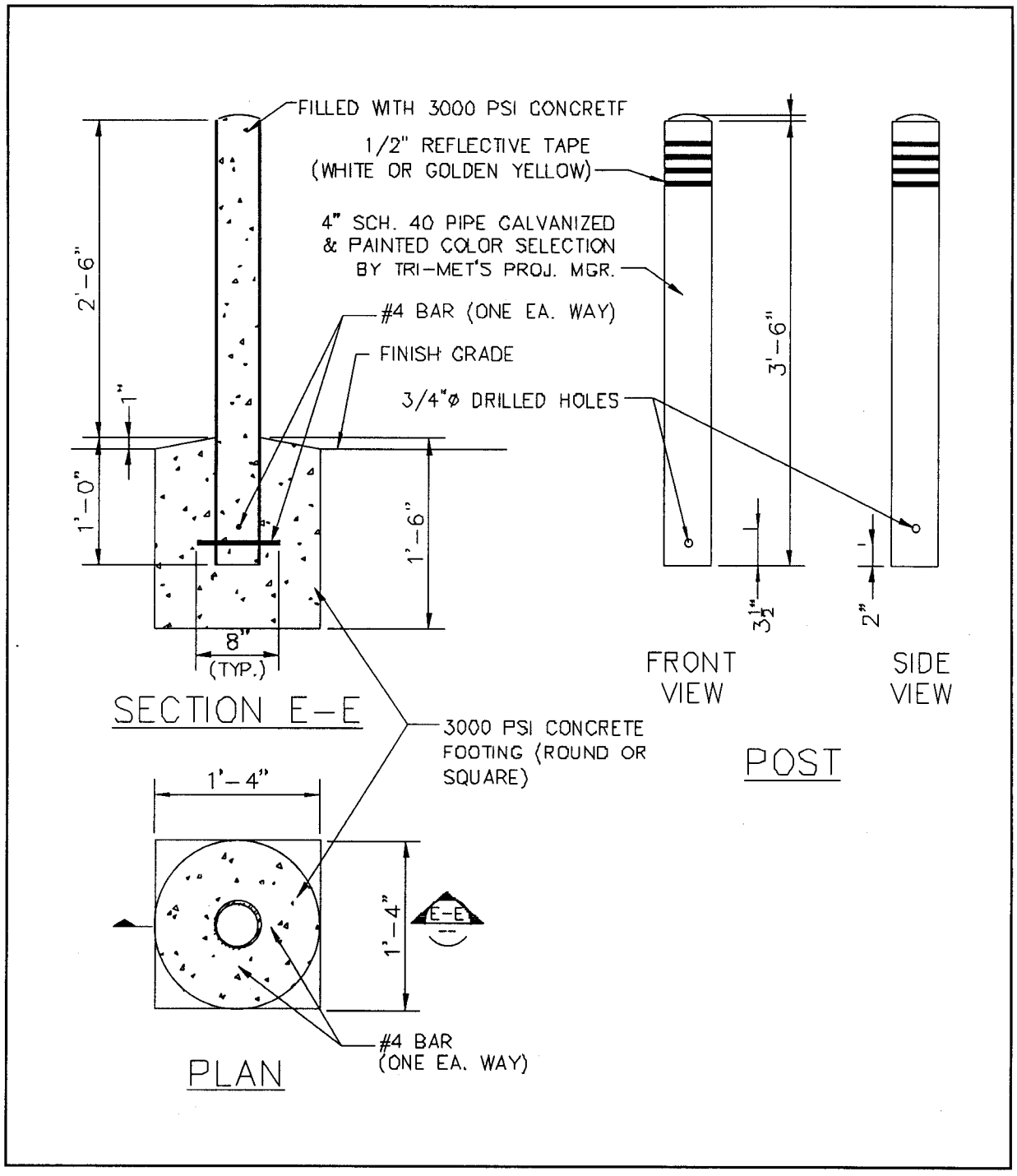




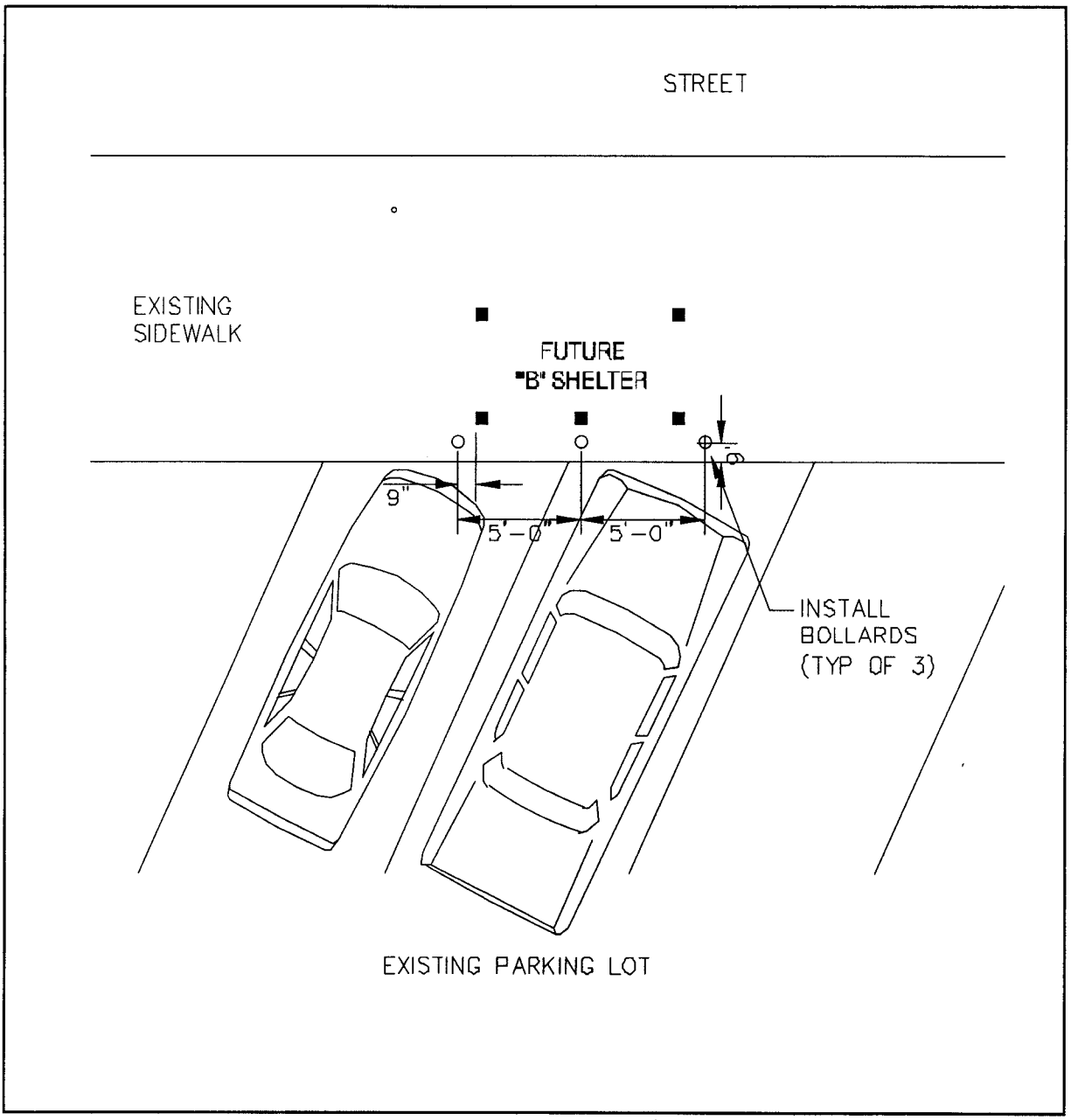
* NOTE:
LENGTH OF PEDESTAL SHOWN IS
FOR TYPE B & BX SHELTERS.
PEDESTAL LENGTH FOR TYPE A IS 3'-3"

PLAN DETAIL
SCALE: 1" = 1'-0"

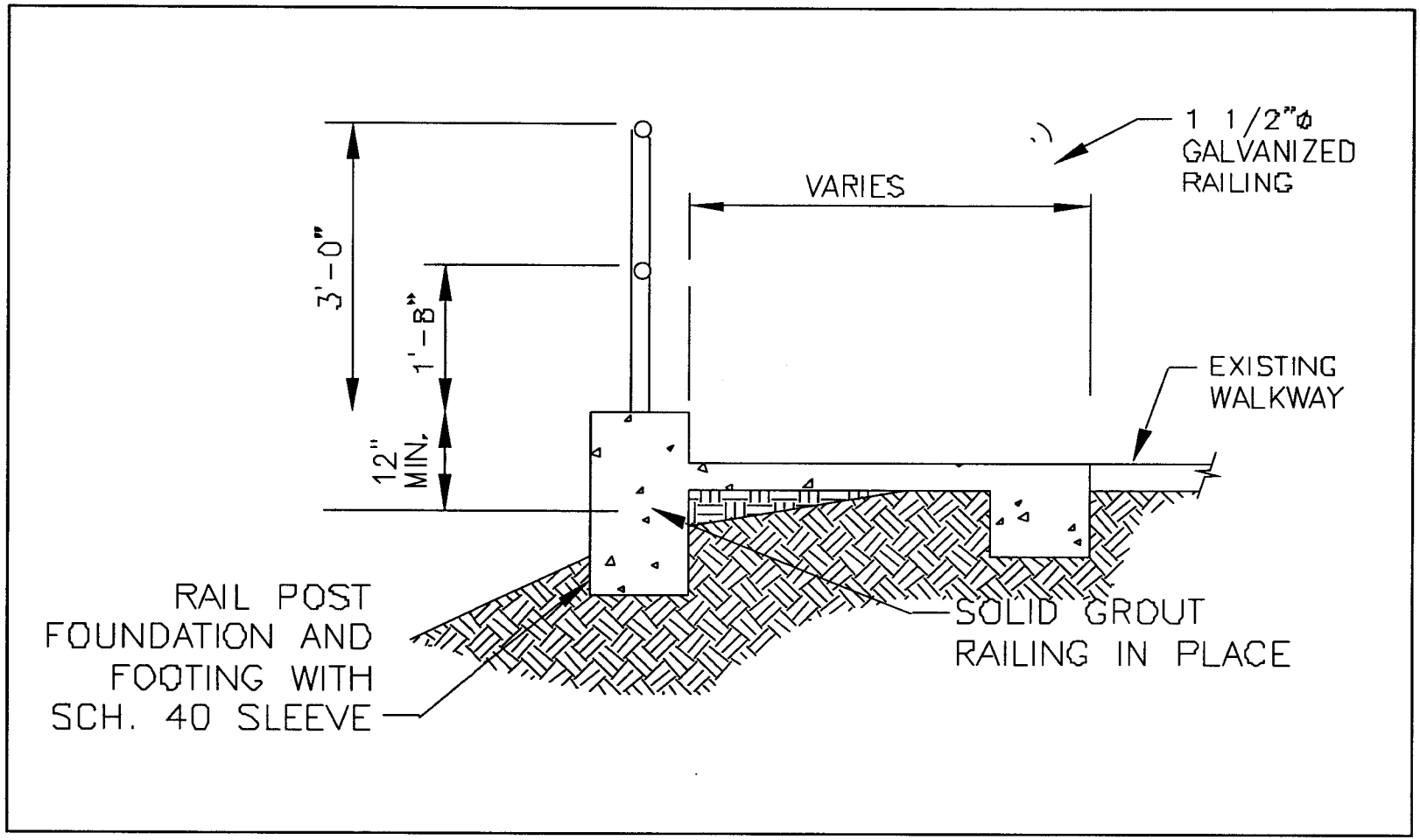
Leveling Pedestal
Figure 22



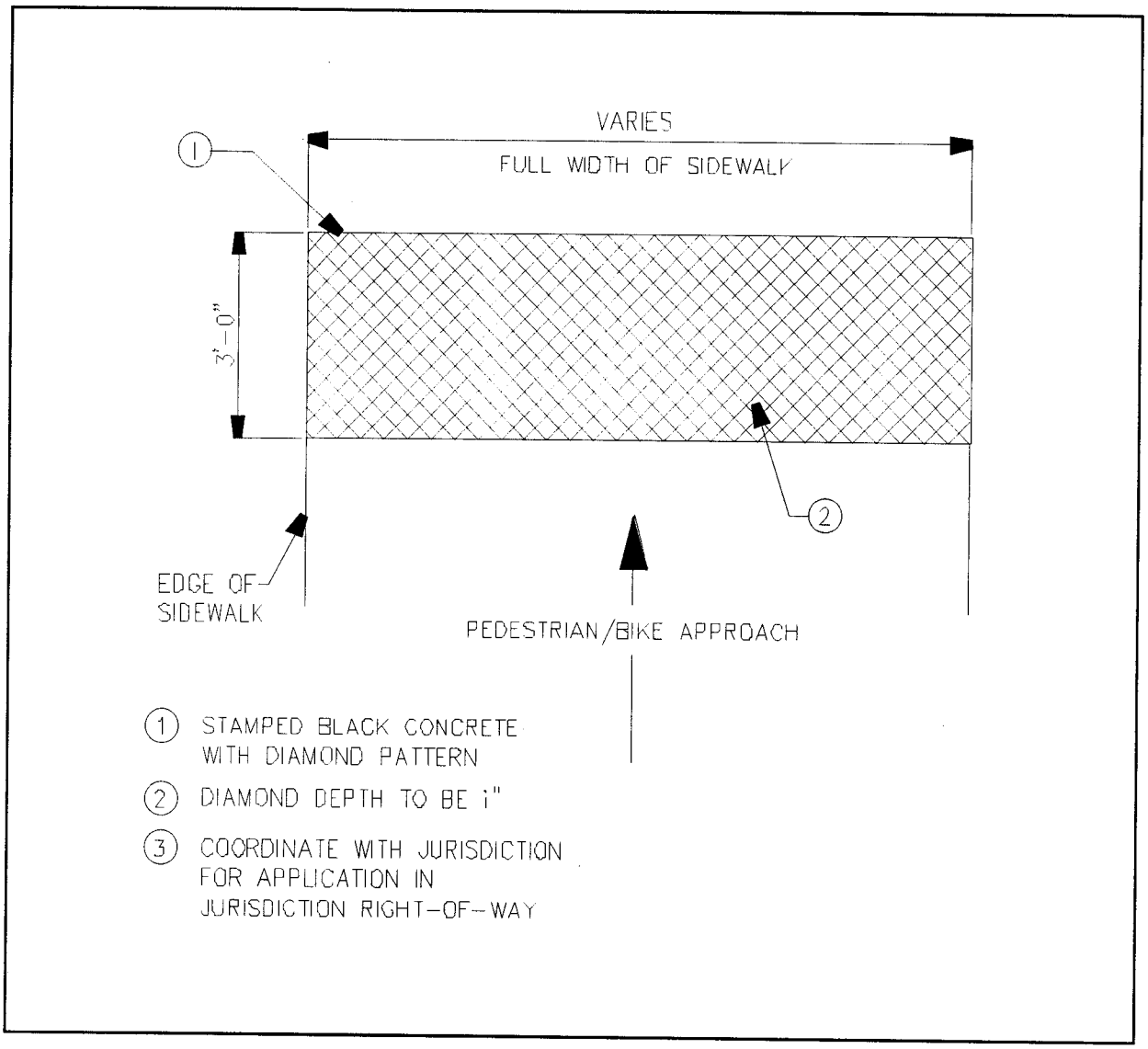
Bollard
Figure 23



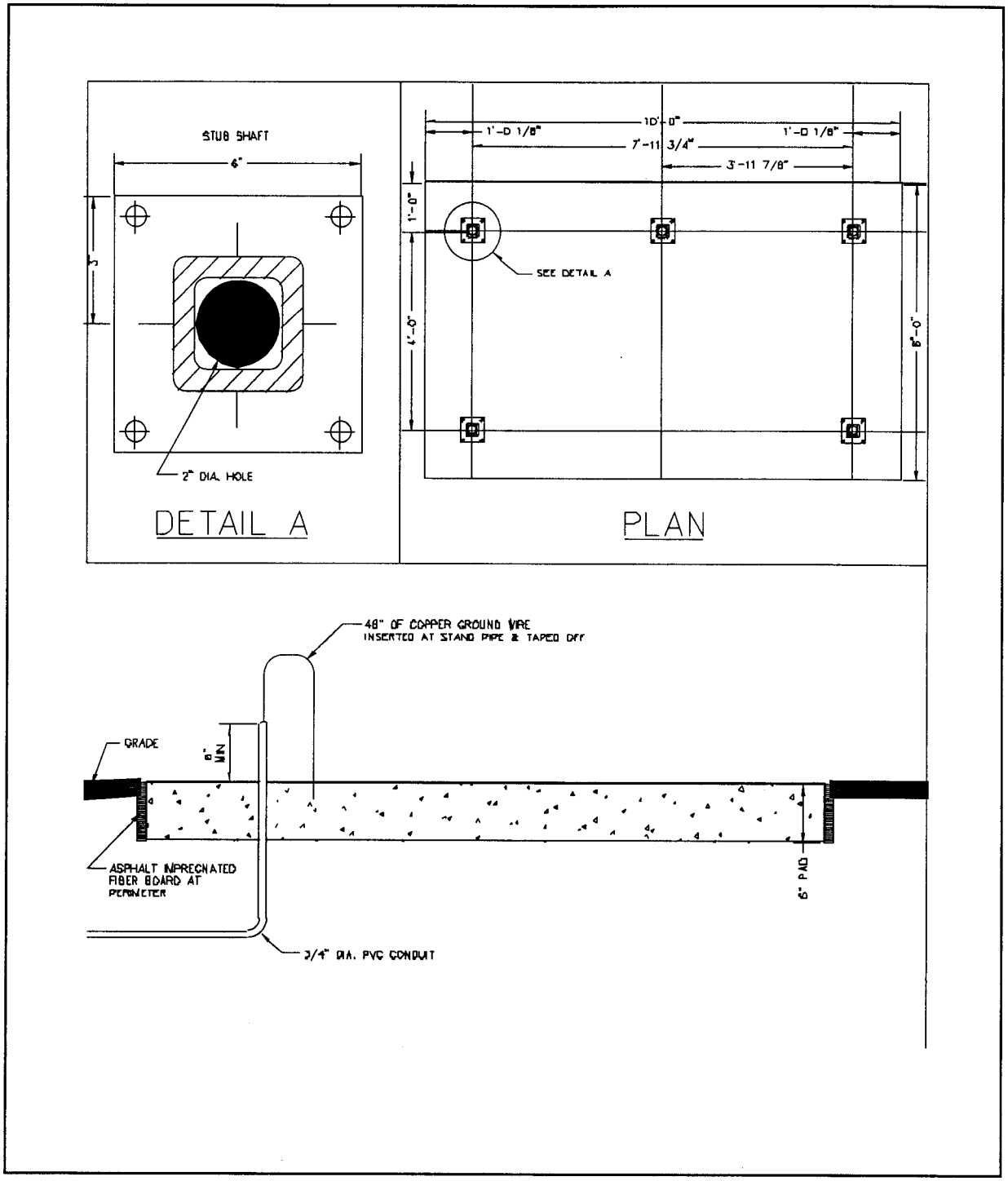
Bollard Installation
Figure 24



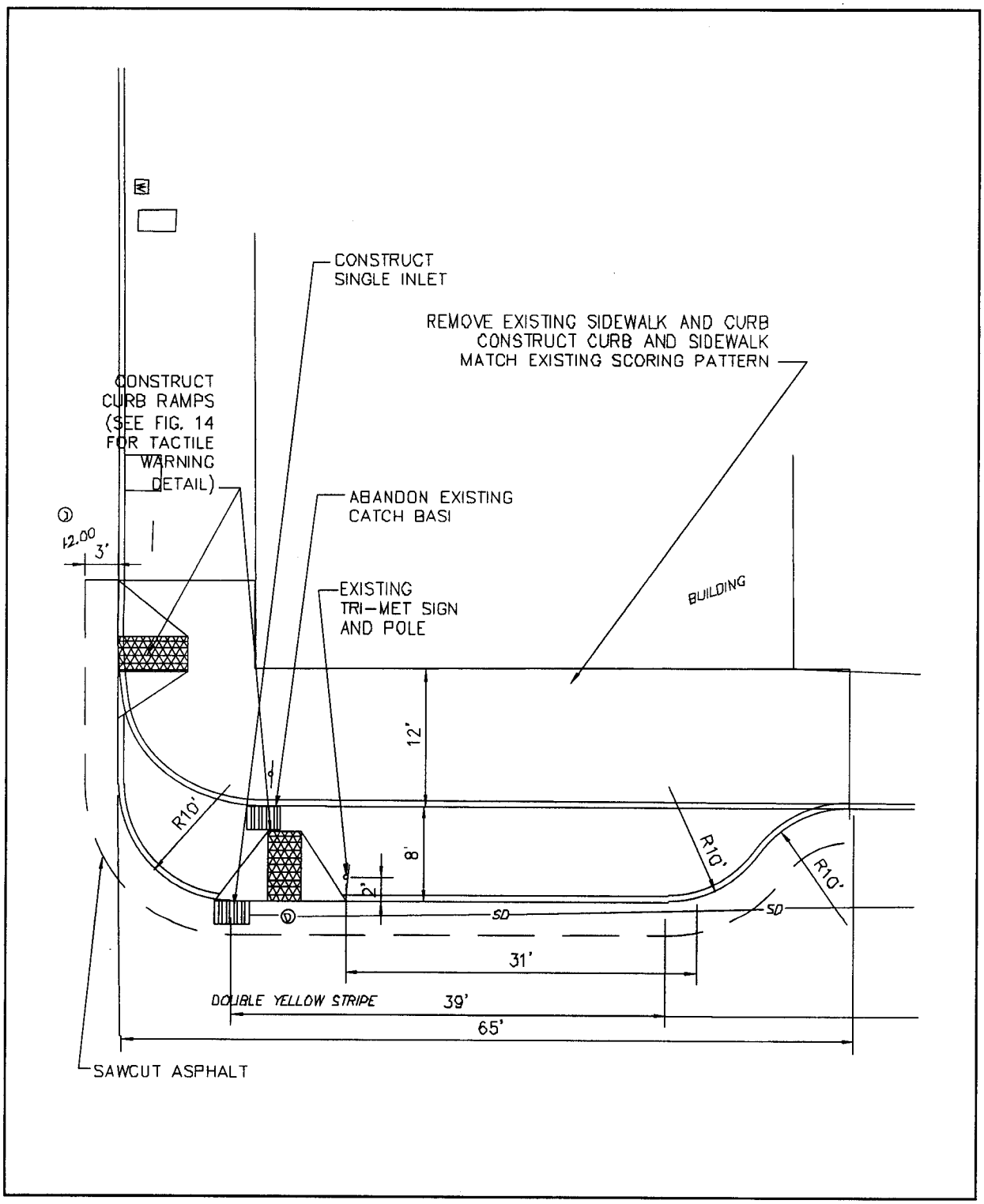
Railing
Figure 25



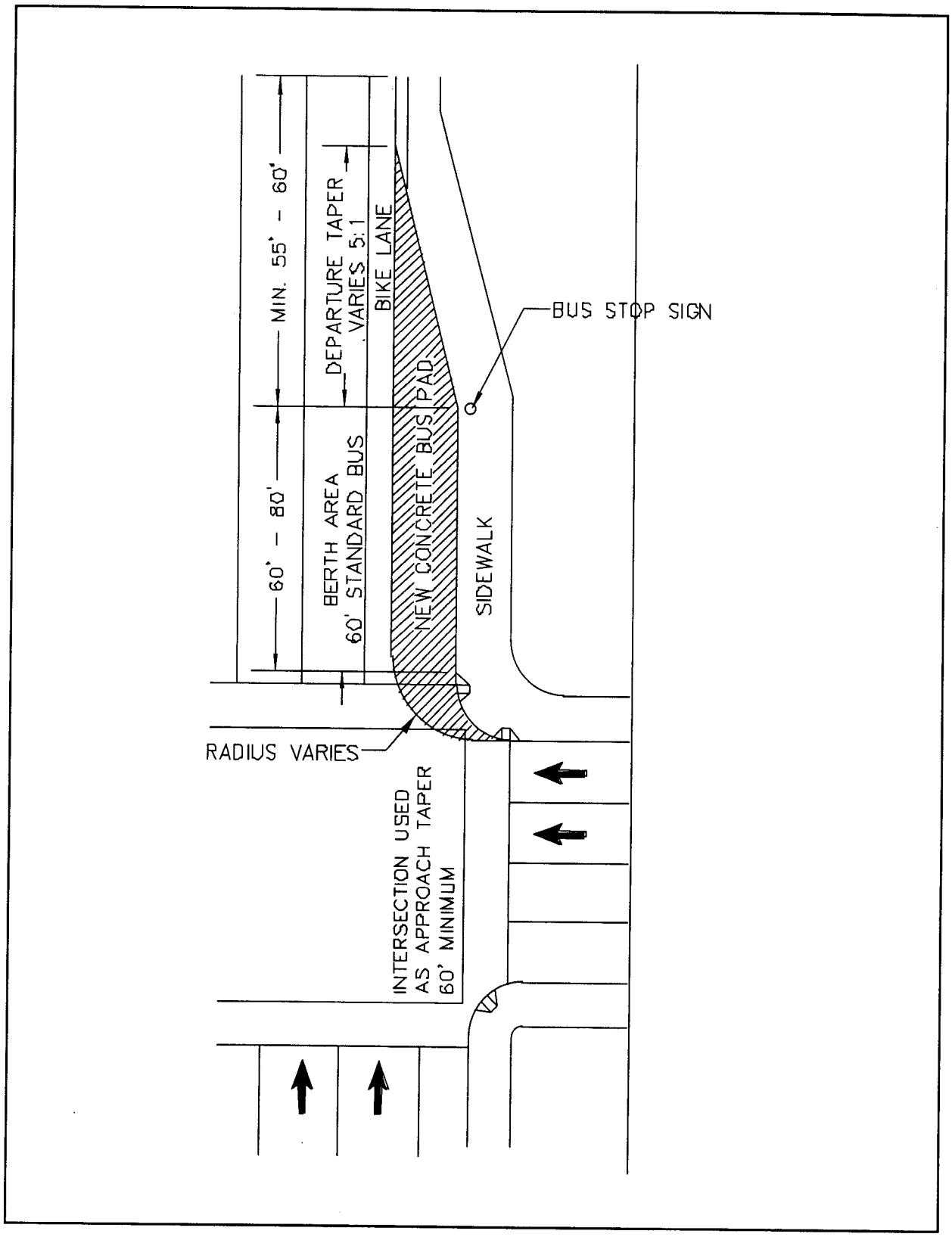
Tactile Warning
Figure 26



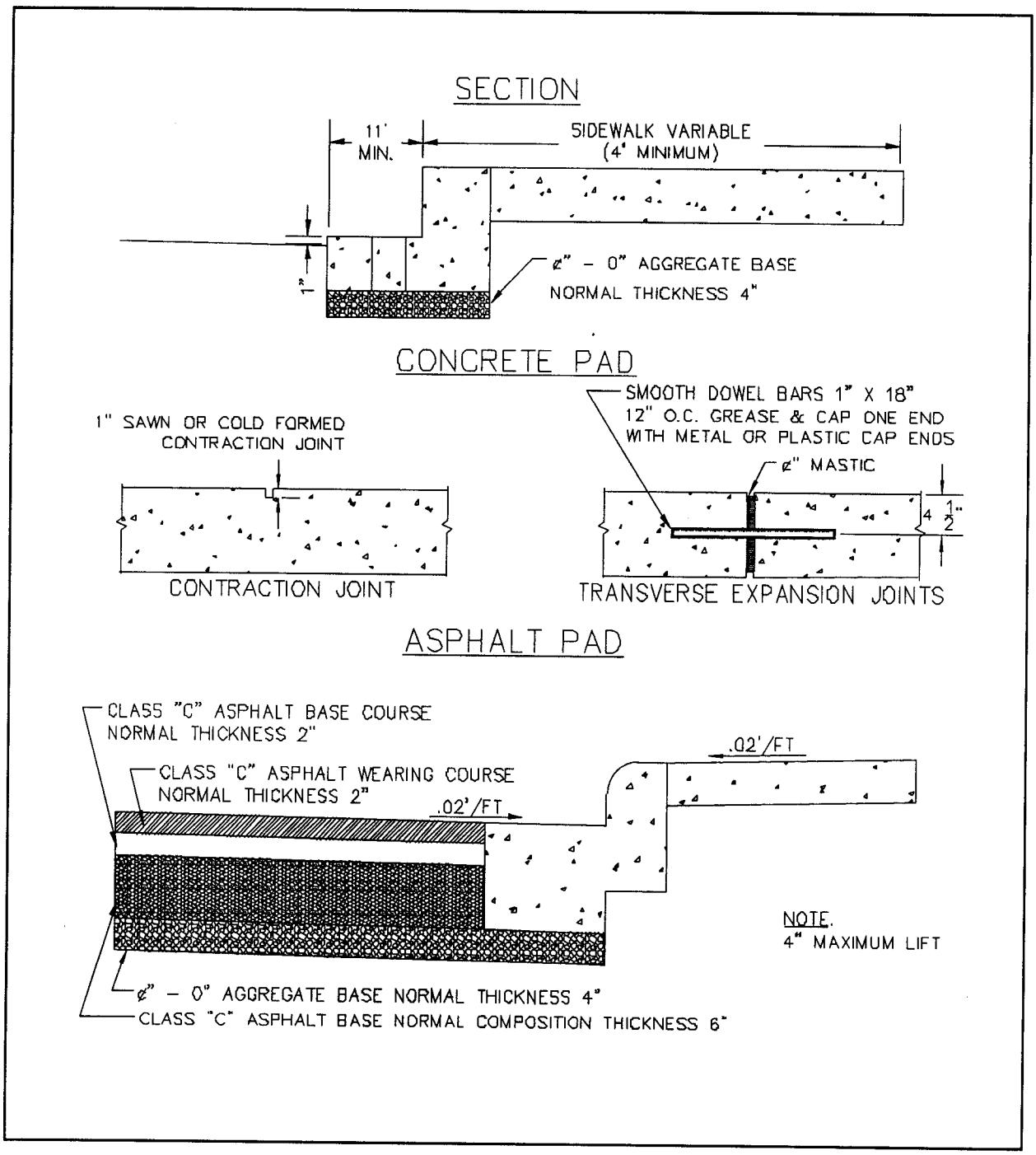
Shelter Pad Conduit Location
Figure 27



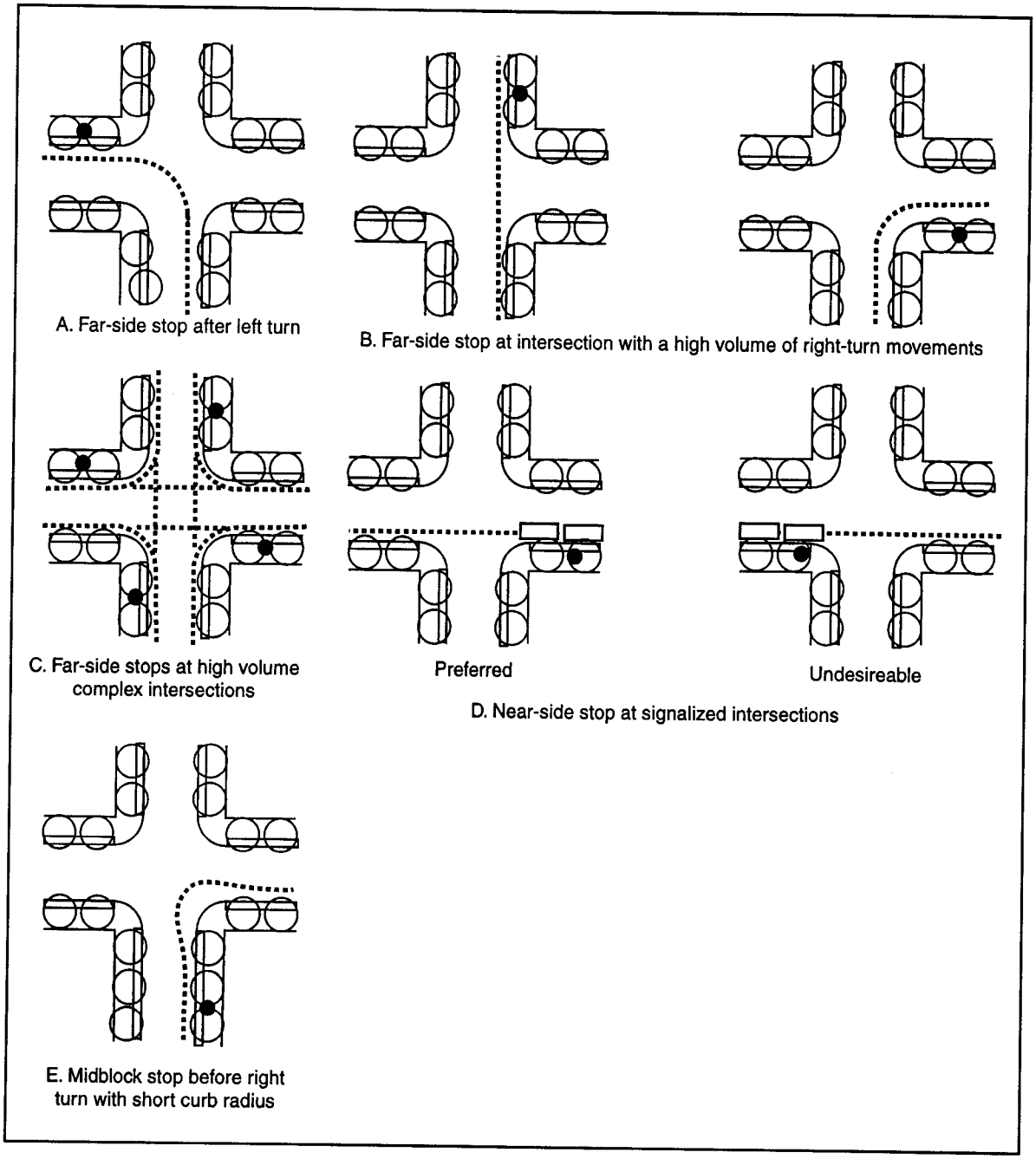
Full Curb Extension
Figure 28



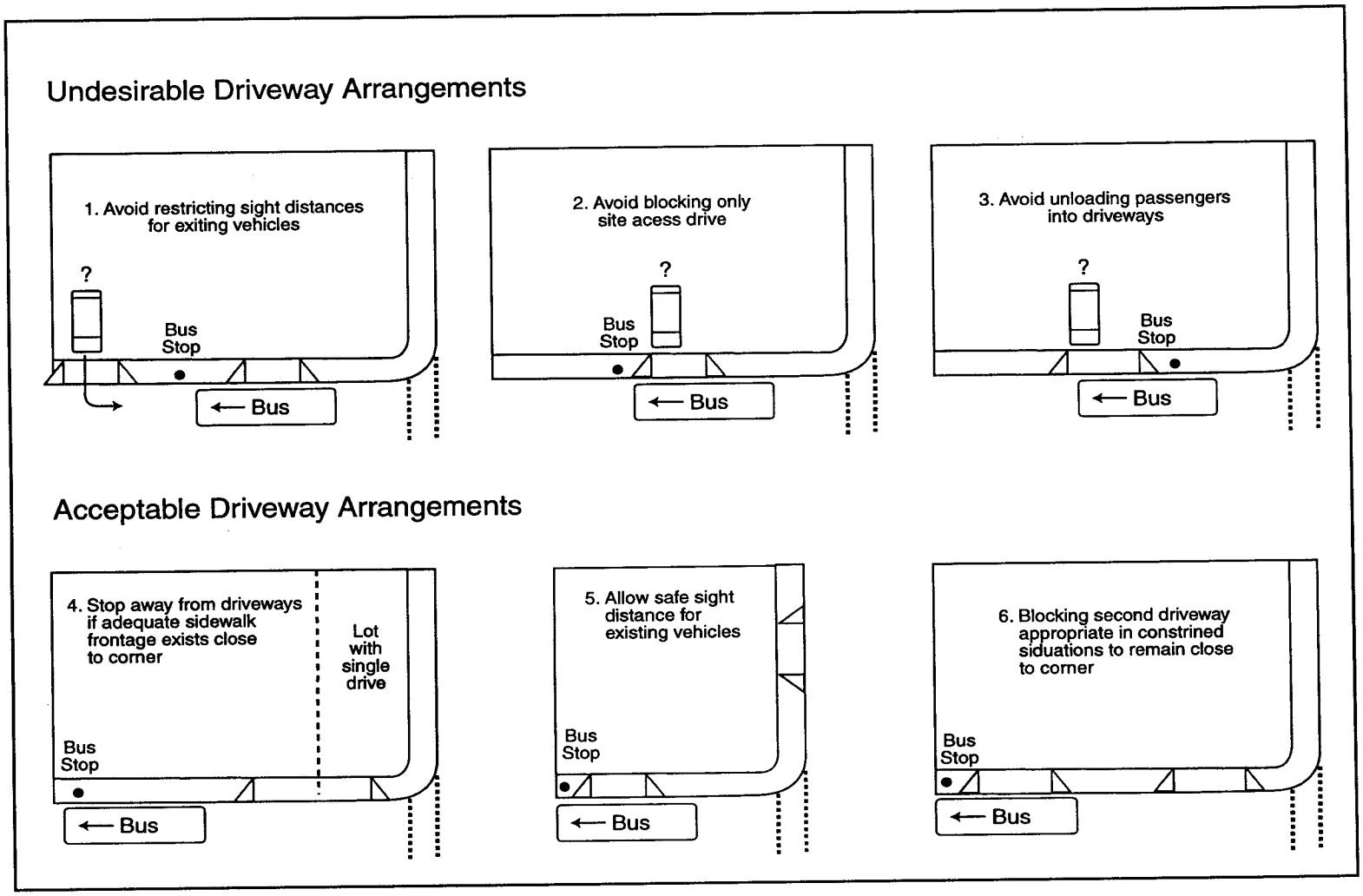
Bus Pull Out & Bus Pad
Figure 29



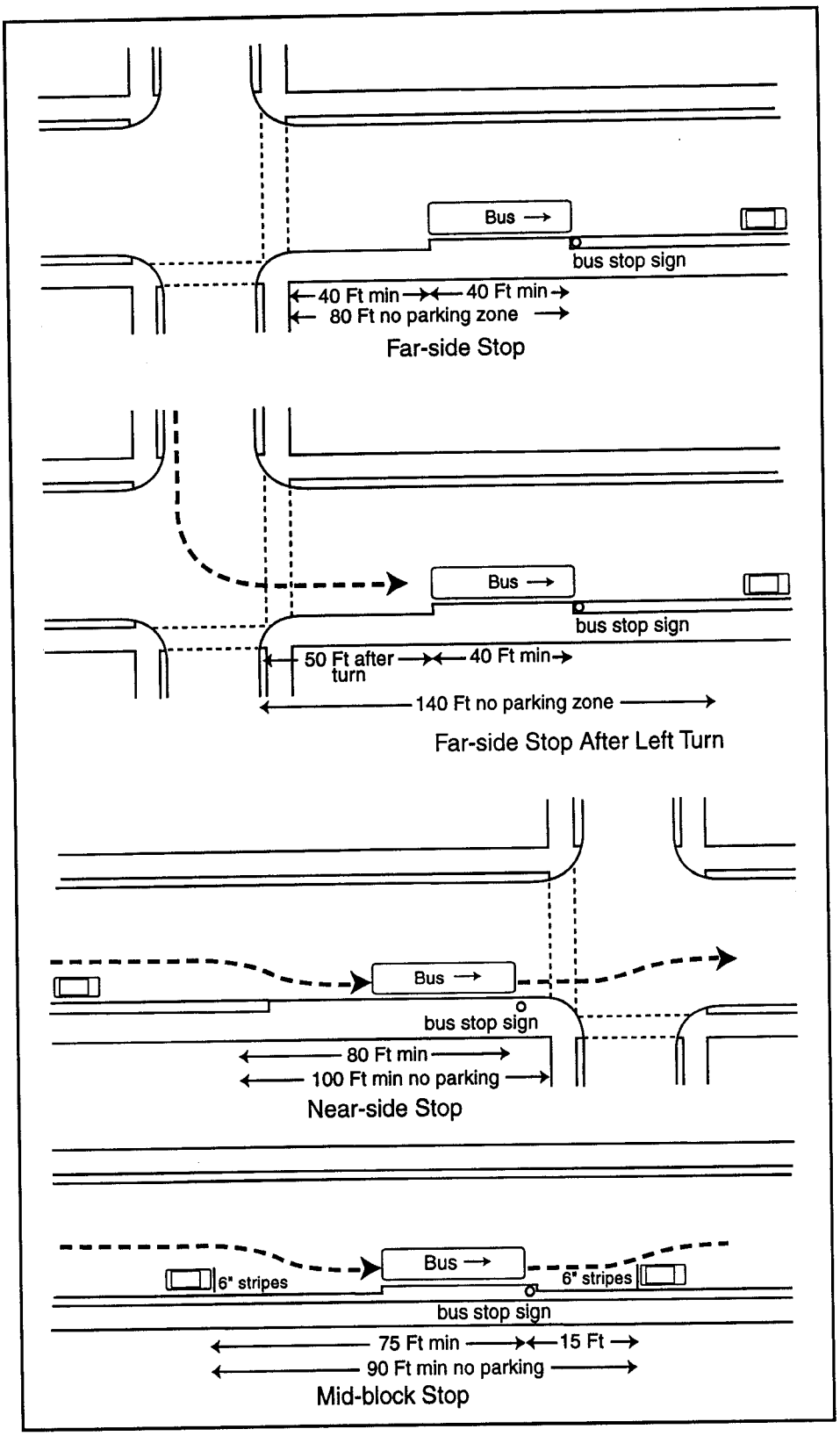
Bus Pad Section
Figure 30



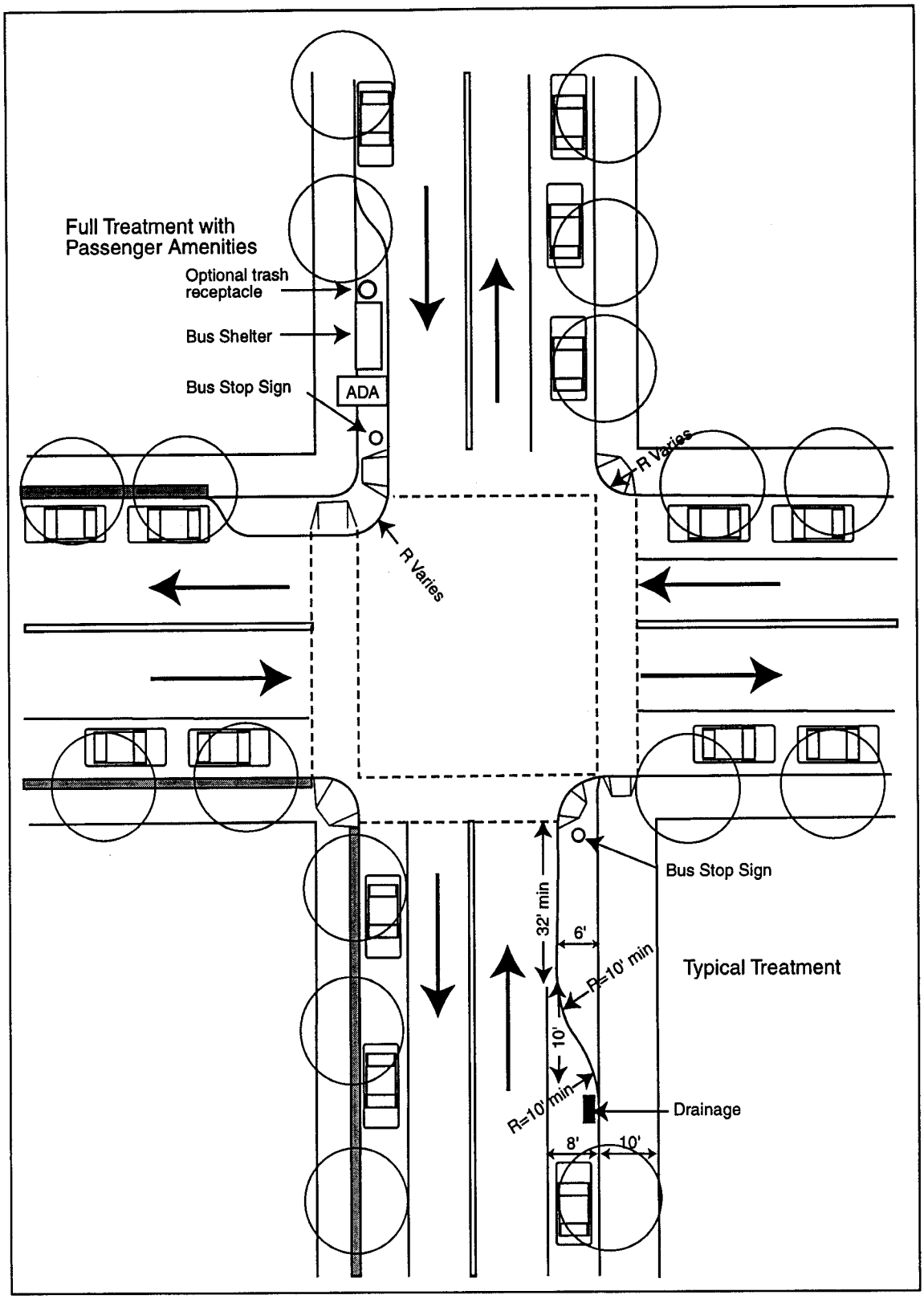
Stop Locations
Figure 31



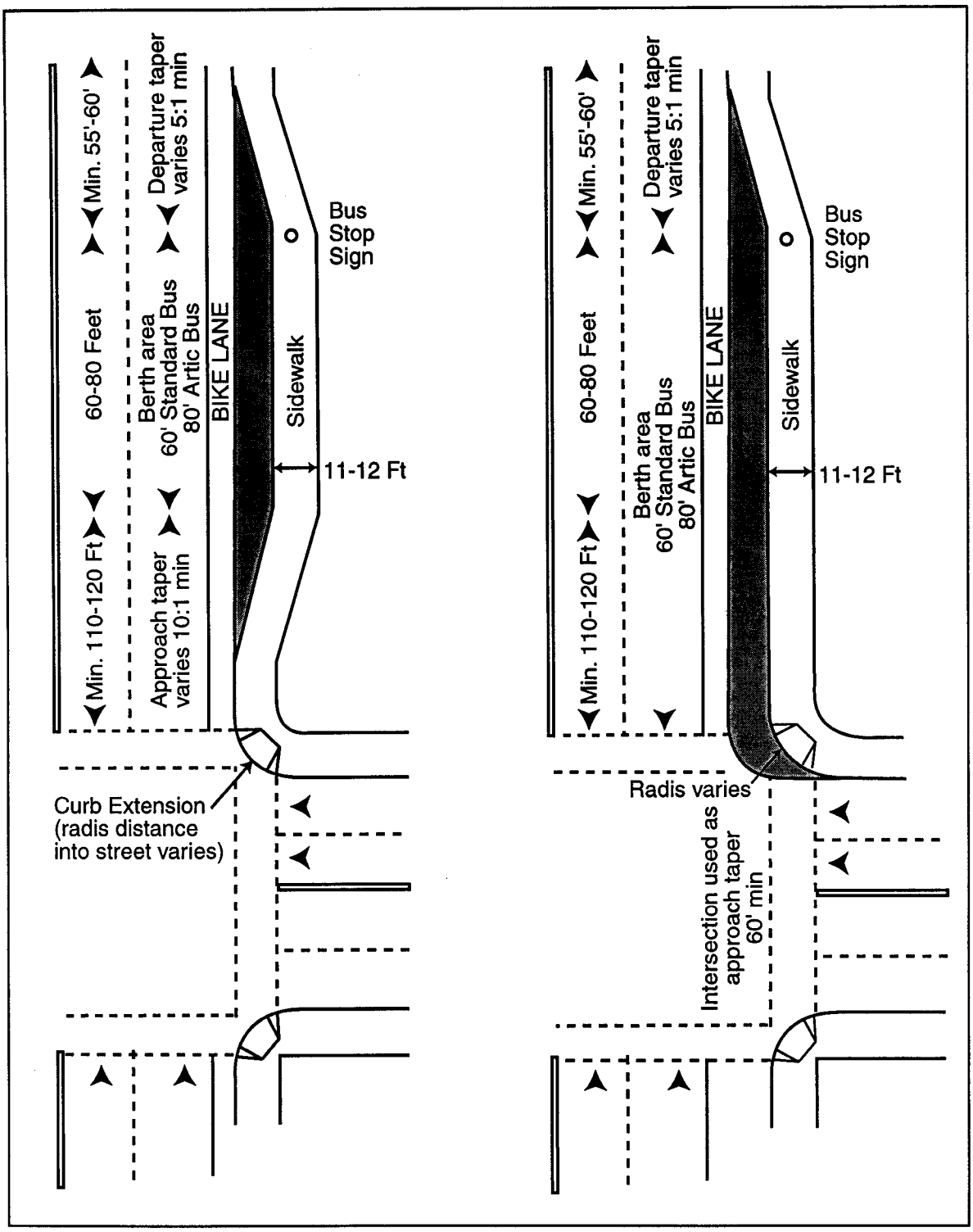
Driveway Locations near Bus Stops
Figure 32



Recommended Bus Stop/Zone Placement
Figure 33



Curb Extension Treatment
Figure 34



Bus Pullout Design Options
Figure 35

ATTACHMENT 2

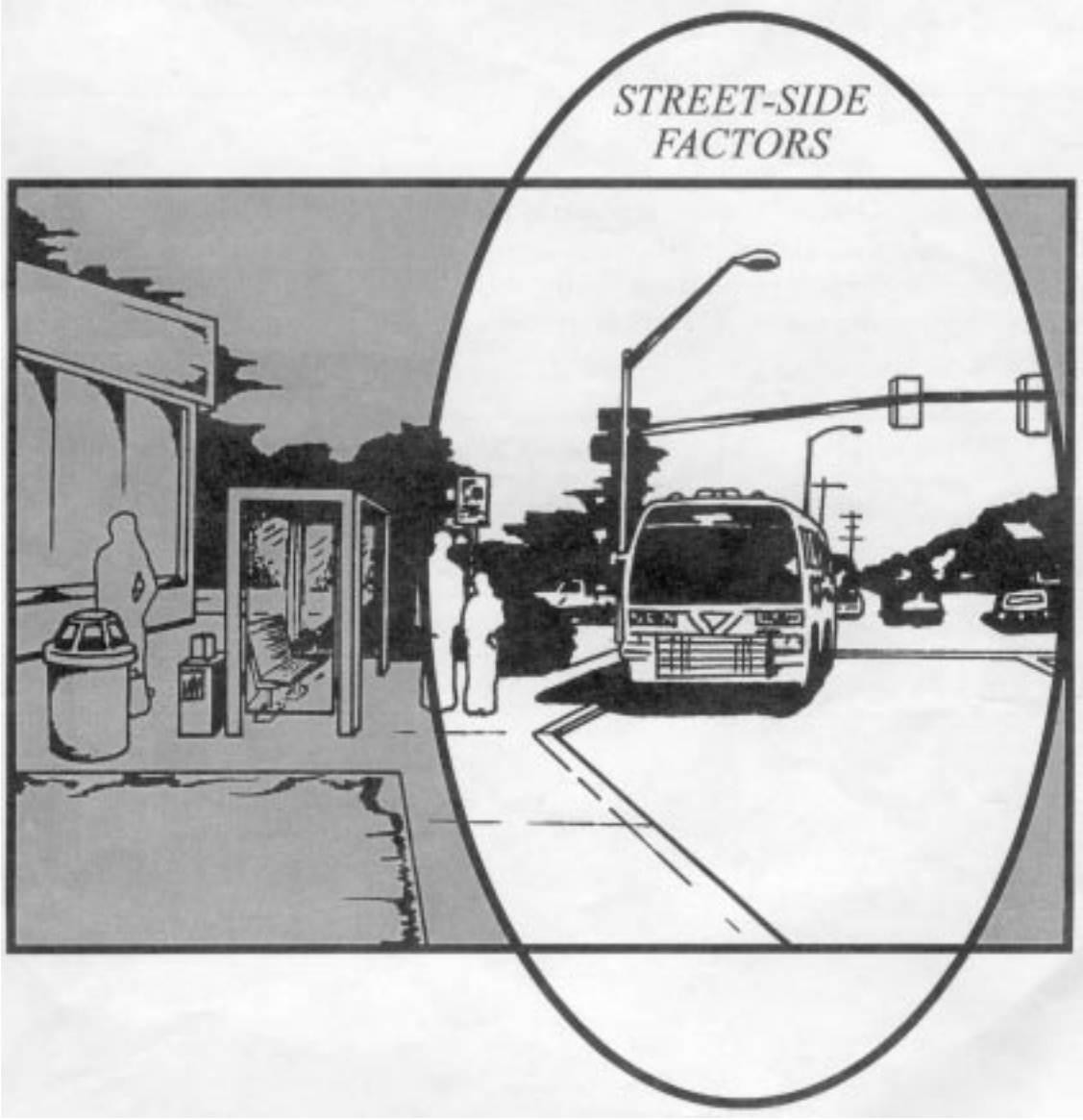
TCRP Report 19 - Chapter 3
Curb-Side Factors

STREET-SIDE FACTORS

Chapter 3

ORGANIZATION

Street-side factors include those factors associated with the roadway that influence bus operations. This chapter begins with discussion of bus stop placement. Next is information on bus stop zone design types. Following the detailed presentation of the different types of bus stops (e.g., bus bays, nubs, etc.) is discussion of vehicle characteristics. This is followed by information on how roadway and intersection design can accommodate the unique qualities of buses. The chapter ends with information on safety and a checklist for evaluating street-side factors.



Chapter 3

STREET-SIDE FACTORS

PLACEMENT CONSIDERATIONS—Stop Spacing

Bus stop spacing has a major impact on transit vehicle and system performance. Stop spacing also affects overall travel time, and therefore, demand for transit. In general, the trade-off is between:

Close stops (every block or 1/8 to 1/4 mile), short walk distances, but more frequent stops and a longer bus trip.	Versus	Stops farther apart, longer walk distances, but more infrequent stops, higher speeds, and therefore, shorter bus trips.

The determination of bus stop spacing is primarily based on goals that are frequently subdivided by development type, such as residential area, commercial, and/or a central business district (CBD). Another generally accepted procedure is placing stops at major trip generators. The following are typical bus stop spacings used. The values represent a composite of prevailing practices.

Environment	Spacing Range	Typical Spacing
Central Core Areas of CBDs	300 to 1000 feet	600 feet
Urban Areas	500 to 1200 feet	750 feet
Suburban Areas	600 to 2500 feet	1000 feet
Rural Areas	650 to 2640 feet	1250 feet

STREET-SIDE FACTORS

Chapter 3

PLACEMENT CONSIDERATIONS—General Considerations

After ridership potential has been established, the most critical factors in bus stop placements are safety and avoidance of conflicts that would otherwise impede bus, car, or pedestrian flows.

In selecting a site for placement of a bus stop, the need for future passenger amenities is an important consideration (see Chapter 4). If possible, the bus stop should be located in an area where typical improvements, such as a bench or a passenger shelter, can be accommodated in the public right-of-way. The final decision on bus stop location is dependent on several safety and operating elements that require on-site evaluation. Elements to consider in bus stop placement include the following:

Safety:

- Passenger protection from passing traffic
- Access for people with disabilities
- All-weather surface to step from/to the bus
- Proximity to passenger crosswalks and curb ramps
- Proximity to major trip generators
- Convenient passenger transfers to routes with nearby stops
- Proximity of stop for the same route in the opposite direction
- Street lighting

Operating:

- Adequate curb space for the number of buses expected at the stop at one time
- Impact of the bus stop on adjacent properties
- On-street automobile parking and truck delivery zones
- Bus routing patterns (i.e., individual bus movements at an intersection)
- Directions (i.e., one-way) and widths of intersection streets
- Types of traffic signal controls (signal, stop, or yield)
- Volumes and turning movements of other traffic
- Width of sidewalks
- Pedestrian activity through intersections
- Proximity and traffic volumes of nearby driveways

Chapter 3

STREET-SIDE FACTORS

PLACEMENT OF BUS STOP—Far-Side, Near-Side, and Midblock Stops

Determining the proper location of bus stops involves choosing among far-side, near-side, and midblock stops (see Figure 1). Table 1 presents a comparison of the advantages and disadvantages of each bus stop type. The following factors should be considered when selecting the type of bus stop:

- Adjacent land use and activities
- Bus route (for example, is bus turning at the intersection)
- Bus signal priority (e.g., extended green suggests far side placement
- Impact on intersection operations
- Intersecting transit routes
- Intersection geometry
- Parking restrictions and requirements
- Passenger origins and destinations
- Pedestrian access, including accessibility for handicap/wheelchair patrons
- Physical roadside constraints (trees, poles, driveways, etc.)
- Potential patronage
- Presence of bus bypass lane
- Traffic control devices

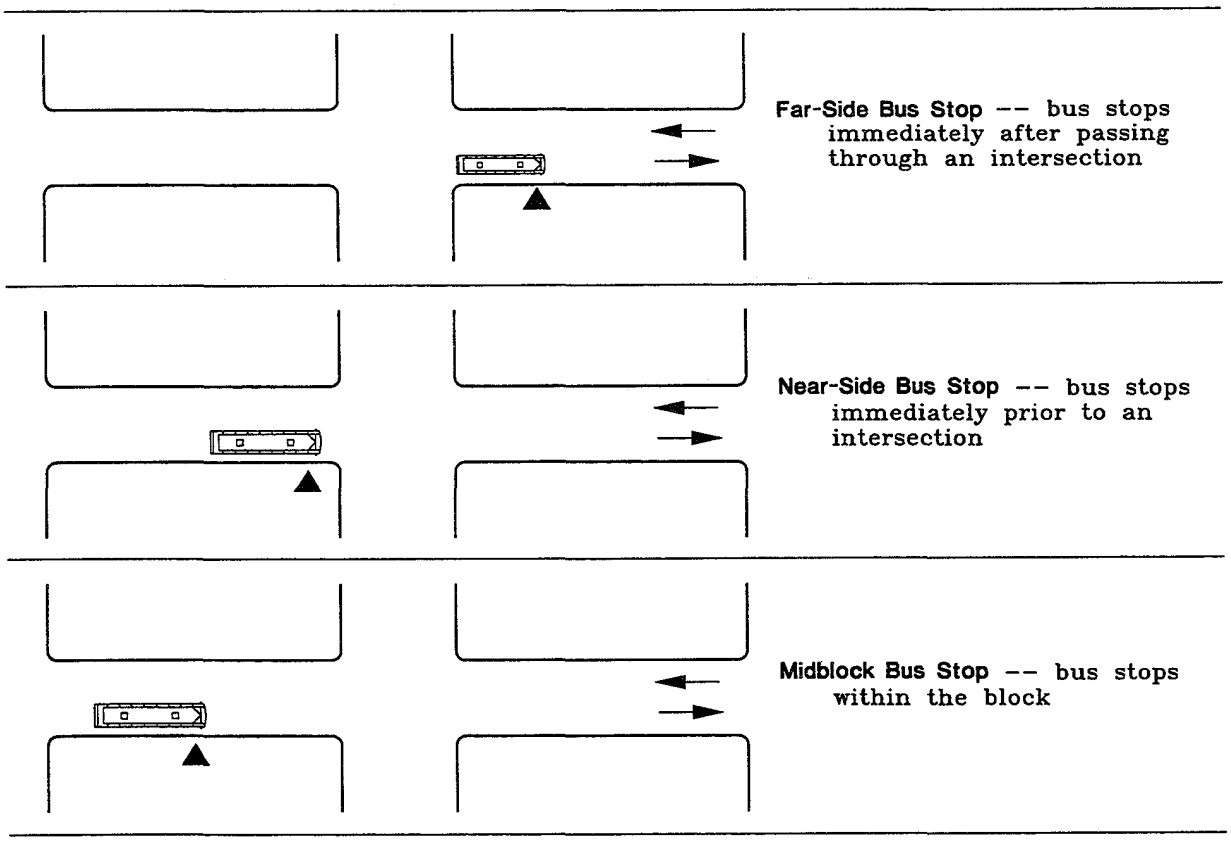


Figure 1. Example of Far-Side, Near-Side, and Midblock Stops.

STREET-SIDE FACTORS

Chapter 3

PLACEMENT OF BUS STOP—Far-Side, Near-Side, and Midblock Stops

Table 1. Comparative Analysis of Bus Stop Locations.

	Advantages	Disadvantages
Far-Side Stop	• Minimizes conflicts between right turning vehicles and buses • Provides additional right turn capacity by making curb lane available for traffic • Minimizes sight distance problems on approaches to intersection • Encourages pedestrians to cross behind the bus • Creates shorter deceleration distances for buses since the bus can use the intersection to decelerate • Results in bus drivers being able to take advantage of the gaps in traffic flow that are created at signalized intersections	• May result in the intersections being blocked during peak periods by stopping buses • May obscure sight distance for crossing vehicles • May increase sight distance problems for crossing pedestrians • Can cause a bus to stop far side after stopping for a red light, which interferes with both bus operations and all other traffic • May increase number of rear-end accidents since drivers do not expect buses to stop again after stopping at a red light • Could result in traffic queued into intersection when a bus is stopped in travel lane
Near-Side Stop	• Minimizes interferences when traffic is heavy on the far side of the intersection • Allows passengers to access buses closest to crosswalk • Results in the width of the intersection being available for the driver to pull away from curb • Eliminates the potential of double stopping • Allows passengers to board and alight while the bus is stopped at a red light • Provides driver with the opportunity to look for oncoming traffic, including other buses with potential passengers	• Increases conflicts with right-turning vehicles • May result in stopped buses obscuring curbside traffic control devices and crossing pedestrians • May cause sight distance to be obscured for cross vehicles stopped to the right of the bus • May block the through lane during peak period with queuing buses • Increases sight distance problems for crossing pedestrians.
Mid-block Stop	• Minimizes sight distance problems for vehicles and pedestrians • May result in passenger waiting areas experiencing less pedestrian congestion	• Requires additional distance for no-parking restrictions • Encourages patrons to cross street at midblock (jaywalking) • Increases walking distance for patrons crossing at intersections

Chapter 3

STREET-SIDE FACTORS

BUS STOP ZONE DESIGN TYPES—Types of Stops

Various configurations of a roadway are available to accommodate bus service at a stop. Figure 2 illustrates different street-side bus stop design while Table 2 presents their advantages and disadvantages.

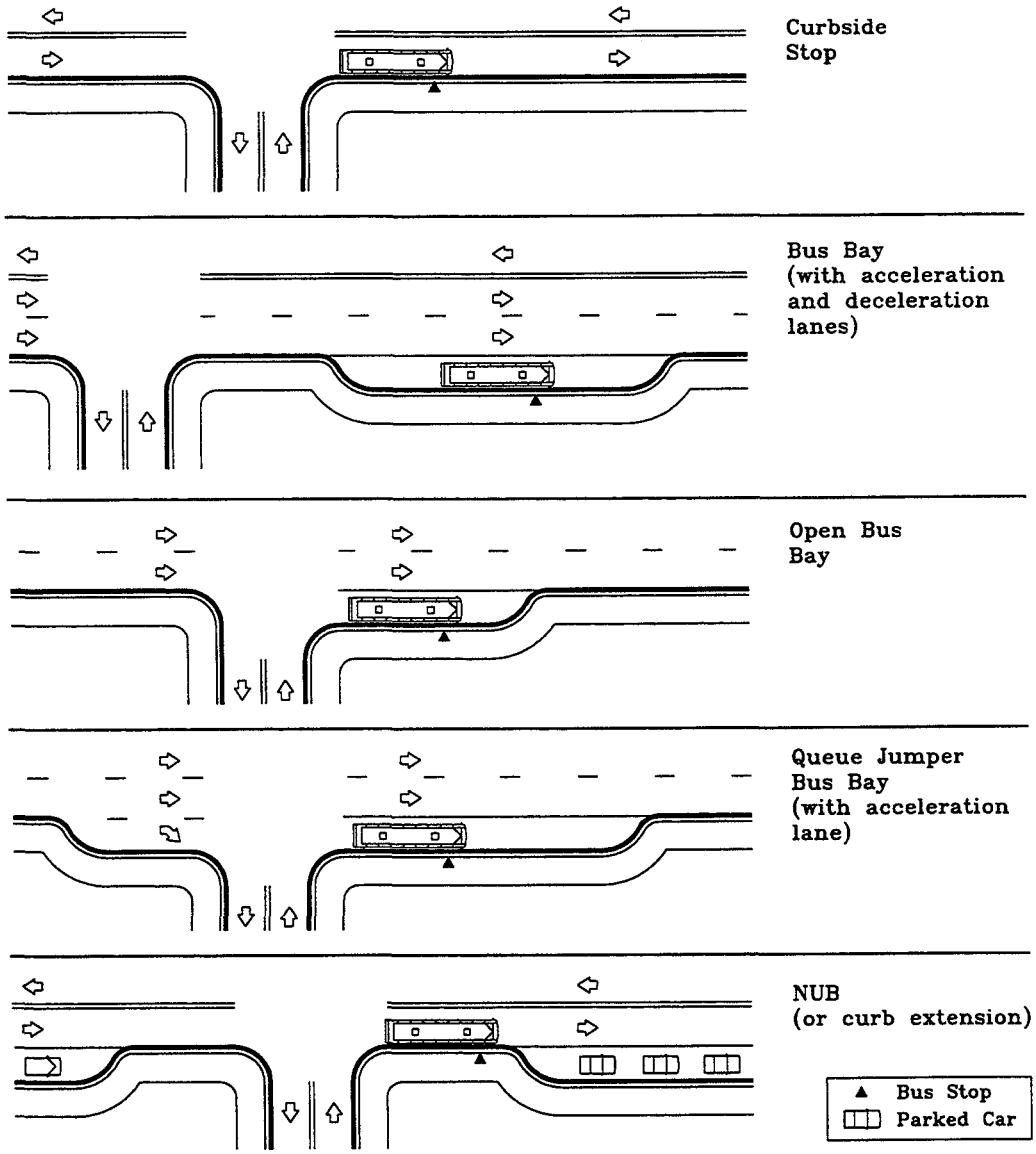


Figure 2. Street-Side Bus Stop Design.

Table 2. Comparative Analysis of Types of Stops.

Type of Stop	Advantages	Disadvantages
Curb-side	• Provides easy access for bus drivers and results in minimal delay to bus • Is simple in design and easy and inexpensive for a transit agency to install • Is easy to relocate	• Can cause traffic to queue behind stopped bus, thus causing traffic congestion • May cause drivers to make unsafe maneuvers when changing lanes in order to avoid a stopped bus
Bus Bay	• Allows patrons to board and alight out of the travel lane • Provides a protected area away from moving vehicles for both the stopped bus and the bus patrons • Minimizes delay to through traffic	• May present problems to bus drivers when attempting to re-enter traffic, especially during periods of high roadway volumes • Is expensive to install compared with curbside stops • Is difficult and expensive to relocate
Open Bus Bay	• Allows the bus to decelerate as it moves through the intersection • See Bus Bay advantages	• See Bus Bay disadvantages
Queue Jumper Bus Bay	• Allows buses to bypass queues at a signal • See Open Bus Bay advantage	• May cause delays to right-turning vehicles when a bus is at the start of the right turn lane • See Bus Bay disadvantages
Nub	• Removes fewer parking spaces for the bus stop • Decreases the walking distance (and time) for pedestrians crossing the street • Provides additional sidewalk area for bus patrons to wait • Results in minimal delay for bus	• Costs more to install compared with curbside stops • See Curb-side disadvantages

Chapter 3

STREET-SIDE FACTORS

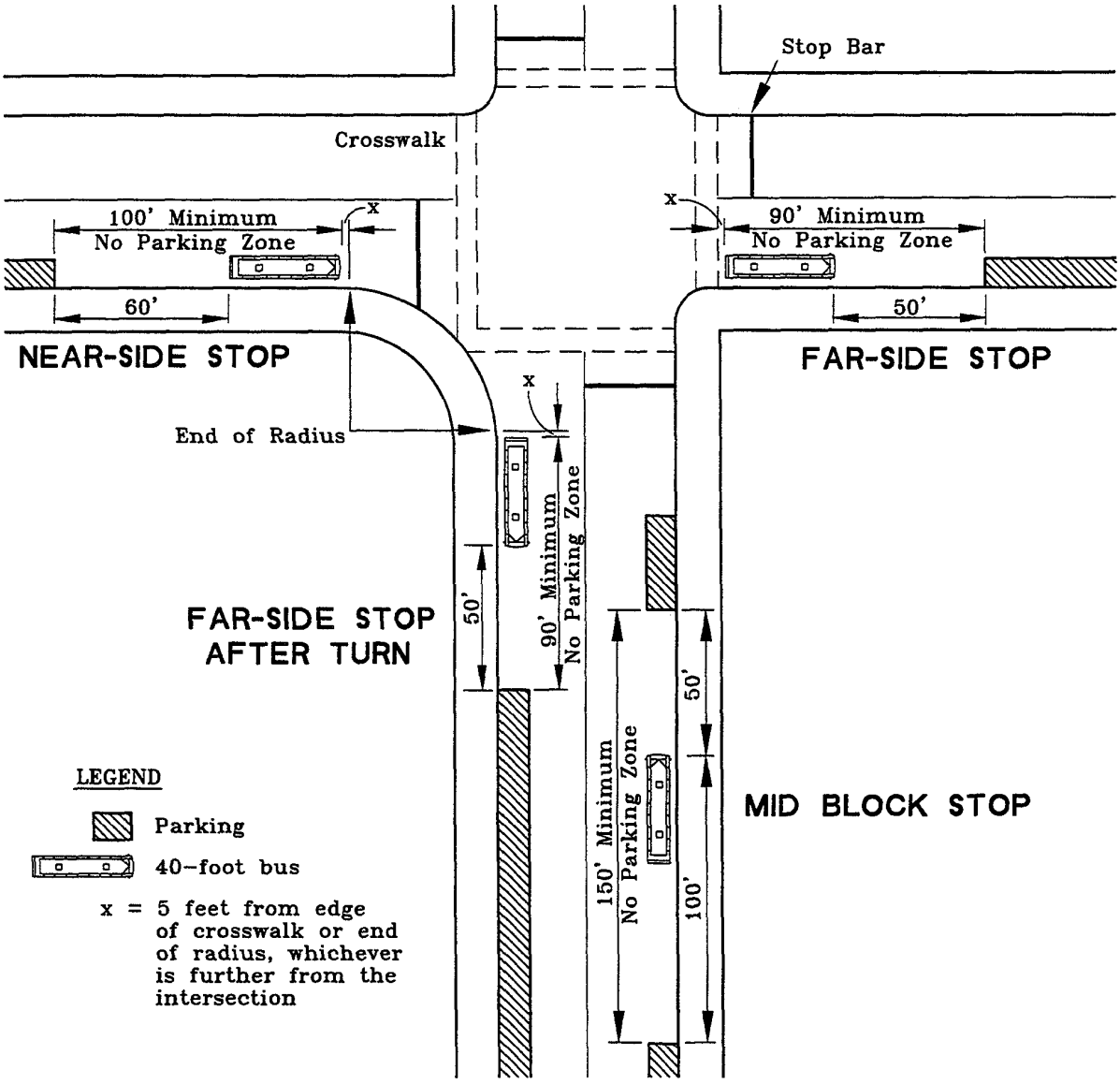
BUS STOP ZONE DESIGN TYPES—Curb-Side Bus Stop Zone Dimensions

A bus stop zone is the portion of a roadway marked or signed for use by buses when loading or unloading passengers. The lengths of bus stop zones vary among different transit agencies. In general, bus stop zones for far-side and near-side stops are a minimum of 90 and 100 feet, respectively, and midblock stops are a minimum of 150 feet. Far-side stops after a turn typically have a minimum 90-foot zone, however, a longer zone will result in greater ease for a bus driver to position the bus. Bus stop zones are increased by 20 feet for articulated buses. Representative dimensions for bus stop zones are illustrated in Figure 3.

More than one bus may be at a stop at a given time. The number of bus-loading positions required at a given location depends on 1) the rate of bus arrivals and 2) passenger service time at the stop. Table 3 presents suggested bus stop capacity requirements based on a range of bus flow rates and passenger service times. For example, if the service time at a stop is 30 seconds and there are 60 buses expected in the peak hour, two bus loading positions are needed. The arrival rate is based on a Poisson (random) arrival rate and a 5 percent chance the bus zone capacity will be exceeded.

Table 3. Recommended Bus Stop Bay Requirements.

Peak-Hour Bus Flow	Capacity Required (Bays) When Service Time at Stop Is				
	10 Seconds	20 Seconds	30 Seconds	40 Seconds	60 Seconds
15	1	1	1	1	1
30	1	1	1	1	2
45	1	1	2	2	2
60	1	1	2	2	3
75	1	2	2	3	3
90	1	2	2	3	4
105	1	2	3	3	4
120	1	2	3	3	5
150	2	3	3	4	5
180	2	3	4	5	6



Notes:

1) Add 20 feet to bus stop zones for an articulated bus.
2) Increase bus stop zone by 50 feet for each additional standard 40-foot bus or 70 feet for each additional 60-foot articulated bus expected to be at the stop simultaneously. See Table 3 for the suggested bus stop capacity requirements based on a range of bus flow rates and passenger service times.

Figure 3. Typical Dimensions for On-Street Bus Stops.

Chapter 3

STREET-SIDE FACTORS

BUS STOP ZONE DESIGN TYPES—Bus Bay

A bus bay (or turnout) is a specially constructed area separated from the travel lanes and off the normal section of a roadway that provides for the pick up and discharge of passengers (see Figure 4). This design allows through traffic to flow freely without the obstruction of stopped buses. Bus bays are provided primarily on high-volume or high-speed roadways, such as suburban arterial roads. Additionally, bus bays are frequently constructed in heavily congested downtown and shopping areas where large numbers of passengers may board and alight.

Figure 4. Example of a Bus Bay.

STREET-SIDE FACTORS

Chapter 3

BUS STOP ZONE DESIGN TYPES—Use of Bus Bays

Bus bays should be considered at a location when the following factors are present:

- Traffic in the curb lane exceeds 250 vehicles during the peak hour,
- Traffic speed is greater than 40 mph,
- Bus volumes are 10 or more per peak hour on the roadway,
- Passenger volumes exceed 20 to 40 boardings an hour,
- Average peak-period dwell time exceeds 30 seconds per bus,
- Buses are expected to layover at the end of a trip,
- Potential for auto/bus conflicts warrants separation of transit and passenger vehicles,
- History of repeated traffic and/or pedestrian accidents at stop location,
- Right-of-way width is adequate to construct the bay without adversely affecting sidewalk pedestrian movement,
- Sight distances (i.e., hills, curves) prevent traffic from stopping safely behind a stopped bus,
- A right-turn lane is used by buses as a queue jumper lane,
- Appropriate bus signal priority treatment exists at an intersection,
- Bus parking in the curb lane is prohibited, and
- Improvements, such as widening, are planned for a major roadway. (This provides the opportunity to include the bus bay as part of the reconstruction, resulting in a better-designed and less-costly bus bay.)

Evidence shows that bus drivers will not use a bus bay when traffic volumes exceed 1000 vehicles per hour per lane. Drivers explain that the heavy volumes make it extremely difficult to maneuver a bus out of a midblock or near-side bay, and that the bus must wait an unacceptable period of time to re-enter the travel lane. Consideration should be given to these concerns when contemplating the design of a bay on a high-volume road. Using acceleration lanes, signal priority, or far-side (versus near-side or midblock) placements are potential solutions.

Chapter 3

STREET-SIDE FACTORS

BUS STOP ZONE DESIGN TYPES—Bus Bay Dimensions

The total length of the bus bay should allow room for an entrance taper, a deceleration lane, a stopping area, an acceleration lane, and an exit taper (see Figure 5). However, the common practice is to accept deceleration and acceleration in the through lanes and only build the tapers and the stopping area. Providing separate deceleration and acceleration lanes is desirable on suburban arterial roads and should be incorporated in the design wherever feasible.

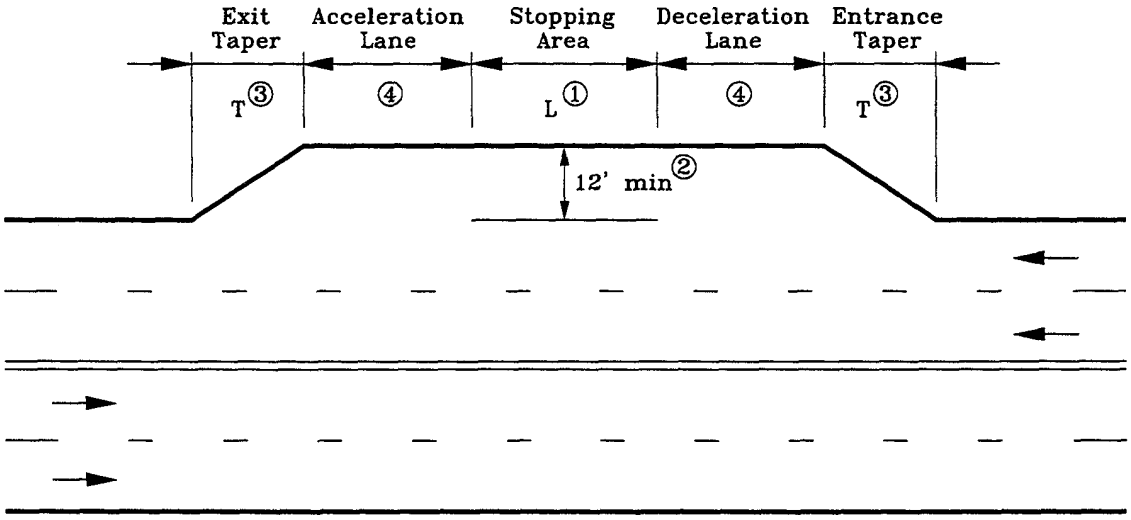
An acceleration lane in a bay design allows a bus to obtain a speed that is within an acceptable range of the through traffic speed and more comfortably merge with the through traffic. The presence of a deceleration lane enables buses to decelerate without inhibiting through traffic. Typical bus bay dimensions (minimum and recommended) are shown in Figure 5. Where bike lanes are provided, a bus bay should include a marked through lane to guide bicyclists along the outside of the bus bay.

Following are some guidelines on where to locate bus bays (e.g., far side or near side):

- Far-side intersection placement is desirable (may vary with site conditions). Bus bays should be placed at signal-controlled intersections so that the signal can create gaps in traffic.

- Near-side bays should be avoided because of conflicts with right-turning vehicles, delays to transit service as buses attempt to re-enter the travel lane, and obstruction of traffic control devices and pedestrian activity.

- Midblock bus bay locations are not desirable unless associated with key pedestrian access to major transit-oriented activity centers.



Notes:

1) Stopping area length consists of 50 feet for each standard 40-foot bus and 70 feet for each 60-foot articulated bus expected to be at the stop simultaneously. See Table 3 for the suggested bus stop capacity requirements based on a range of bus flow rates and passenger service times.
2) Bus bay width is desirably 12 feet. For traffic speeds under 30 mph, a 10-foot minimum bay width is acceptable. These dimensions do not include gutter width.
3) Suggested taper lengths are listed in table below. Desirable taper length is equal to the major road through speed multiplied by the width of the turnout bay. A taper of 5:1 is a desirable minimum for an entrance taper to an arterial street bus bay while the merging or re-entry taper should not be sharper than 3:1.
4) Minimum design for a busy bay does not include acceleration or deceleration lanes. Recommended acceleration and deceleration lengths are listed in the table below.

Through Speed (mph)	Entering Speed[a] (mph)	Length of Acceleration Lane (Feet)	Length of Deceleration Lane[b] (Feet)	Length of Taper (Feet)
35	25	250	184	170
40	30	400	265	190
45	35	700	360	210
50	40	975	470	230
55	45	1400	595	250
60	50	1900	735	270

[a] Bus speed at end of taper, desirable for buses to be within 10 mph of travel lane vehicle speed at the end of the taper.
[b] Based on 2.5 mph/sec deceleration rate.

Figure 5. Typical Bus Bay Dimensions.

Chapter 3

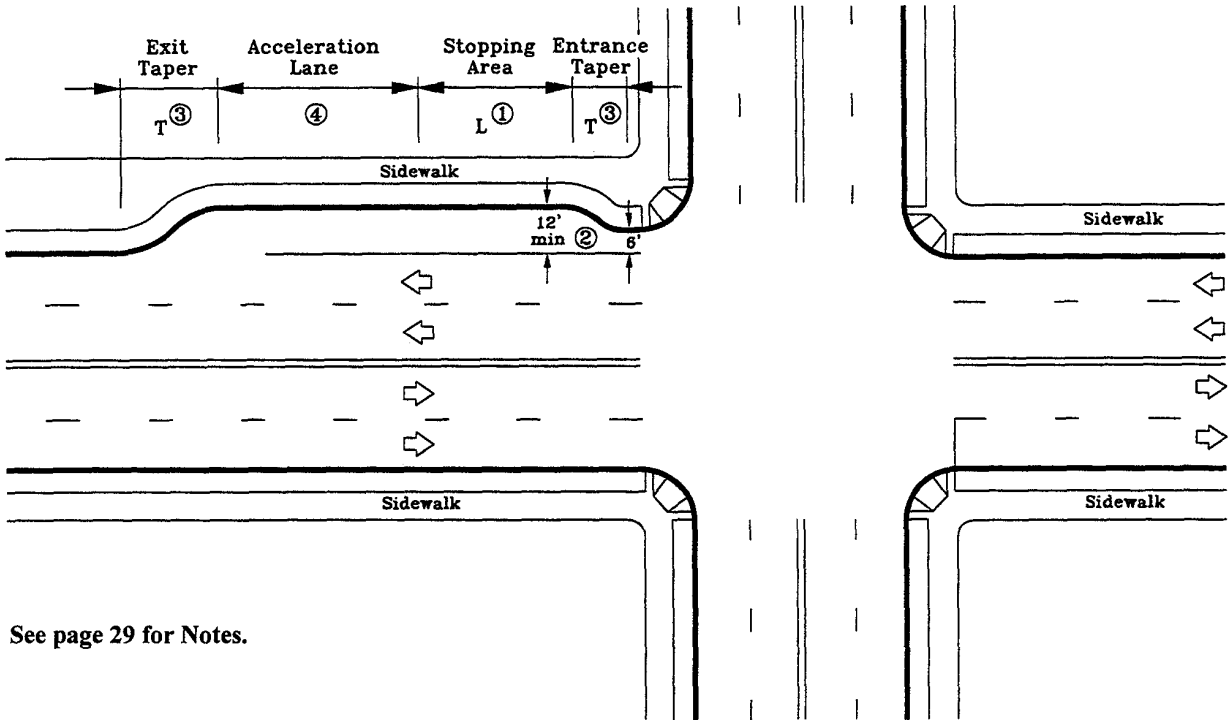
STREET-SIDE FACTORS

BUS STOP ZONE DESIGN TYPES—Open Bus Bay

The open bus bay design is a variation of the bus bay design. In an open bus bay design, the bay is open to the upstream intersection (see Figure 6 for an example). The bus driver has the pavement width of the upstream cross street available to decelerate and to move the bus from the travel lane into the bay. Advantages of this design include allowing the bus to move efficiently into the bay as well as allowing the bus to stop out of the flow of traffic. Re-entry difficulties are not eliminated; however, they are no more difficult than with the typical bus bay design. A disadvantage for pedestrians is that the pedestrian crossing distance at an intersection increases with an open bus bay design because the intersection width has been increased by the width of the bay.

Figure 6. Bus Approaching an Open Bus Bay.

Another alternative to the bus bay design is a partial open bus bay (or a partial sidewalk extension). This alternative allows buses to use the intersection approach in entering the bay and provides a partial sidewalk extension to reduce pedestrian street-crossing distance. It also prevents right-turning vehicles from using the bus bay for acceleration movements. Figure 7 illustrates the design for a partial open bus bay.



See page 29 for Notes.

Figure 7. Partial Open Bus Bay.

Chapter 3

STREET-SIDE FACTORS

BUS STOP ZONE DESIGN TYPES—Queue Jumper Bus Bay

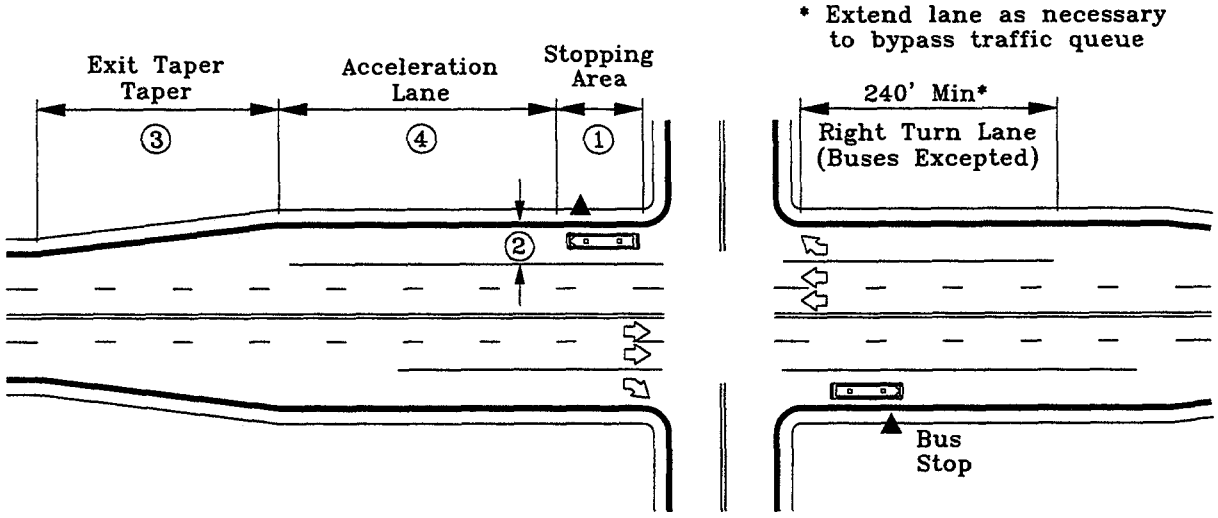
Queue jumper bus bays provide priority treatment for buses along arterial streets by allowing buses to bypass traffic queued at congested intersections. These bus stops consist of a near-side, right-turn lane and a far-side open bus bay. Buses are allowed to use the right-turn lane to bypass traffic congestion and proceed through the intersection. The right-turn lane could be signed "Right Turns Only—Buses Excepted." Queue jumpers provide the double benefit of removing stopped buses from the traffic stream (to benefit general traffic operations) and guiding moving buses through congested intersections (to benefit bus operations). Figure 8 is a photograph of a queue jumper bus bay while Figure 9 illustrates the layout for a queue jumper bus bay.

Figure 8. Example of a Queue Jumper Bus Bay.

According to the transit agencies that use queue jumper bus bays, these bays should be considered at arterial street intersections when the following factors are present:

- High-frequency bus routes have an average headway of 15 minutes or less;
- Traffic volumes exceed 250 vehicles per hour in the curb lane during the peak hour;
- The intersection operates at a level of service "D" or worse (see the Transportation Research Board's *Highway Capacity Manual* for techniques on evaluating the operations at an intersection); and
- Land acquisitions are feasible and costs are affordable.

An exclusive bus lane, in addition to the right-turn lane, should be considered when right-turn volumes exceed 400 vehicles per hour during the peak hour.



Notes for Comments 1, 2, 3, and 4 are on page 29.

Figure 9. Queue Jumper Bus Bay Layout.

Chapter 3

STREET-SIDE FACTORS

BUS STOP ZONE DESIGN TYPES—Nub

Nubs are a section of sidewalk that extend from the curb of a parking lane to the edge of the through lane (see Figure 10). Nubs have been used as traffic-calming techniques and as bus stops. When used as a bus stop, the buses stop in the traffic lane instead of weaving into the bus stop that is located in the parking lane—therefore, they operate similarly to curb-side bus stops. Nubs offer additional area for patrons to walk and wait for a bus and provide space for bus patron amenities, such as shelters and benches. Other names used for nubs include "curb extensions" and "bus bulbs."

Nubs reduce pedestrian crossing distances, create additional parking (compared with typical bus zones), and mitigate traffic conflicts between autos and buses merging back into the traffic stream. Nubs should be designed to allow for an adequate turning radius for right-turn vehicles. Figure 11 is a schematic of a typical bus stop nub design.

Nubs should be considered at sites with the following characteristics:

- High pedestrian activity,
- Crowded sidewalks,
- Reduced pedestrian crossing distances, and
- Bus stops in travel lanes.

Figure 10. Example of a Nub.

Nubs have particular application along streets with lower traffic speeds and/or low traffic volumes where it would be acceptable to stop buses in the travel lane. Collector streets in neighborhoods and designated pedestrian districts are good candidates for this type of bus stop. Nubs should be designed to accommodate vehicle turning movements to and from side streets.

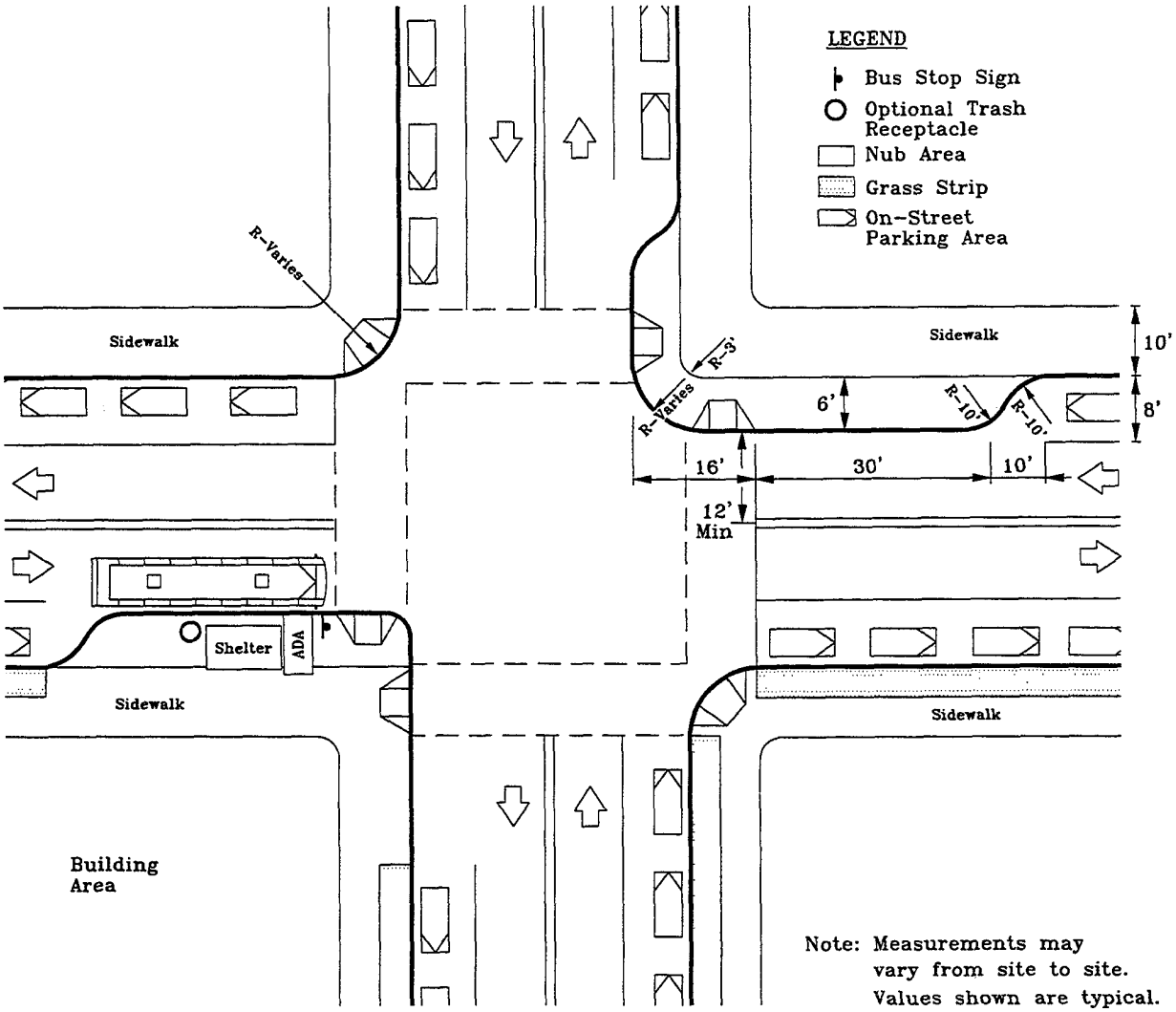


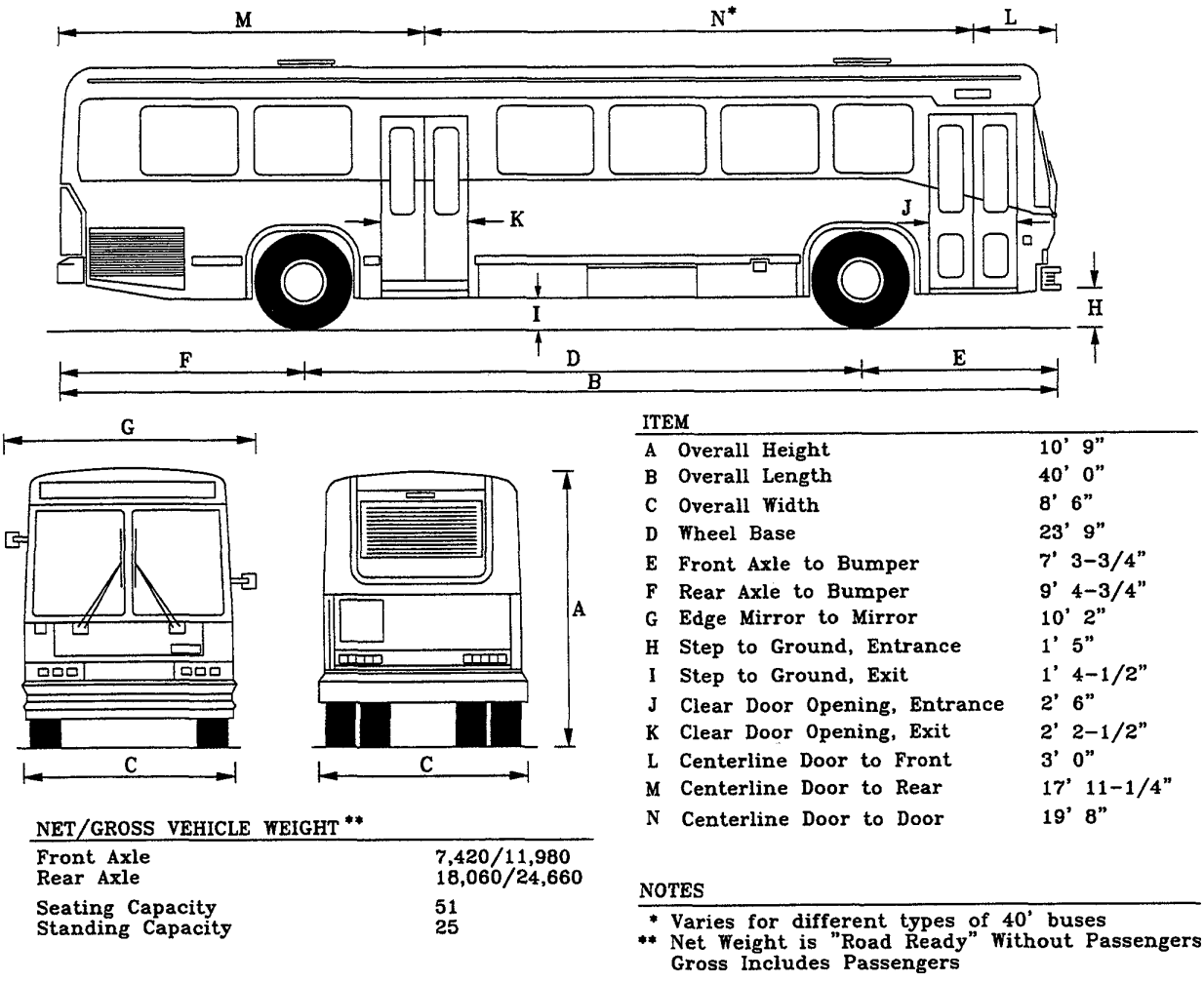
Figure 11. Typical Dimensions for a Nub.

Chapter 3

STREET-SIDE FACTORS

VEHICLE CHARACTERISTICS—Vehicle Types and Dimensions

In the design of facilities for buses, it is important to define a design vehicle that represents a compilation of critical dimensions from those vehicles currently in operation. These dimensions are used when designing roadway features. For example, the weight of the expected vehicle is important to pavement design. The following two basic bus types are commonly used by transit service providers: 1) 40-foot "standard" bus; and 2) 60-foot articulated bus.



ITEM		
A	Overall Height	10' 9"
B	Overall Length	40' 0"
C	Overall Width	8' 6"
D	Wheel Base	23' 9"
E	Front Axle to Bumper	7' 3-3/4"
F	Rear Axle to Bumper	9' 4-3/4"
G	Edge Mirror to Mirror	10' 2"
H	Step to Ground, Entrance	1' 5"
I	Step to Ground, Exit	1' 4-1/2"
J	Clear Door Opening, Entrance	2' 6"
K	Clear Door Opening, Exit	2' 2-1/2"
L	Centerline Door to Front	3' 0"
M	Centerline Door to Rear	17' 11-1/4"
N	Centerline Door to Door	19' 8"

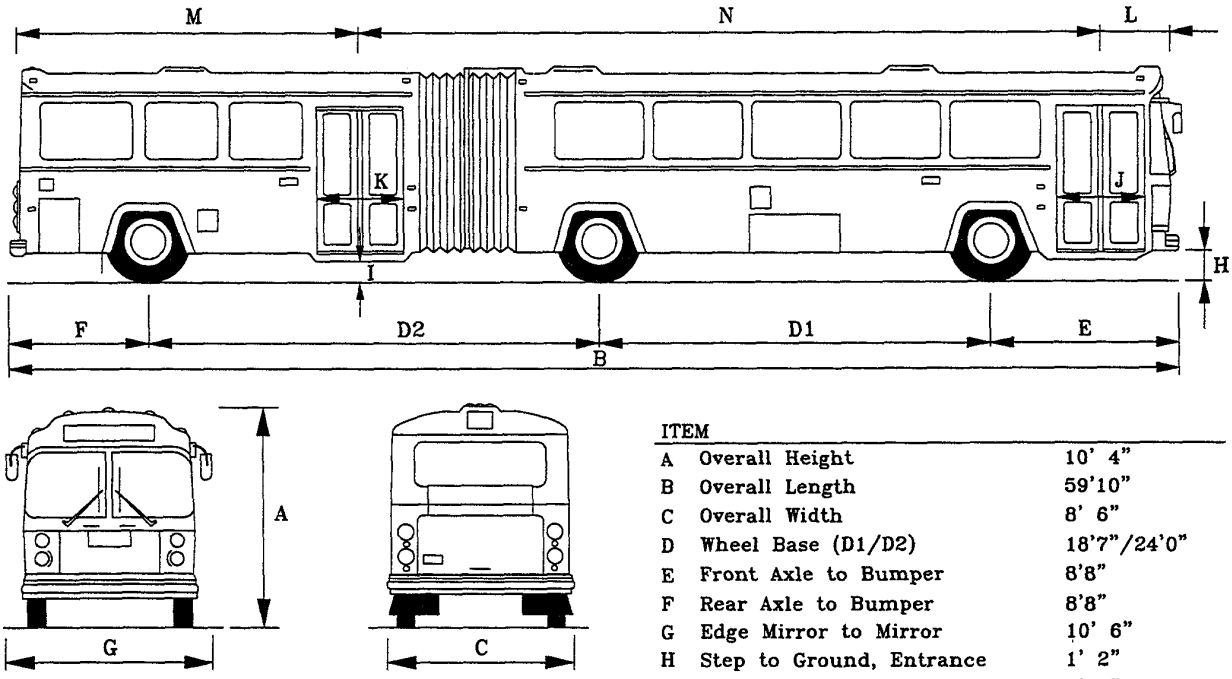
NET/GROSS VEHICLE WEIGHT **	
Front Axle	7,420/11,980
Rear Axle	18,060/24,660
Seating Capacity	51
Standing Capacity	25

NOTES

* Varies for different types of 40' buses
** Net Weight is "Road Ready" Without Passengers
Gross Includes Passengers

Figure 12. Typical Dimensions for 40-Foot Bus.

The standard 40-foot bus and the 60-foot articulated bus are generally the largest buses in a transit fleet and represent the most common designs. (Currently, manufacturers are also producing 30- and 35-foot buses.) Key roadway design features, such as lane and shoulder widths, lateral and vertical clearances, vehicle storage dimensions, and minimum turning radii are typically based on the standard 40-foot bus. The articulated bus, while longer, has a "hinge" near the center of the vehicle that allows maneuverability comparable to the 40-foot bus. Figures 12 and 13 show the dimensions for a 40-foot and 60-foot bus, respectively.



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

NET/GROSS VEHICLE WEIGHT *	
Front Axle	11,800/16,420
Rear Axle	12,130/16,420
Center Axle	14,970/24,250
MAXIMUN BEND ANGLE	
Horizontal	± 36 deg
Vertical	± 11 deg
Seating Capacity	70

* Net Weight is "Road Ready" Without Passengers
Gross Includes Passengers

Figure 13. Typical Dimensions for 60-Foot Articulated Bus.

Chapter 3

STREET-SIDE FACTORS

VEHICLE CHARACTERISTICS—Turning Radium Template

Design templates for minimum turning paths for single-unit (40-foot) and articulated (60-foot) buses are shown in Figures 14 and 15, respectively. The templates are usable for either left turn or right turn designs depending on how the template is oriented (i.e., either face-up for right turn design or face-down for left turn design).

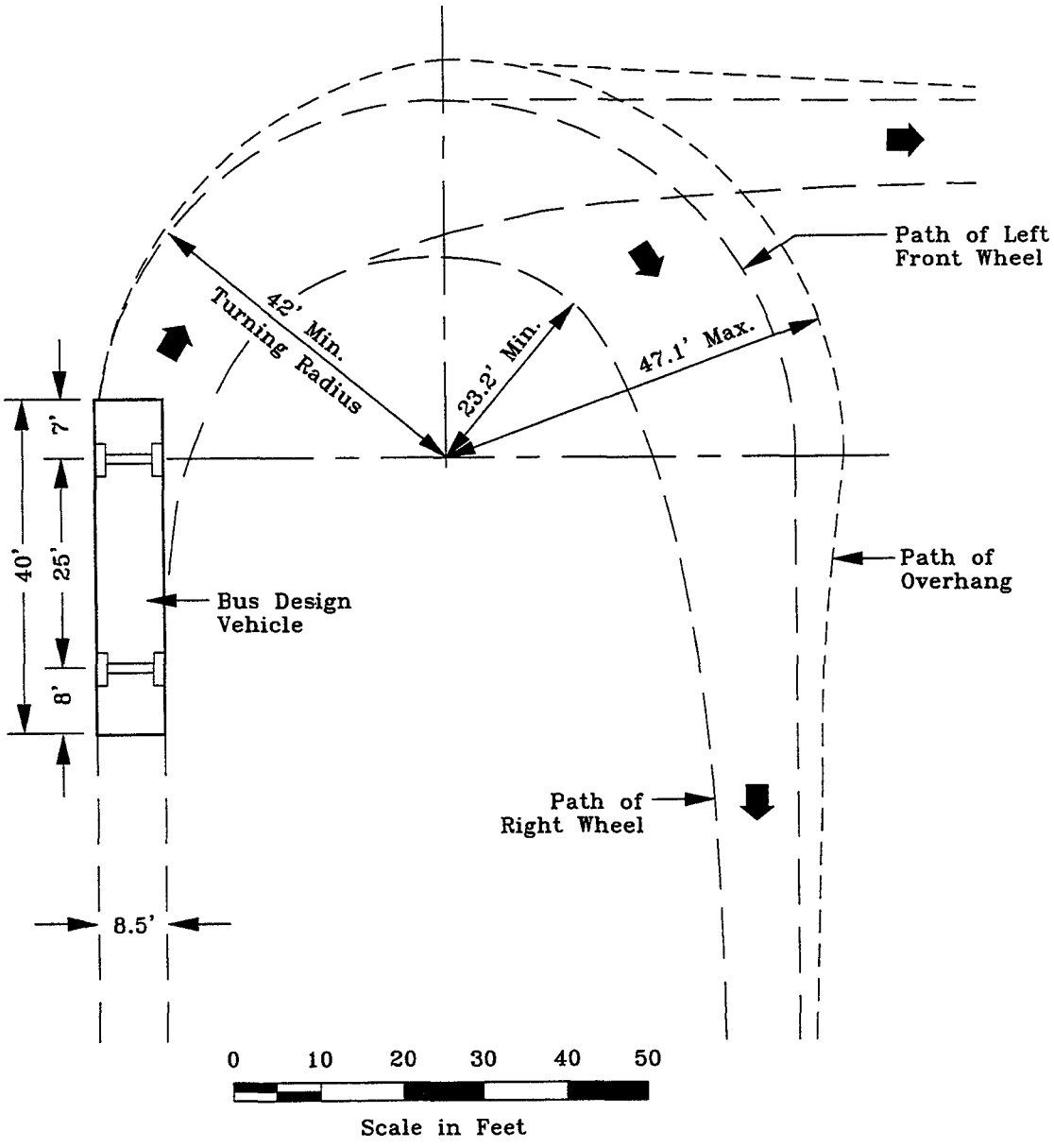


Figure 14. Design Template for Single-Unit (40 foot) Bus.

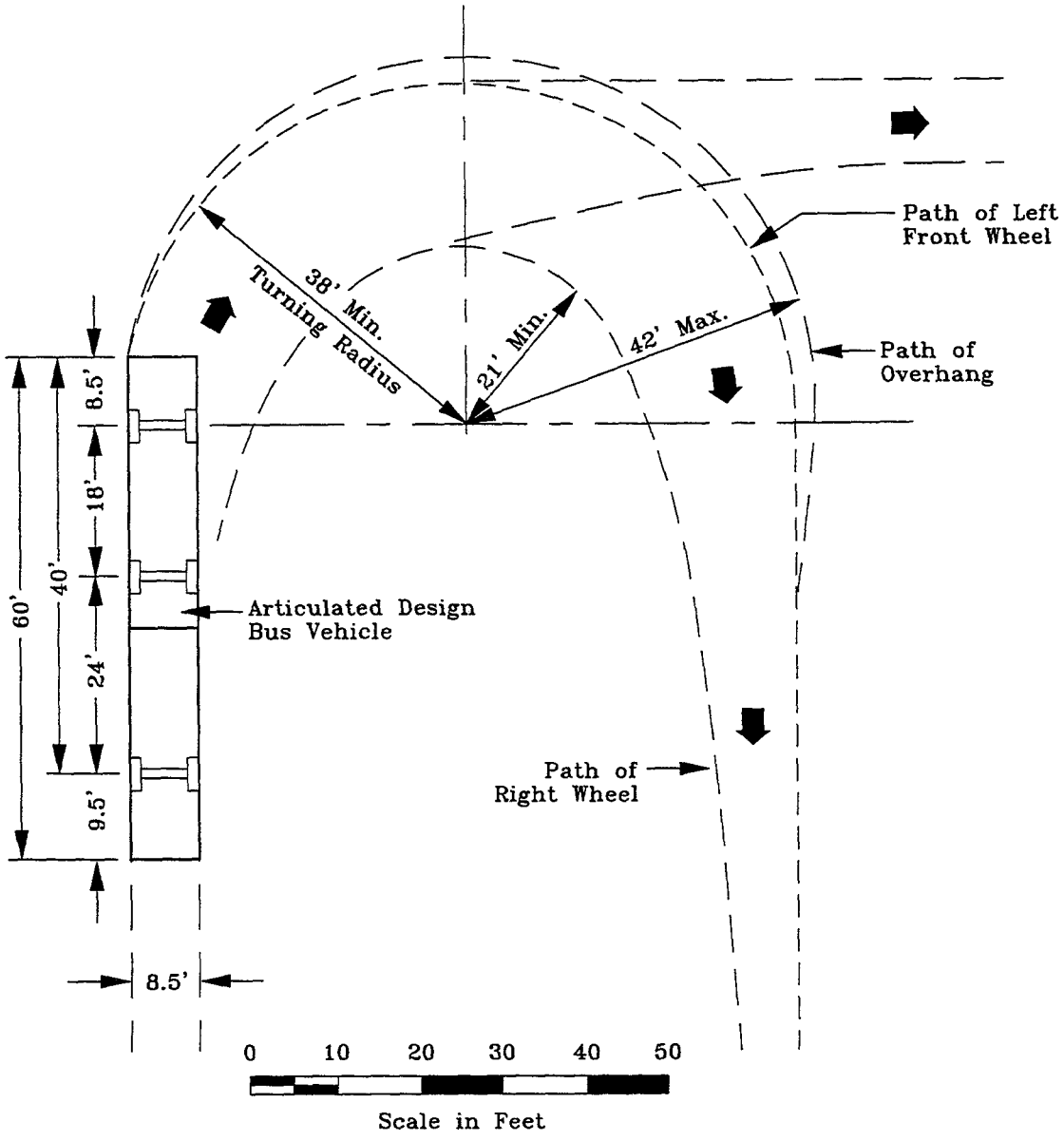


Figure 15. Design Template for Articulated (60-foot) Bus.

Chapter 3

STREET-SIDE FACTORS

VEHICLE CHARACTERISTICS—Wheelchair Lift

Presently, the most common lifts used on buses are conventional wheelchair lifts. Figure 16 illustrates the use of a wheelchair lift. Since the wheelchair lift may be at the front or rear door, bus stop designs need to allow for either possibility. Figure 17 shows the critical dimensions for a wheelchair lift.

Low floor buses can be adjusted so the floor height is approximately 10 inches above the street level. Bus passengers in wheelchairs are then able to reach the sidewalk by using a ramp deployed from the floor of the bus. The length of the ramp typically extends 2 to 3 feet from the edge of the bus for a standard height curb.

Figure 16. Wheelchair Lift in Operation.

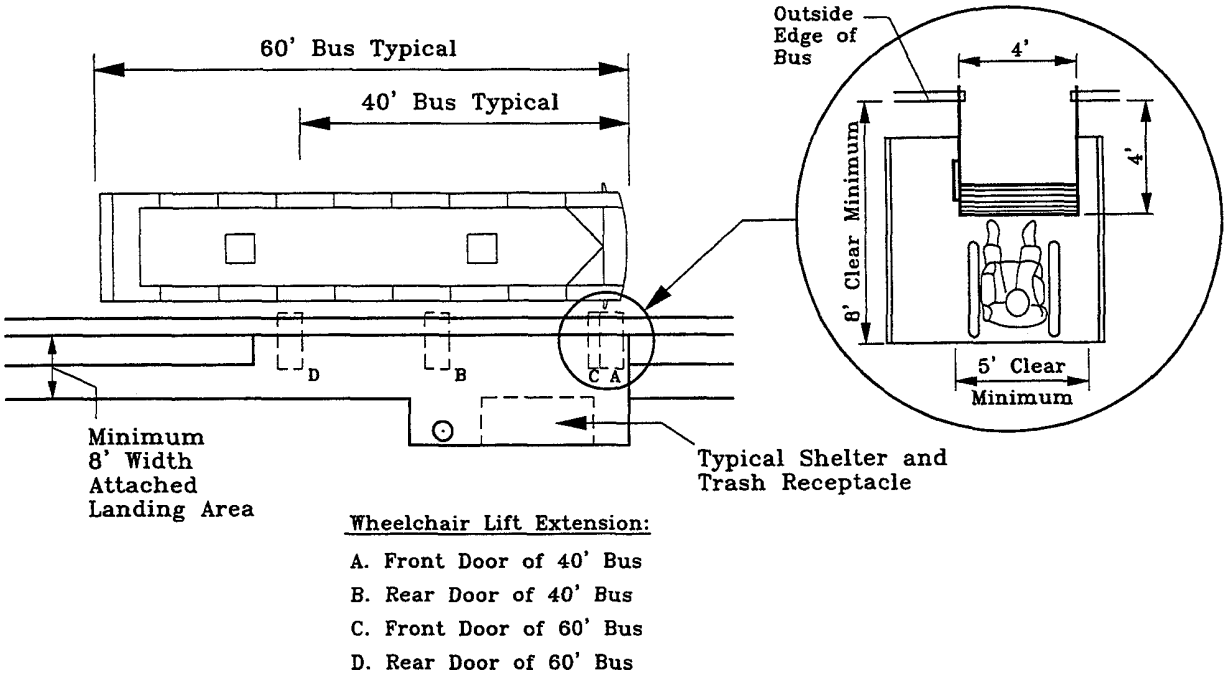


Figure 17. Wheelchair Lift Dimensions.

Several transit agencies now have on-vehicle bus storage programs. In some cases, passengers are allowed to bring their bicycles into the interior of the bus. In others, a bicycle rack is attached to the front of the bus (see Figure 18). These racks generally hold two bicycles. Busturning radius design needs to allow for the additional length of a bus with a bicycle rack attached (generally 3 feet).

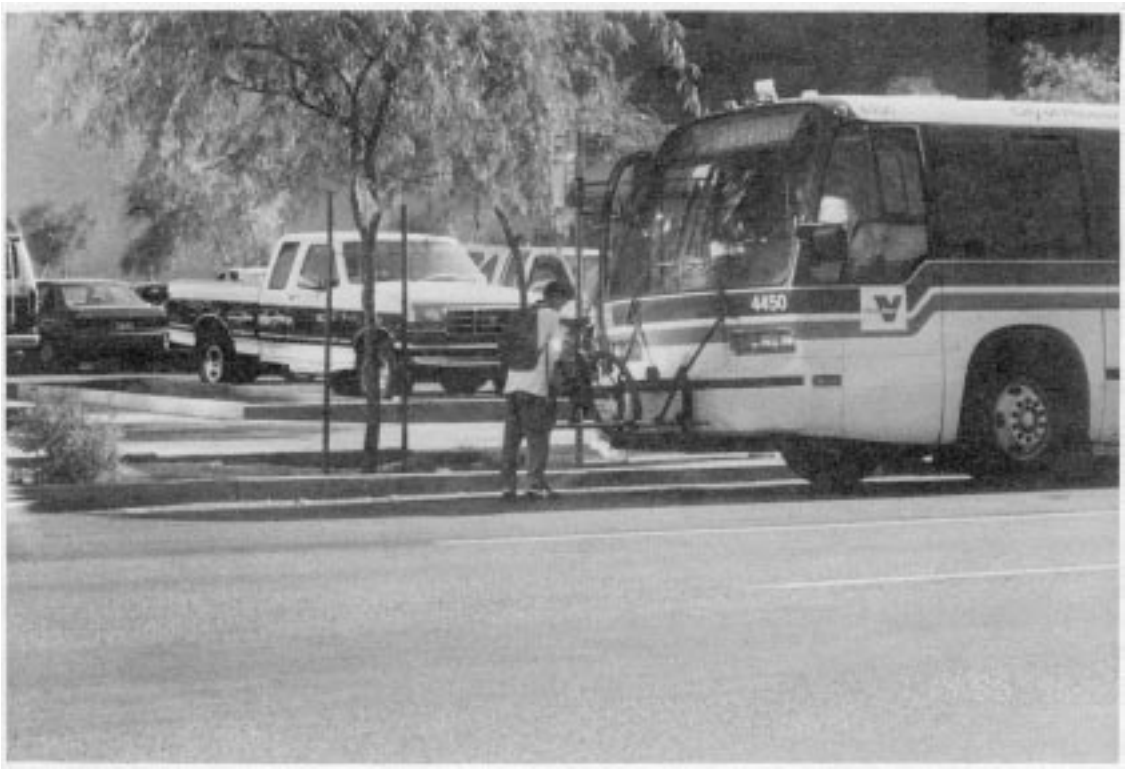


Figure 18. Front-Mounted Bike Rack in Use.

Chapter 3

STREET-SIDE FACTORS

ROADWAY AND INTERSECTION DESIGN—Roadway Design

Roadways and intersections with bus traffic and bus stops should be designed to accommodate the size, weight, and turning requirements of buses. The safety and operation of a roadway improve when these elements are incorporated into the design.

Because of their need to make frequent stops, buses generally travel in the traffic lane closest to the curb. Therefore, consideration of the following bus clearance requirements in roadway design is important.

- Overhead obstructions should be a minimum of 12 feet above the street surface;
- Obstructions should not be located within 2 feet of the edge of the street to avoid being struck by a bus mirror;
- A traffic lane used by buses should be no narrower than 12 feet in width because the maximum bus width (including mirrors) is about 10.5 feet; and.
- Desirable curb lane width (including the gutter) is 14 feet.

Selection of the roadway grade is related to topography and cut and fill material considerations. Typically, the maximum grade for 40-foot buses is between 6 and 8 percent. The recommended grade change between a street and a driveway is less than 6 percent.

An appropriate curb height for efficient passenger-service operation is between 6 and 9 inches. If curbs are too high, the bus will be prevented from moving close to it and the operations of a wheelchair lift could be negatively affected. If curbs are too low or not present, elderly persons and passengers with mobility impairments may have difficulty boarding and alighting. The effective use of low floor buses is also influenced by the height of the curb.

Roadway pavements (or shoulders, if that is where the buses stop) need to be of sufficient strength to accommodate repetitive bus axle loads of up to 25,000 pounds. Exact pavement designs will depend on site-specific soil conditions. Areas where buses start, stop, and turn are of particular concern because of the increased loads associated with these activities. Using reinforced concrete pavement pads (see Figure 19) in these areas reduces pavement failure problems that are common with asphalt. The pad should be a minimum of 11 feet wide (12 feet desirable) with a pavement section designed to accept anticipated loadings. The length of the pad should be based on the anticipated length of the bus that will use the bus stop and the number of buses that will be at the stop simultaneously.

Figure 19. Example of a Bus Pad.

The corner curb radii used at intersections (see C in Figure 20) can affect bus operations when the bus makes a right turn. Some advantages of a properly designed curb radius are as follows:

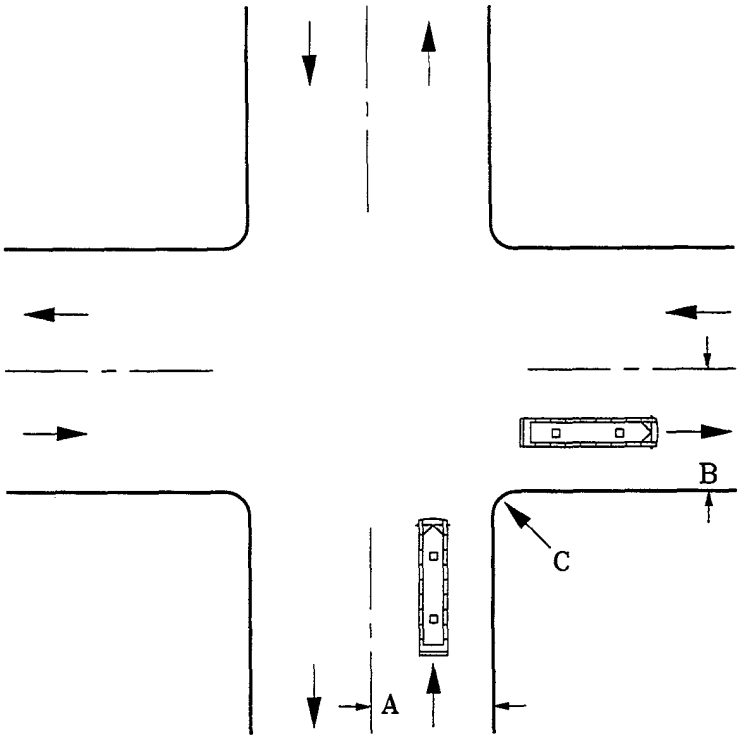
- Less bus/auto conflict at heavily used intersections (buses can make turns at higher speeds and with less encroachment);
- Higher bus operating speeds and reduced travel time; and
- Improved bus patron comfort.

A trade-off in providing a large curb radius is that the crossing distance for pedestrians is increased. This greater crossing distance increases the pedestrians' exposure to on-street vehicles and can influence how pedestrians cross an intersection, both of which are safety concerns. The additional time that a pedestrian is in the street because of larger curb radii should be considered in signal timing and median treatment decisions.

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

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

Figure 20 shows appropriate corner radii for transit vehicles and various combinations of lane widths. This figure can be used as a starting point; the radii values should be checked with an appropriate turning radius template before being incorporated into a final design.



A Approach Width (feet)	B Entering Width (feet)	C Radii* (feet)
12 (1 lane)	12 16 20 24	50 45 40 35
16 (1 lane with 4-foot shoulder)	12 16 20 24	45 40 30 25
20 (1 lane with parking)	12 16 20 24	40 35 30 25

* Assumes no parking on cross street and minimal lane encroachment on opposing travel lanes.

Figure 20. Recommended Corner Radii.

Chapter 3

STREET-SIDE FACTORS

ROADWAY AND INTERSECTION DESIGN—Driveways

Bus stops are commonly located near intersections. Driveways leading to gasoline stations and other developments are also common at intersections. Ideally, bus stops should not be located close to a driveway; however, if the situation cannot be avoided:

- Attempt to keep at least one exit and entrance driveway open for vehicles accessing the development while a bus is loading or unloading passengers.
- Locate the stop to allow good visibility for vehicles leaving the development and to minimize vehicle/bus conflicts. This is best accomplished by placing the stop on the far side of the driveway.
- Locate the stop so that passengers are not be forced to wait for a bus in the middle of a driveway.
- Locate the stop so that patrons board or alight directly from the curb rather than from the driveway.

Transit agencies should work closely with local and state jurisdictions to preserve a safe loading zone for passengers from either a driveway being moved or the construction of new driveways. Cooperation in finding an alternative stop is recommended when driveways moves are unavoidable and may severely affect the bus stop. Driveways within bus bays are of special concern. Relocating a bus bay is expensive and may shift a sometimes unwanted burden to the adjacent property owner.

Figure 21 shows undesirable driveway situations where either visibility is restricted or the only drive into a parking area is blocked. The figure also shows acceptable driveway situations where visibility is enhanced and access is allowed.

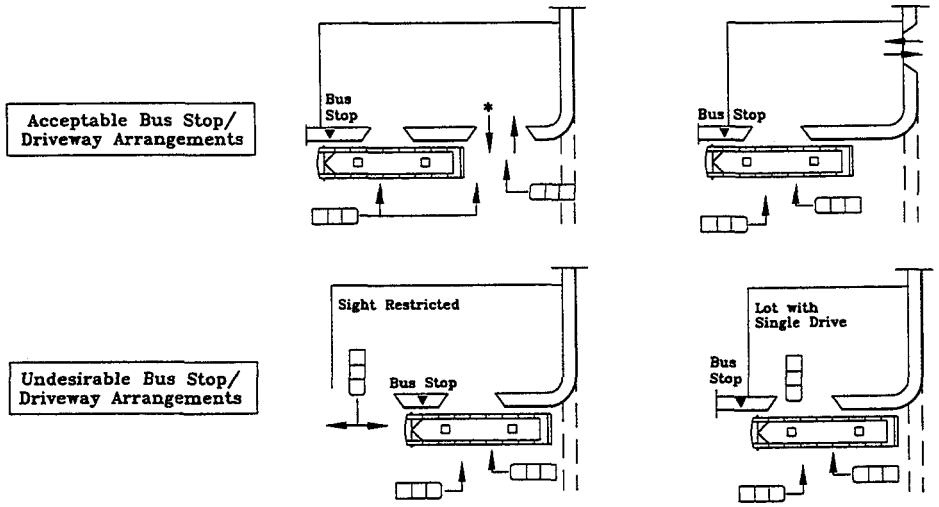


Figure 21. Bus Stop Locations Relative to Driveways.

Bus stops are frequently located at signalized intersections. Traffic signal design should accommodate buses and bus passengers. The following should be considered in designing traffic signal systems in new developments or upgrading/redesigning signals at existing intersections:

- Location of bus stops should be coordinated with traffic signal pole and signal head location. Bus stops should be located so that buses do not totally restrict visibility of traffic signals from other vehicles. (These problems can be effectively addressed by using far-side bus stops.)

- The use of a far-side, curbside stop at a signalized intersection can cause vehicles stopping behind the bus to queue into the intersection. A far-side bus bay is preferred at a signalized intersection.

- Since all bus passengers become pedestrians upon leaving the bus, it is important to have "WALK" and "DON'T WALK" indicators at signalized intersections at bus stops.

- When traffic-actuated signals are installed, pedestrian push buttons should also be installed to (1) activate the "WALK" and "DON'T WALK" indicators or (2) extend the signal's green indicator so that additional time needed by the pedestrian to cross the street is provided.

- Near-side stop areas are often located between the advance detectors for a traffic signal and the crosswalk. Detectors should be located at the bus stop to enable the bus to actuate the detector and the signal controller to obtain or extend the green light. Without a detector, a bus is forced to wait until other traffic approaching from the same direction actuates the signal controller.

- Timing of traffic signals should also reflect the specific needs of buses. Longer clearance intervals may be required on higher speed roadways with significant bus traffic. Vehicle passage times must provide adequate time for a bus to accelerate from the bus stop into the intersection. Intersections adjacent to railroad tracks should incorporate the need for buses to stop at railroad crossings into their timing and detection.

Chapter 3

STREET-SIDE FACTORS

ROADWAY AND INTERSECTION DESIGN—Sign Locations

Proper signs at bus stops are an important element of good transit service. Signs serve as a source of information to patrons and operators regarding the location of the bus stop and are excellent marketing tools to promote transit use. For example, letter styles, sign appearance, and color choice should be unique to the transit system so that passengers can readily identify bus stops. Doublesided signs which provide for visibility from both directions and reflectorized signs for night time visibility are preferred.

Bus stop signs should be placed at the location where people board the front door of the bus. The bus stop sign shows the area where passengers should stand while waiting for the bus. It also 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. Figure 22 shows typical bus stop sign placement standards.

Transit agencies and local and/or state jurisdictions should coordinate efforts when deciding locations for bus stops and sign posts. In some cases, a shared sign post can be used to reduce the number of obstructions in high pedestrian volume locations. Bus stop signs are also commonly located on a shelter or existing pole (such as a street light). The signs should not be obstructed by trees, buildings, or other signs. Bus stop sign posts that are not protected by a guardrail or other feature should be a break-away type to minimize injuries and vehicular damage, and to facilitate replacement of the post.

Pavement markings associated with bus stops are generally installed and maintained by local authorities. The most common marking is a yellow or red painted curb at the bus stops. Stop lines and/or crosswalk markings are also desirable when the bus stop location is at an intersection.

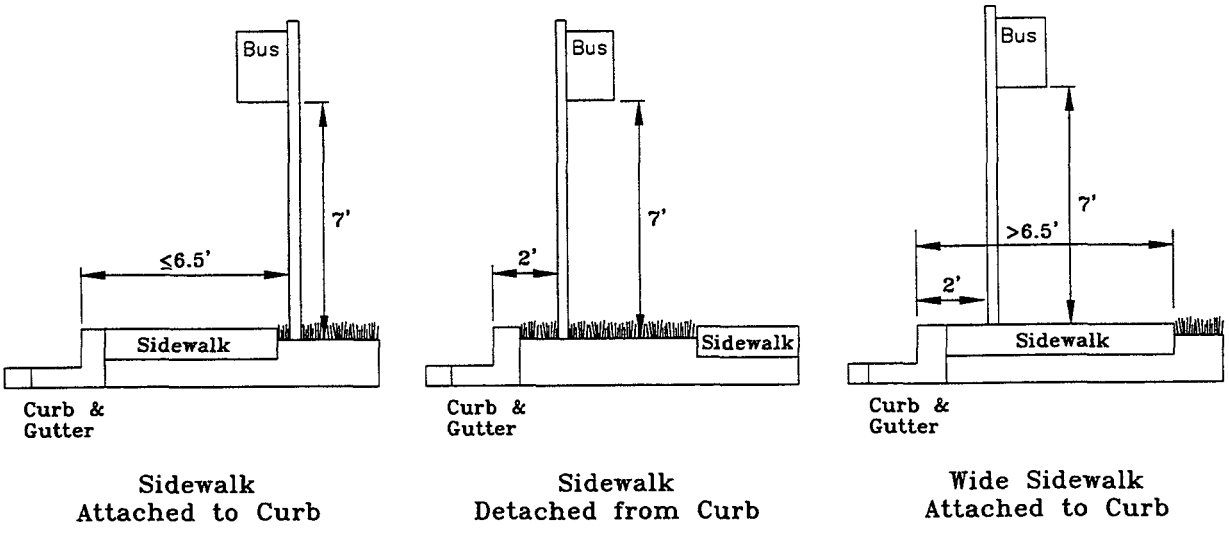
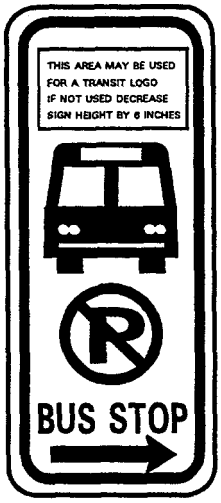


Figure 22. Guidelines for Bus Stop Sign Placement.

Traffic regulations prohibit parking, standing, or stopping at bus stops. These regulations can be established only when authorized by appropriate laws or ordinances. In general, an ordinance is needed to authorize and require a transit agency to establish bus stop locations and to designate bus stops with the appropriate signs. Another ordinance prohibits other vehicles from stopping, standing, or parking in officially designated and appropriately signed bus stops. An allowance for passenger vehicles to stop to load or unload passengers in the bus stops may be included.

The *Manual on Uniform Traffic Control Devices (MUTCD)* (maintained by the Federal Highway Administration) includes general specifications for no parking signs at bus stops and curb markings to indicate parking restrictions, as well as guidelines for the placement of the signs. Suggested signs in the *MUTCD* are shown in Figure 23. The R7-107a sign is a permissible alternative design for the R7-107 sign shown in the *MUTCD.* Other alternative designs discussed in the *Manual* may include a transit logo, an approved bus symbol, a parking prohibition, the words BUS STOP, and right-, left-, and double-headed arrows. The preferred bus symbol color is black, but other dark colors may be used. Additionally, the transit logo may be shown on the bus face in the appropriate colors instead of placing the logo separately. The reverse side of the sign may contain bus routing information.

The *MUTCD* also discusses the use of curb markings to indicate parking restrictions. At the option of local authorities, special colors (none are specified in the *MUTCD*) may be used for curb markings. When signs are not used, restrictions should be stenciled on the curb.



R7-107a
12" x 30"

R7-107
12" x 18"

Figure 23. *MUTCD* Bus Stop Signs.

Chapter 3 STREET-SIDE FACTORS

SAFETY

As with all aspects of roadway design and bus operations, an important element in the design of bus stops is safety. General safety considerations for bus stops include the following:

- The bus stop must be located so that passengers may alight and board with reasonable safety.

- The stopped bus will affect sight distance for pedestrians using the parallel and transverse crosswalks at the intersection.

- The stopped bus will also affect sight distance for parallel traffic and cross traffic. For instance, at a near-side stop, vehicular right turns are facilitated and sight distance is improved when the bus stop is set back from the crosswalk.

- The bus affects the traffic stream as it enters or leaves a stop.

A recently completed study on pedestrian accidents found that approximately 2 percent of pedestrian accidents in urban areas and 3 percent in rural areas are related to bus stops. These accidents generally involved pedestrians who stepped into the street in front of a stopped bus and were struck by vehicles moving in the adjacent lane. This situation develops when the line of sight between the pedestrian and an oncoming vehicle is blocked, or when the pedestrian simply does not look for an oncoming vehicle. This type of accident can be reduced by relocating the bus stop from the near side of an intersection to the far side, thus encouraging pedestrians to cross the street from behind the bus instead of in front of it. This makes pedestrians more visible to motorists approaching from behind the bus. Not only can far-side bus stops reduce the potential for bus stop accidents involving pedestrians, they are also less likely to obscure traffic signals, signs, and pedestrian movements at intersections, as opposed to near-side bus stops. Also, conflicts between buses and right-turning vehicles can be reduced by using far-side bus stops. Problems may occur, however, when cars illegally park in far-side bus stops preventing buses from completely clearing the cross street.

Along with the minimum desirable curb length, the condition of the curb lane and the curb height can influence the safety and efficiency of bus-passenger operation. When poor pavement conditions exist in the curb lane, bus drivers often avoid it and stop the buses away from the curb. Boardings and alighting operations away from the curb are more hazardous for riders than curb operations, especially for elderly persons and passengers with disabilities during inclement weather. The additional hazard appears to result from the increased height between the ground and the first step of the bus and from moving vehicles (such as bicycles) between the curb and the bus.

Lighting is important for safety. A brightly lit bus stop makes it easier for the transit operator to observe waiting passengers and allows motorists to see boarding and alighting pedestrians. Because the step well is the most hazardous area on a transit vehicle for accidents, a brightly lit well will assist boarding and alighting passengers as they judge distances and locations of steps and curbs. Auxiliary lighting in the step well is required on new buses, but it will be years before this feature is universal.

The bus stop should be located either before the turn lane (for through routes) or at the far side of the intersection in areas that have a dedicated right-hand turn lane. Transit agencies should work closely with local and state jurisdictions wherever traffic improvements affect the safety of a bus stop. The addition of turn lanes will often require advance planning for incorporating transit accommodations as part of the highway project and/or for relocating the bus stop to an acceptable location.

Chapter 3

STREET-SIDE FACTORS

STREET-SIDE PLACEMENT CHECKLIST

Several items should be considered when designing and locating a bus stop on a roadway. The following checklist of street-side items should be reviewed with each design because it brings together related issues that can have a significant impact on the safe operations of the bus stop.

- **Standardization:** One of the most critical factors in the street-side design and placement of a bus stop involves standardization or consistency. Standardization is desirable because it results in less confusion for bus operators, passengers, and motorists. Consistency in design, however, can be difficult to achieve since traffic, parking loss, turning volume, community preference, and political concerns can influence the decisions.

- **Periodic Review:** A periodic review of bus stop conditions (both street side and curb side) is recommended to ensure the safety of bus passengers. This will encourage the timely reporting of items such as missing bus stop signs and poor pavement.

- **Near-Side/Far-Side/Midblock Placement:** Each type of placement has advantages and disadvantages. In general, each bus stop location should be evaluated individually to decide the best placement for the stop.

- **Visibility:** Bus stops should be easy to see. If the bus stop is obscured by nearby trees, poles, or buildings, the bus operator may have difficulty locating the stop. More importantly, however, motorists and bicyclists may not know of its existence and will be unable to take necessary precaution when approaching and passing the stop. In addition, visibility to pedestrians crossing a street is also an important consideration in areas that permit "right turns on red."

- **Bicycle Lanes and Thoroughfares:** When a bike lane and a bus stop are both present, the operators need to be able see cyclists in both directions while approaching the stop. Sufficient sight distance for cyclists to stop safely upon encountering a stopped bus is also needed.

- **Traffic Signal and Signs:** Bus stops should be located so that buses do not restrict visibility of traffic signals and signs from other vehicles. Because all bus passengers become pedestrians upon leaving the bus, pedestrian signal indicators should be considered at nearby signalized intersections.

STREET-SIDE FACTORS

Chapter 3

STREET-SIDE PLACEMENT CHECKLIST

- **Roadway Alignment:** Horizontal and vertical roadway curvature reduces sight distance for bus operations, motorists, bicyclists, and pedestrians. Additionally, bus stops located on curves make it difficult for the bus operator to stop the bus parallel to the curb and safely return to the driving lane. Where possible, bus stops should be located on sections of relatively straight and flat roadway. Trees and poles should not obstruct the visibility of the bus operator for cross traffic and passenger and pedestrian movement.

- **Driveways:** Avoid locating bus stops close to a driveway. If placing a bus stop close to a driveway is unavoidable (for example, to lessen the loss of parking in a commercial area), keep at least one driveway open to vehicles accessing the adjacent development while a bus is loading or unloading passengers. Also, locate bus stops to allow full visibility for vehicles leaving an adjacent development and to minimize vehicle/bus conflicts. Placing bus stops on the far side of driveways will minimize conflicts; however, sight distance for left-turning vehicles from the driveway will still be a concern.

- **Location of Pedestrian Crosswalks:** A minimum clearance distance of 5 feet between a pedestrian crosswalk and the front or rear of a bus at a bus stop is desirable.

- **Location of the Curb:** Where possible, locate stops where a standard curb height of 6 inches exists. Bus steps are designed with the assumption that the curb is the first step. It is more difficult for elderly persons and passengers with mobility impairments to board and alight from the bus if the curb is absent or damaged.

- **Street Grades:** Where possible, bus stops should not be located on an upgrade in a residential area, since the bus engine noise created when the vehicle accelerates from a stop will bother area residents. Placing bus stops on steep grades should be avoided if slippery winter conditions prevail.

- **Road Surface Conditions:** Since alighting passengers generally move from their seats when the bus decelerates on approach to a bus stop, do not locate a bus stop where the roadway is in poor condition such as areas with broken pavement, potholes, or ruts or where a storm drain is located. The resultant motion of the bus in such a situation may cause bus passengers to fall and injure themselves. Boarding and standing passengers are also susceptible to falls or injuries where poor pavement conditions or low drainage basins exist.

ATTACHMENT 3

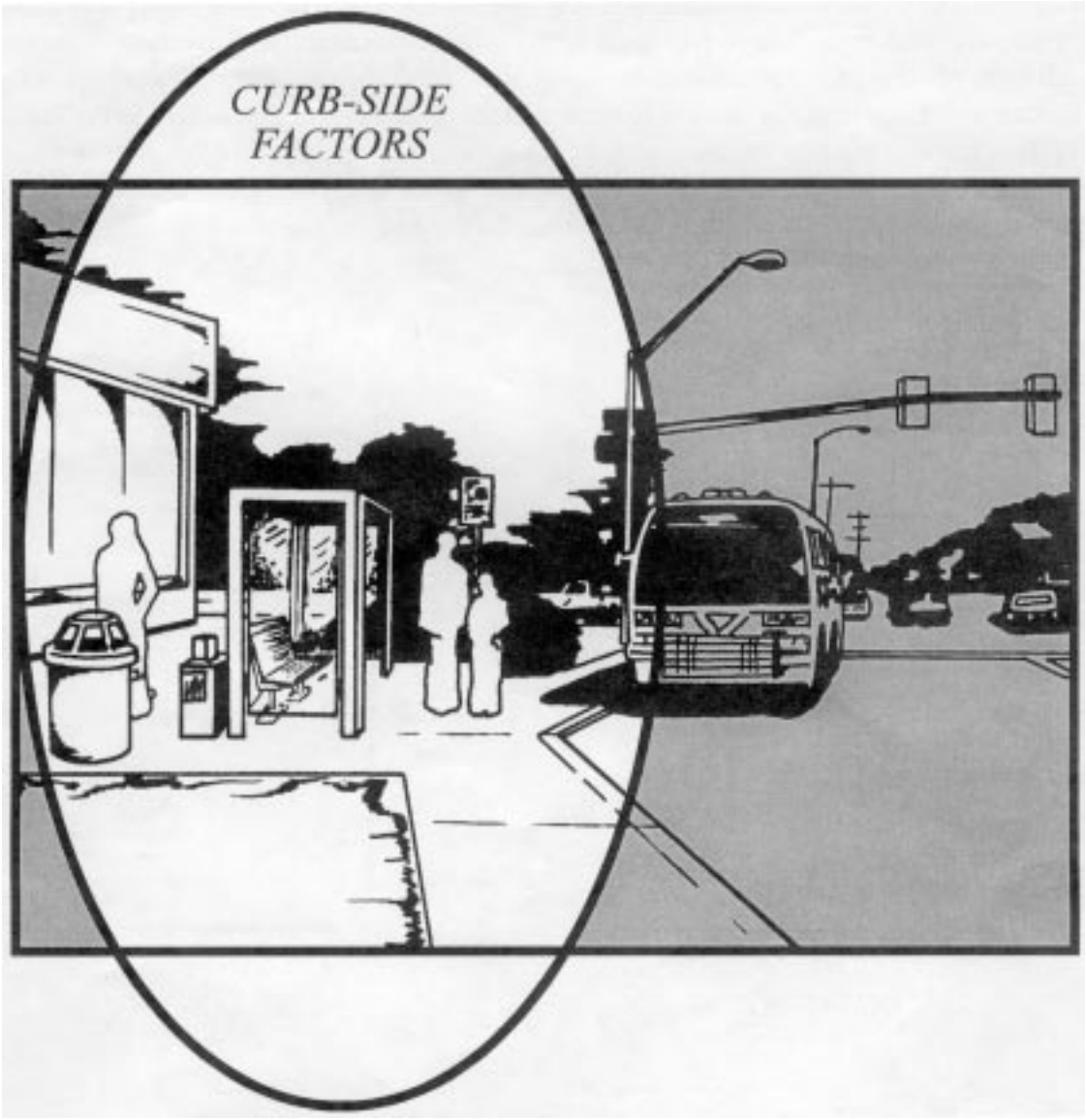
TCRP Report 19 - Chapter 4
Street-Side Factors

CURB-SIDE FACTORS

Chapter 4

ORGANIZATION

Curb-side factors include those factors and issues that can affect the comfort, safety, and convenience of bus patrons. The information in this chapter can be used by transit professionals to provide safe, clean facilities at the bus stop. The chapter also provides information on how to choose bus stop locations that improve access and convenience in pedestrian-friendly communities. Areas of discussion include shelter design and placement, amenities, and enhancing bus patron comfort at bus stops. Also of value to transit professionals are tables that compare the advantages and disadvantages of the various amenities that can be included at the bus stop. A checklist provided at the end of the chapter refers to the various curb-side elements associated with bus stop design and location.



Chapter 4

CURB-SIDE FACTORS

PEDESTRIAN ACCESS—Patron Access

Providing defined access to and from the bus stop is important. Sidewalks should be constructed of impervious non-slip material and should be well drained. Access to the bus stop from the intersection or land use should be as direct as possible. When possible, sidewalks and bus stops should be coordinated with existing street lights to provide a minimum level of lighting and security. To accommodate wheelchairs, sidewalks should be a minimum of 3 feet wide (preferably 4 to 5 feet wide) and equipped with wheelchair ramps at all intersections. Other improvements include defined pedestrian crosswalks and signals at intersections. Pedestrian enhancements, such as sidewalks, should be coordinated with roadway improvements to help improve bus patron comfort and convenience.

Installation of a discontinuous sidewalk from the intersection to the bus stop is one way to achieve greater patron access to the bus stop in areas with limited or no sidewalk coverage. Although, the sidewalk may not continue toward the next land use or along the roadway, this strategy is the first step toward providing complete access to the bus stop. This ensures that access to the bus stop is not through uneven grass or exposed soil, which can be further impaired by poor drainage and surface changes during inclement weather. People who are elderly or have disabilities may find access to the bus stop difficult as well. See Figure 24 for an example.

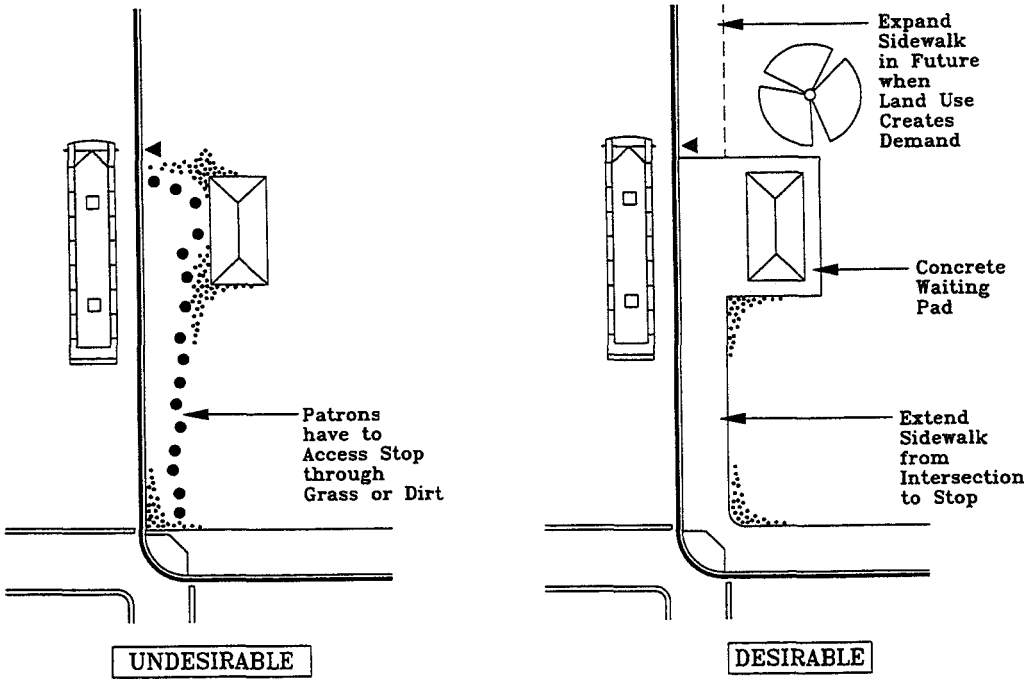


Figure 24. Example of Providing Access In Developing Regions.

Bus patrons should encounter defined pathways from the sidewalk to the back-face of the curb. To prevent poor access from the sidewalk to the curb, a waiting pad and an accessway from the waiting pad to the curb should be installed. When the sidewalk is parallel and directly adjacent to the curb, the waiting pad should be installed directly behind the sidewalk. However, when the sidewalk is far from the curb, paved access from the waiting pad to the curb is necessary. The waiting pad and accessway should be constructed of impervious non-slip material, preferably concrete or asphalt, and have proper drainage. Figure 25 presents two different waiting pad location scenarios for providing paved connections between the bus waiting pad and the curb.

Patrons should not have to walk through grass or exposed soil to reach the bus. In such cases, the areas between the sidewalk, bus stop, and curb can become worn and decline to muddy areas during inclement weather. Snow accumulation from road clearings during the winter months can also create additional access problems in the space between the sidewalk and curb.

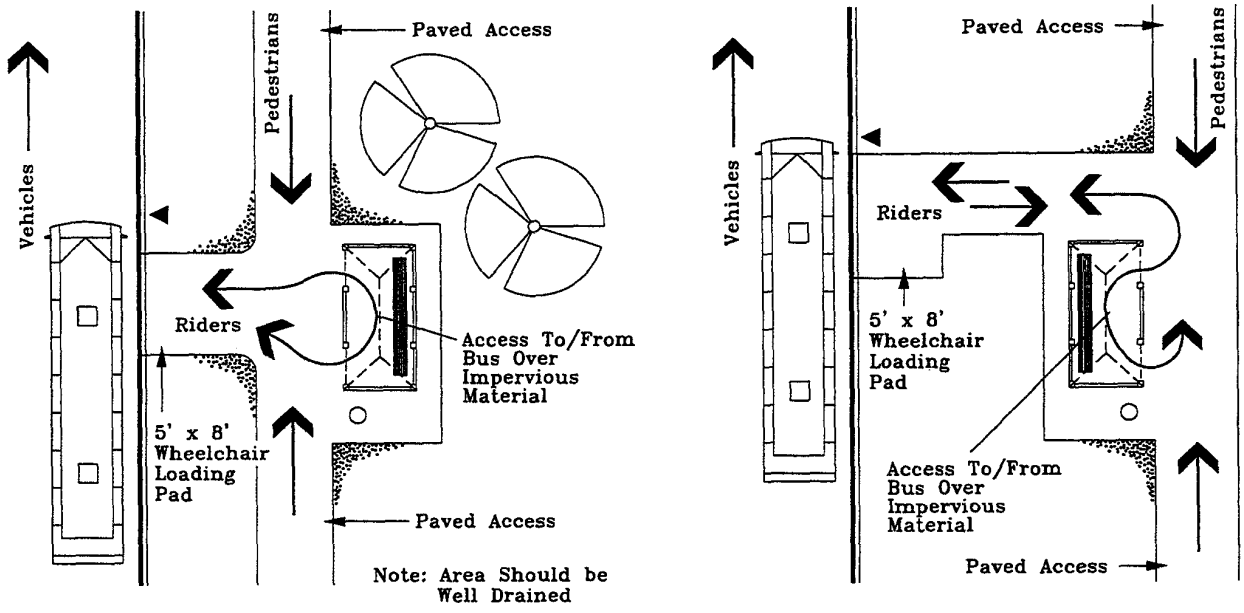


Figure 25. Examples of Providing Access from the Waiting Pad to the Curb.

Chapter 4

CURB-SIDE FACTORS

PEDESTRIAN ACCESS—Coordinating Access with Commercial or Business Development

A strategy to improve pedestrian access at or to bus stops is to coordinate development with the location of the bus stop. Coordination and cooperation with the landowner or developer 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. Pedestrian improvements include defined or designated walkways through parking lots and openings or gates through walls. Accessways can be as elaborate as a landscaped sidewalk through the parking lot or as minimal as painted walkways that caution drivers and direct pedestrians. As with any pedestrian improvement, strict adherence to mobility clearances, widths, and slopes should be followed to improve access for persons with disabilities. Safety improvements and shorter walking times can be achieved by implementing such strategies.

Another solution is to place buildings closer to the road and place parking to the rear and sides of buildings. Figure 26 is an example of coordinating transit with a hypothetical business office complex by designing defined pedestrian accessways and providing a gate through the fence. Another example of re-orienting the building or changing the location of the parking is illustrated in Chapter 2 as a Hypothetical Medical Center.

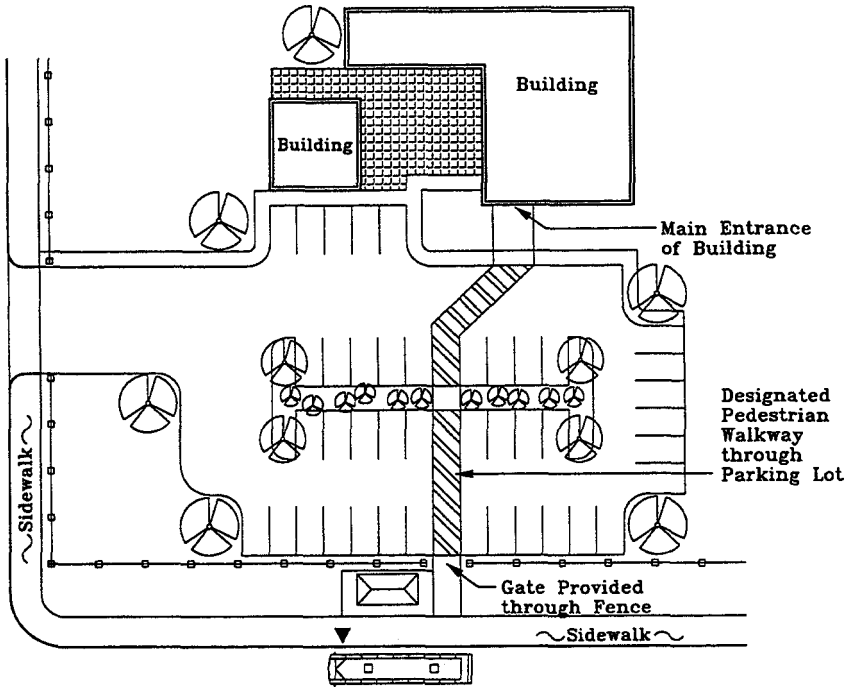


Figure 26. Pedestrian Improvements at a Hypothetical Business Complex.

Bus passengers need efficient ways to reach the bus stop from their residences. Transit agencies need to be involved early in the development approval process to reduce walking times and improve direct access to and from the bus stop. Sidewalk placement that is coordinated with land use and bus stop locations is critical to encouraging the use of transit.

Concerns over residential security have led to a proliferation of walled residential communities that restrict access to a limited number of entry and exit points. By doing so, walking times to bus stops may be increased because direct access may not be available. Circuitous or curvilinear sidewalks can also increase walking times and create coordination problems for the transit agency when choosing the final bus stop location. Curvilinear sidewalks along a street may not align with the final stop destination and may result in access problems through grass, berms, or other landscaping features.

Coordinating sidewalk design and placement is needed between developers and transit agencies to ensure direct access to a paved bus stop. Designing gates, openings through walls, and installing direct sidewalks in residential communities can be coordinated with developers to reduce walking times from the land use to the bus stop. Figure 27 is an example of coordinating access points and sidewalk design with the location of the bus stop.

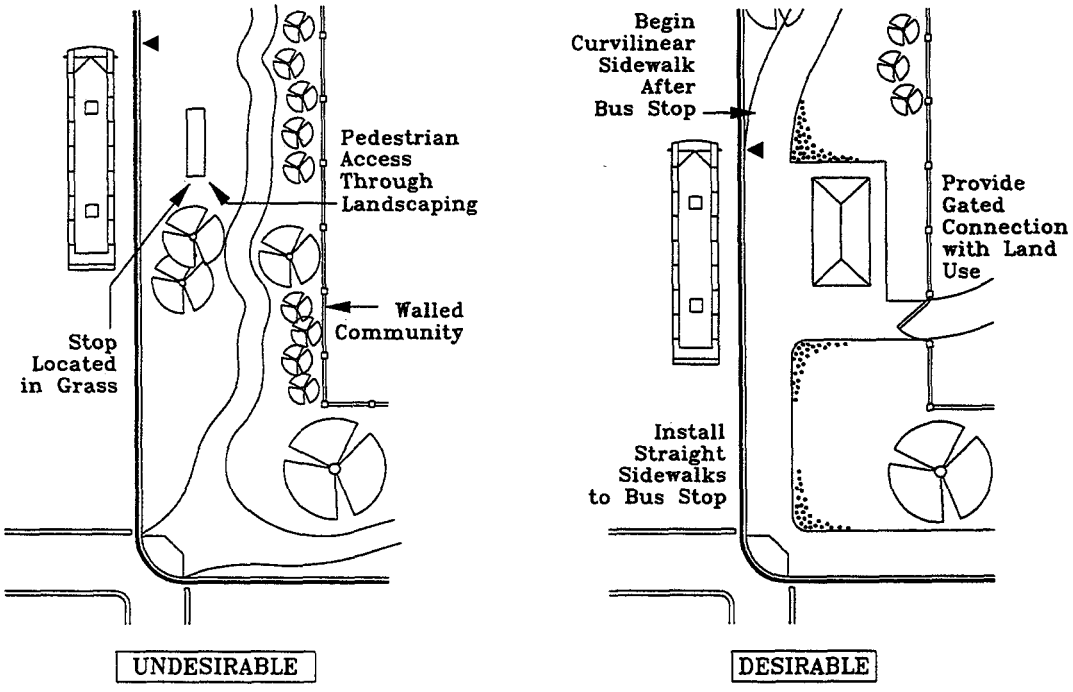


Figure 27. Example of Coordinating Transit with Residential Development Patterns.

Chapter 4

CURB-SIDE FACTORS

ADA—Accessibility Guidelines

The Americans with Disabilities Act of 1990 (ADA) is broad legislation intended to make American society more accessible to people with disabilities. It consists of five sections or titles (employment, public services, public accommodations, telecommunications, and miscellaneous). Titles II and III (public services and public accommodations) affect bus stop planning, design, and construction. Although the definition of disability under the ADA is broad, bus stop placement and design most directly affect persons with mobility and visual impairments. These impairments, which relate to the more physical aspects of bus stop accessibility, have received the most attention.

Making new stops conform to ADA physical dimension requirements is relatively easy. Modifying existing stops to comply with ADA, though desirable from an accessibility perspective, is not required under ADA. Modification of existing stops is more difficult, especially if the stops are at sites with limited easement or not subject to the transit agency's control, such as shopping malls, on state rights-of-way, or suburban subdivisions.

The ADA, however, is concerned with more than physical dimensions. It also involves accessibility from the point of origin to the final destination. For example, to get to the bus stop, individuals with limited mobility or vision need a path that is free of obstacles, as well as a final destination that is accessible. A barrier-free bus stop or shelter is of little value if the final destination is not accessible. Though the ADA does not require retrofitting transit vehicles with lifts, an accessible vehicle is clearly a critical link in the barrier-free trip. Full accessibility is more difficult to achieve when different organizations are responsible for different portions of the path (which is usually the case). Either way, the "equal access" provisions of the ADA require that the route for persons with limited mobility or vision be as accessible as the route used by those without disabilities. A person with disabilities should not have to travel further, or use a roundabout route, to get to a designated area.

Basic Principles for Bus Stop Design and Location to Conform to ADA

Basic aspects of design exist that encourage accessibility and are applicable to most situations. Specific dimensions are available from several references, some of which are listed below. Some general design considerations involve obstacles, surfaces, signs, and telephones.

Obstacles

Examine all the paths planned from the alighting point at the bus stop to destinations off the bus stop premises. Determine whether any protrusions exist that might restrict wheelchair movements. If protrusions exist and they are higher than 27 inches or lower than 80 inches, a person with a vision impairment may not be able to detect an obstacle (such as a phone kiosk) with a cane. A guide dog may not lead the person with the impairment out of the path. Although it may not be the transit agency's responsibility to address accessibility problems along the entire path, an obstacle anywhere along the path may make it inaccessible for some transit users with disabilities.

Surfaces

Surfaces must be stable, firm, and slip-resistant. Such provisions are beneficial for all transit users, but especially for those who have disabilities. Avoid abrupt changes in grade, and bevel those that cannot be eliminated. Any drop greater than 1/2 inch or surface grade steeper than 1:20 requires a ramp.

Signs

Signs providing route designations, bus numbers, destinations, and access information must be designed for use by transit riders with vision impairments. Specific guidelines are given for these signs in Section 4.30 of *Accessibility Guidelines for Buildings and Facilities, Transportation Facilities and Transportation Vehicles.* In some cases, two sets of signs may be needed to ensure visibility for most users and to assist users with sight limitations. Route maps or timetables are not required at the stop, though such information would be valuable to all passengers.

Telephones

Telephones at bus stops are not required under ADA, but if telephones are in place, they must not obstruct access to the facility and must be suitable for users with hearing impairments. At least one phone must be accessible for wheelchair users. Telephone directories must also be accessible.

Figure 28 illustrates a design approach to a bus stop with a shelter that would meet ADA requirements.

Chapter 4

CURB-SIDE FACTORS

ADA—Accessibility Guidelines

Accessible Bus Stop Pad & Shelter
Minimum Dimensions

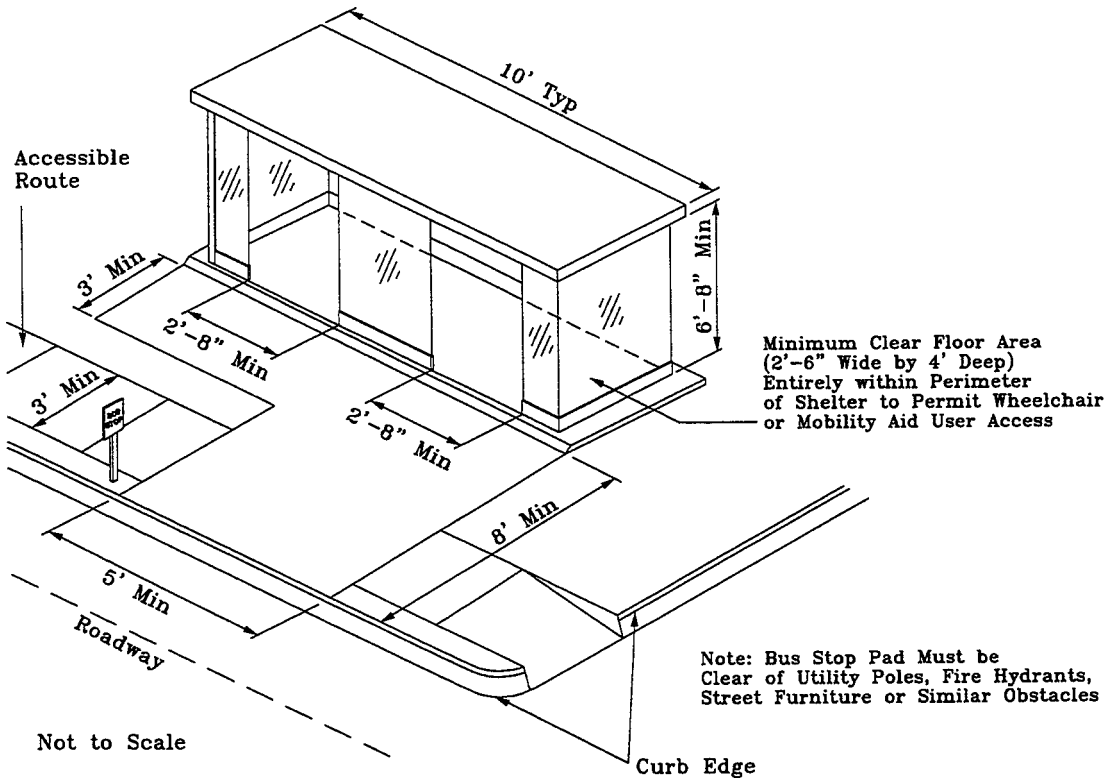


Figure 28. Shelter Design Example to Meet ADA Requirements.

Resources and References

An excellent guide to the design of bus stops (as well as other facilities) for ADA compliance is

> *Americans with Disabilities Act: Accessibility Guidelines for Buildings and Facilities, Transportation Facilities, and Transportation Vehicles.* U. S. Architectural and Transportation Barriers Compliance Board, Washington, DC, 1994. It is commonly known as the *ADA Guide.*

Another useful publication, which translates the *ADA Guide* accessibility guidelines into specific design parameters, is

> *Accessibility Handbook for Transit Facilities.* Federal Transit Administration, Report No. FTA-MA-06-0200-92-1, July 1992. Prepared by the Ketron Division of Bionetics Corp. This document is available through the National Technical Information Service (NTIS), Springfield, VA 22161.

As civil rights legislation, the ADA goes beyond physical dimensions to include policy and practice. Many of these issues will be resolved through experience and in the courts. Various sources are available for monitoring the current status of the ADA and its specific provisions. These include legal journals, ADA-specific newsletters, and World Wide Web "home pages." Examples of each are as follows:

> *Temple Law Review* and *Transportation Law Journal*—both frequently publish analyses of the original ADA legislation and recent developments, as do other legal journals.

> *TD Access & Safety Report*—provides information on access, safety, and liability relating to the transportation of people with disabilities and the transportation-disadvantaged. Published by Serif Press, Inc., 1331 H Street, NW, Washington, DC, 20005.

> Americans with Disabilities Act Document Center (http://janweb.icdi.wvu.edu/kinder/)—This website, sponsored by the National Institute on Disability and Rehabilitation Research, contains copies of ADA regulations and technical manuals prepared or reviewed by EEOC or the Department of Justice. Links to other Internet sources are also provided.

Chapter 4

CURB-SIDE FACTORS

WAITING OR ACCESSORY PADS—Sizing and Positioning

A waiting or accessory pad is a paved area at a bus stop provided for bus patrons and can contain either a bench or a bus shelter. Amenities, such as trash receptacles or bike racks, can also be located on the waiting pad. The size of the waiting pad depends on several factors. The length and width of shelters and benches, clearance requirements for street furniture, location of wheelchair lift extension (front or back door of bus), and the length of the bus are common size-determining factors. Transit agencies, typically, have one or two accessory-pad variations to accomodate different configurations and components that may be installed. Figure 29 illustrates elements that may influence the size and shape of the waiting pad.

Waiting pads are usually separated from the sidewalk to preserve general pedestrian flow. It is generally recommended that 5 feet of clearance be preserved on sidewalks to reduce potential pedestrian conflicts and limit congestion during boardings and alightings. The pad can be located on either side of the sidewalk, depending on available right-of-way space, utility poles, or buildings. In either case, a paved surface should be provided from the waiting pad to the back-face of the curb to enhance access and comfort. ADA mobility guidelines should be followed when street furniture is to be included on a waiting pad. A waiting pad should accommodate a 5-foot (measured parallel to the street) by 8-foot (measured from the back face of the curb) wheelchair landing pad that is free of all street furniture and overhangs.

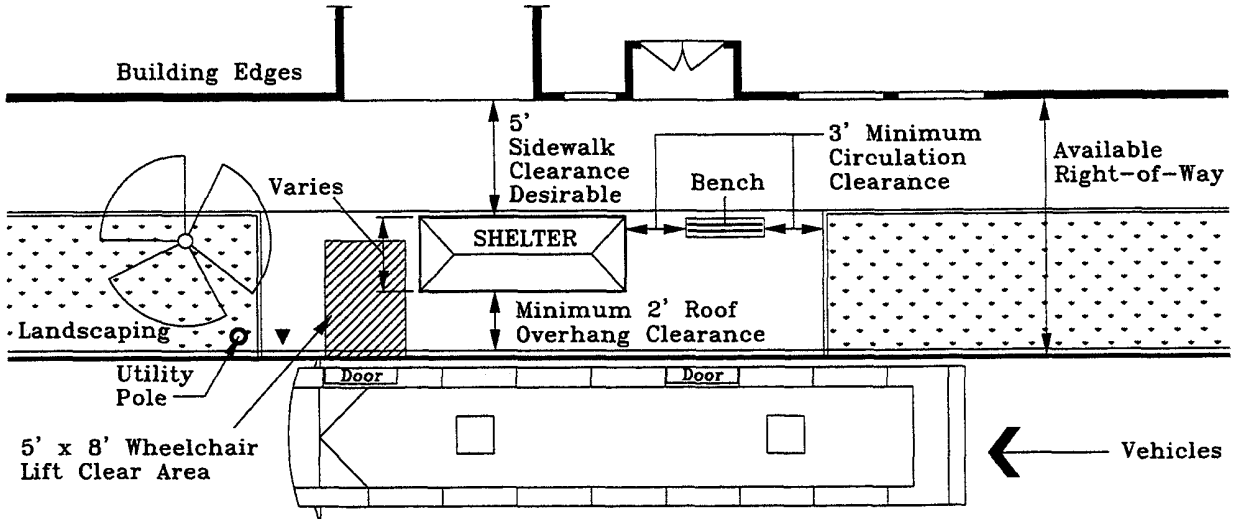


Figure 29. Example of Influential Factors on Waiting Pad Size.

Nubs, also known as bus bulbs or curb extensions, solve the problem of locating bus patron amenities in dense urban environments with considerable pedestrian traffic. A nub is essentially a sidewalk extension through the parking lane that becomes directly adjacent to the travel lane. When space limitations prevent the inclusion of amenities, nubs create additional space at a bus stop for shelters, benches, and other transit patron improvements along sidewalks. Nubs provide enough space for bus patrons to comfortably board and alight from the bus away from nearby general pedestrian traffic. Nubs also shorten the pedestrian walking distance across a street, which reduces pedestrian exposure to on-street vehicles.

Transit agencies should consider the use of nubs at sites along crowded city sidewalks with high patron volumes, where parking along the curb is permitted. Figure 30 is a plan view example of a typical nub configuration.

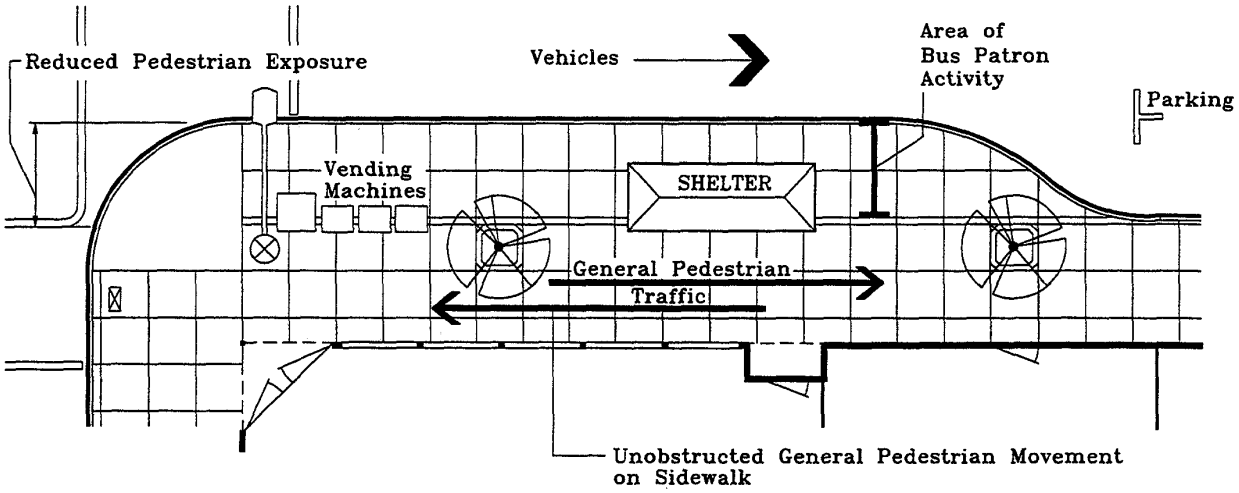


Figure 30. Separating Bus Activities and General Pedestrian Traffic with Nubs.

Chapter 4 CURB-SIDE FACTORS

SHELTERS—Inclusion and Sizing

A bus shelter provides protection from the elements and seating while waiting for a bus. Standardized shelters exist that accommodate various site demands and different passenger volumes. Typically, a shelter is constructed of clear side-panels for clear visibility. Depending on demand and frequency of service, a bus shelter may also have a bench.

The decision to install a shelter is a result of systemwide policy among transit agencies. Many criteria exist to determine shelter installation at a bus stop. In most instances, the estimated number of passenger boardings has the greatest influence. Suggested boarding levels by area type used to decide when to install a shelter are as follows (these values represent a composite of prevailing practices):

Location	Boarding
Rural	10 boardings per day
Suburban	25 boardings per day
Urban	50 to 100 boardings per day

Other criteria used to evaluate the potential for inclusion of a shelter include

- number of transfers at a stop
- availability of space to construct shelters and waiting areas
- number of elderly or physically challenged individuals in the area
- proximity to major activity centers
- frequency of service
- adjacent land use compatibility

Priority may or may not be given to each of these items depending on policy. System equity or funding availability can cause the installation decision to be made on a case-by-case basis. Local priorities and neighborhood requests can also influence the decision to include a shelter at a bus stop.

Other factors that can influence the size of the shelter include availability of right-of-way width, existing street furniture, utility pole locations, landscaping, existing structures, and maintaining proper circulation distances around existing site features.

CURB-SIDE FACTORS

Chapter 4

SHELTERS—Determining the Final Location

Ideally, the final location of a bus stop shelter should enhance the circulation patterns of patrons, reduce the amount of pedestrian congestion at a bus stop, and reduce conflict with nearby pedestrian activities. The location of the curb and sidewalk and the amount of available right-of-way can be determining factors for locating a bus stop shelter. The following placement guidelines should be used when placing a bus stop shelter on a site (see also Figure 31):

- Bus stop shelters should not be placed in the 5-foot-by-8-foot wheelchair landing pad.
- General ADA mobility clearance guidelines should be followed around the shelter and between the shelter and other street furniture.
- Locating shelters directly on the sidewalk or overhanging a nearby sidewalk should be avoided because this may block or restrict general pedestrian traffic. A clearance of 3 feet should be maintained around the shelter and an adjacent sidewalk (more is preferred).
- To permit clear passage of the bus and its side mirror, a minimum distance of 2 feet should be maintained between the back-face of the curb and the roof or panels of the shelter. Greater distances are preferred to separate waiting passengers from nearby vehicular traffic.
- The shelter should be located as close as possible to the end of the bus stop zone so it is highly visible to approaching buses and passing traffic. The walking distance from the shelter to the bus is also reduced.
- Locating bus stop shelters in front of store windows should be avoided when possible so as not to interfere with advertisements and displays.
- When shelters are directly adjacent to a building, a 12-inch clear space should be preserved to permit trash removal or cleaning of the shelter.

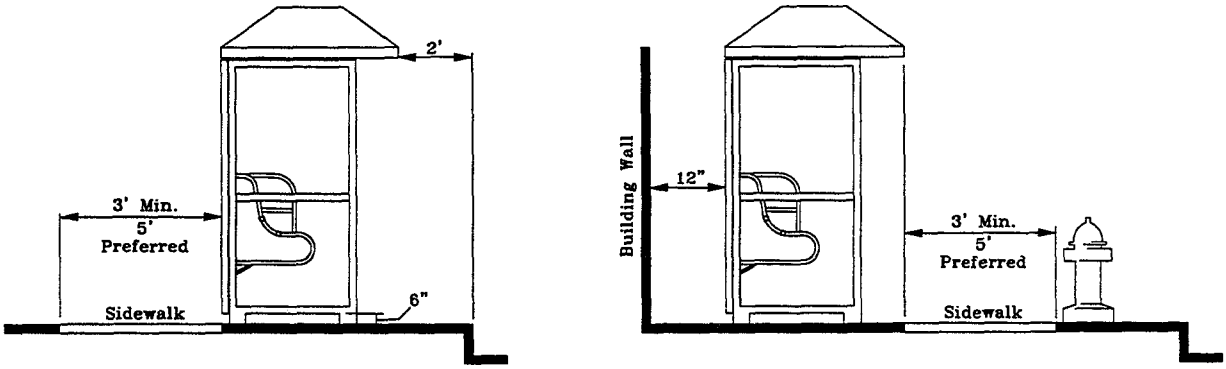


Figure 31. Shelter Clearance Guidelines.

Chapter 4

CURB-SIDE FACTORS

SHELTERS—Configurations and Orientations

In orienting and configuring bus shelters, personnel should consider the environmental characteristics of each site, because placement and design can positively or negatively influence passenger comfort. For example, in very hot climates, particularly in areas with few tall trees, bus shelters may be uncomfortable if they face directly east or west. However, this orientation may be appropriate in cooler climates during the winter months. When shelter interiors are uncomfortable, patrons will seek relief from the elements outside the shelter, appropriating walls or window ledges of nearby private property for their use. Transit agencies should be sensitive to this issue when locating a bus stop shelter.

Different bus shelter configurations can be used to reflect site or regional characteristics (see Figure 32). Shelters can be completely open to permit unlimited movement of air, or panels can be erected to keep the interior of the bus shelter warm. For southern climates, perforated panels can be used to reduce the glare while permitting ventilation. Alternatively, shelters can be fully enclosed by solid panels and the back of the shelter may be rotated to face the street to protect waiting passengers from splashing water or snow build-up. To enhance ventilation and to reduce the clutter that can accumulate inside a shelter, a 6-inch clearance between the ground and the bottom of the panels is standard in fully enclosed shelters. In any case, shelters should be coordinated with landscaping to provide maximum protection from the elements and to enhance the visual quality of the bus stop (see Figure 33). Shade trees reduce heat at a site and provide additional shade for patrons waiting outside the shelter. Technology, such as misters or evapo-cooling towers, can also be used to enhance the interior environment, however, such technology is expensive and maintenance-intensive.

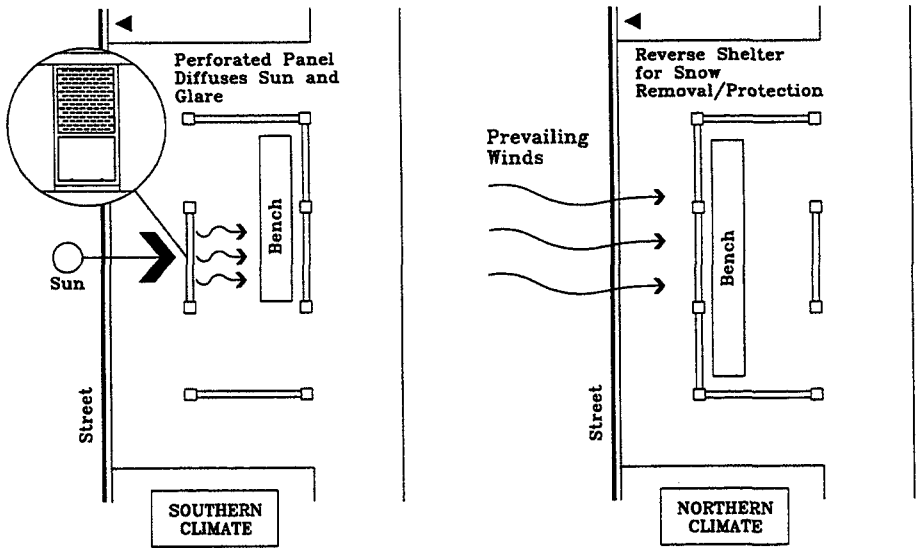


Figure 32. Examples of Orientation and Panel Placement to Improve Interior Comfort.

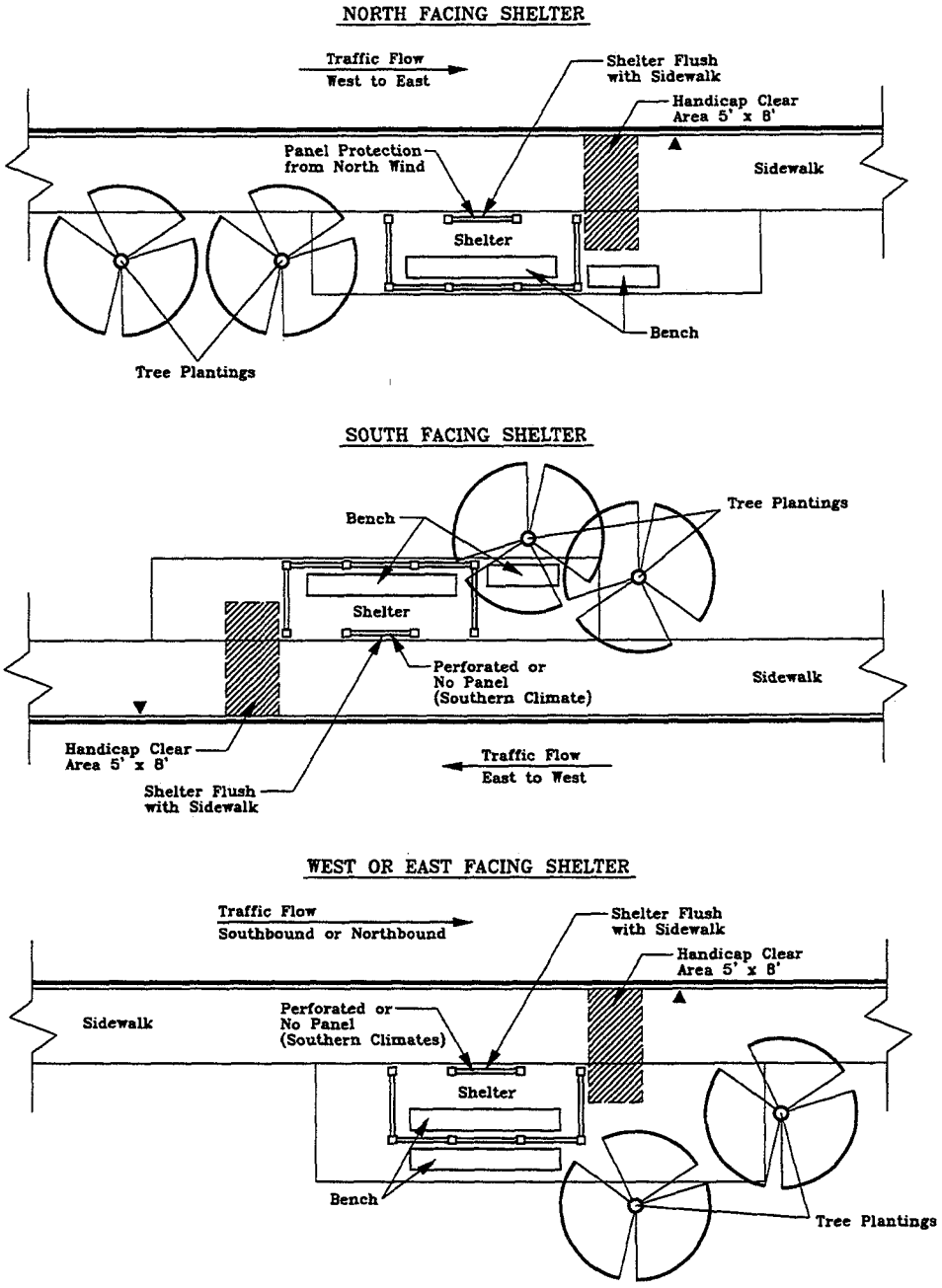


Figure 33. Placement and Orientation Options.

Chapter 4

CURB-SIDE FACTORS

SHELTERS—Advertising

Many transit agencies have paid advertising in bus shelters to supplement funding and to provide other benefits. An advertising-in-shelters program provides the opportunity to install bus shelters at bus stops that otherwise would not receive one. As part of the contract, the advertising company installs the shelter or kiosk. Other benefits of this program include regular maintenance of the bus stop shelters and facilities, including trash removal and installation of interior lighting at selected sites, by the advertising agency.

The advertisements are placed on panels attached to the bus shelter to take advantage of the visibility that the bus stop receives from passing traffic. Backlighting is sometimes used to display the images at night. Advertisements do not necessarily have to be attached to the shelter. In some areas, kiosks are used to display advertisements. Depending on design, the kiosk may provide additional protection from the elements at a bus stop.

Issues associated with advertisements placed on shelters and kiosks include compatibility with local land uses, ordinances, and safety. The signs can conflict with color schemes or limit views of adjacent store fronts. Advertising at bus stops must also comply with local sign ordinances, which may hinder installation in some communities.

Passenger and pedestrian safety and security are of greater concern at shelters with advertising. The advertising panels may limit views in and around a bus stop, making it difficult for bus drivers to see patrons. The panels can also reduce incidental surveillance from passing traffic. To prevent restricted sight lines, advertising panels and kiosks should be placed downstream of the traffic flow. An approaching bus driver should be able to view the interior of the shelter easily. Indirect surveillance from passing traffic should be preserved through proper placement of the panels (see Figure 34).

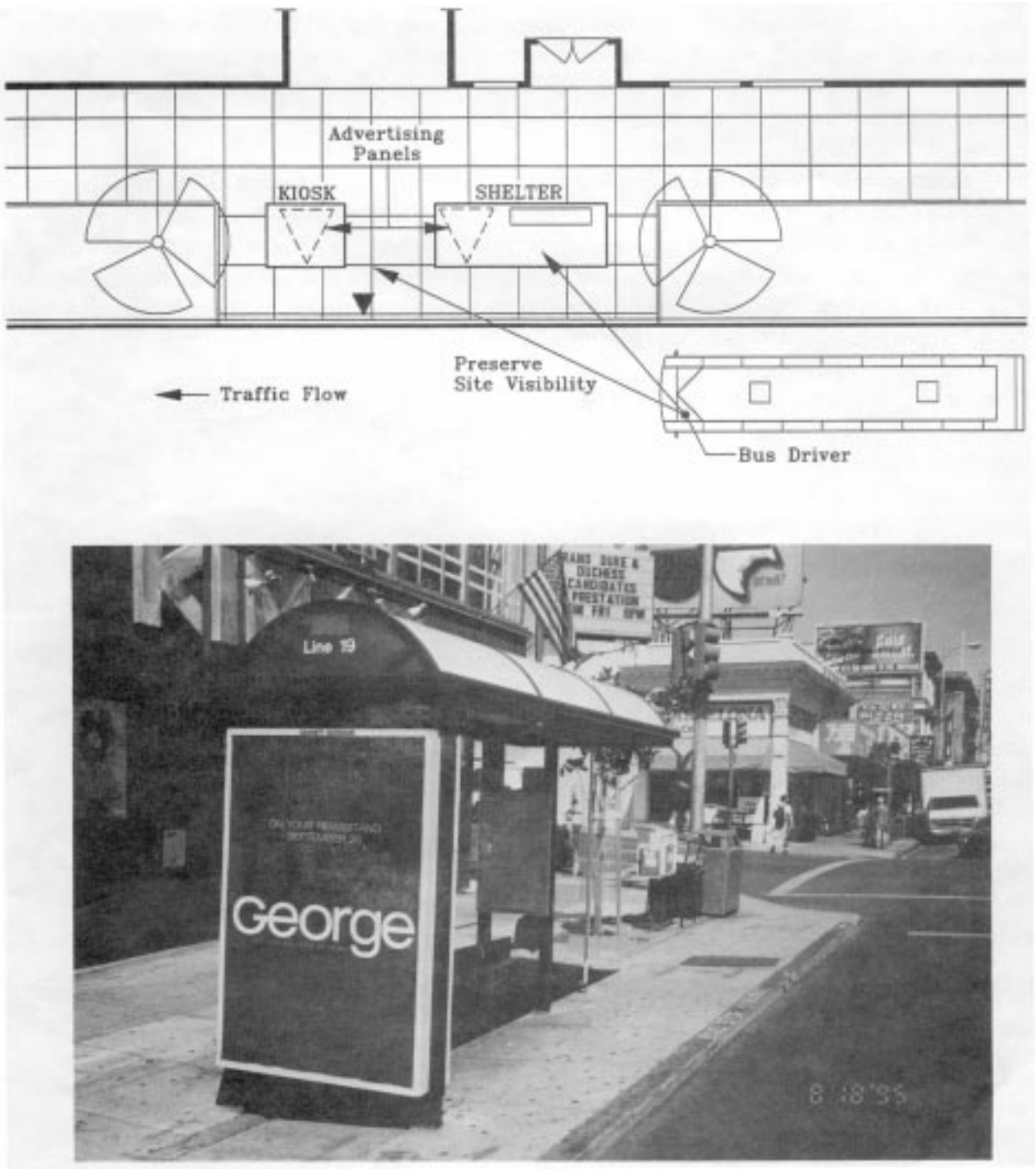


Figure 34. Placement Recommendations for Advertising Panels and Kiosks.

Chapter 4

CURB-SIDE FACTORS

SHELTERS—Developer Provided

Private developers can also provide bus stop shelters. Typically, these shelters are constructed to serve a specific development, neighborhood, complex, or shopping mall. Facilities range in scope from a single stop to a series of coordinated stops serving an entire residential development or office park. The designs are often striking and closely linked visually with the major design features of the central structure, building, or neighborhood.

Bus shelters installed by developers should meet transit agency requirements. These requirements include an acceptable location, safe pedestrian access (i.e., direct sidewalk to the shelter), visibility for vehicles and waiting passengers, access for those with mobility impairments, and signage. Shelter ownership and long-term maintenance responsibilities should be determined before installation. Bus stop location decisions should be made collaboratively by the transit agency and the developer.

When private development and transit service collaborate on shelter installation, the benefits to both are numerous. Transit considerations are factored into the development from the beginning. The development itself may become more transit-friendly through combined transit agency/developer design of routes to provide service to the new development's residents. From the developer's standpoint, designing for transit improves the overall accessibility of the development, may increase the feasible density of the development, may reduce parking requirements, and may increase pedestrian traffic. These factors may have a positive effect on lease (especially retail) value. Improved accessibility can also make recruiting employees easier. Figure 35 is an example of a developer-installed shelter.

Figure 35. Developer-Installed Shelter.

Transit agencies can use artist-designed stops and shelters or other methods to ensure that stops and shelter designs have a theme. One approach is to commission local artists to design or decorate a shelter or waiting area. This requires considerable coordination, the support of the neighborhood, a public relations effort sufficient to generate the interest of local artists, and, ideally, sponsorship by some civic organization. Figure 36 shows an example of a shelter designed by a local artist.

Customized or artistically designed bus stops can make waiting for a bus more pleasant. Innovative designs may also help provide a covered shelter or seating (e.g., flip-seats or awnings) for passengers at locations that do not have sufficient space. However, custom-designed passenger waiting areas should not obscure identification of the bus stop. Transit agency bus stop signs and schedule displays should be available at these types of bus stops. The functionality of the stop should not be compromised in the name of art—the stop should provide as much patron comfort, safety, and security as possible.

Neighborhood or business interests may also want the shelters and bus stop signs to reflect the character of the district. One method is to develop a distinct color or logo for each neighborhood or route group. This can be implemented by the transit agency with appropriate coordination and participation from the neighborhoods.

Figure 36. Artistic Shelter.

Chapter 4

CURB-SIDE FACTORS

AMENITIES—Benches

A bench, even without a bus shelter, provides comfort and convenience at bus stops. As with shelters, benches are usually installed on the basis of existing or projected ridership figures. Ridership figures below those justifying a bus shelter are commonly used. Other factors used in determining bench-only locations include the following:

- The width of the bus stop location.
- Bus stops with long headways and little protection from the weather.
- Locations where the landowner has denied permission to construct a shelter.
- Sites that are frequently used by elderly people or people with disabilities.
- Evidence that transit patrons are sitting or standing on nearby land or structures.

Two factors that greatly influence the use of benches are crowding at a site and the environment at a site. Crowding limits patrons choices about sitting and waiting and forces patrons to wait around, rather than in, the bus stop. Uncomfortable bus stop environmental conditions, such as heat and sun, can also discourage use of the bench.

Preserving minimum circulation guidelines, coordinating with existing landscaping, and providing additional waiting areas can improve bench and site utilization. The following bench placement guidelines are recommended:

- Avoid locating benches in completely exposed locations. Coordinate bench locations with existing shade trees if possible. Otherwise, install landscaping to provide protection from the wind and other elements.
- Coordinate bench locations with existing street lights to increase visibility and enhance security at a stop.
- Locate benches on a non-slip, properly drained, concrete pad. Avoid locating benches in undeveloped areas of the right-of-way.
- Locate benches away from driveways to enhance patron safety and comfort.

- Maintain a minimum separation of 2 feet (preferably 4 feet) between the bench and the back-face of the curb. As the traffic speed of the adjacent road increases, the distance from the bench to the curb should be increased to ensure patron safety and comfort.

- Maintain general ADA mobility clearances between the bench and other street furniture or utilities at a bus stop.

- Do not install the bench on the 5-foot by 8-foot wheelchair landing pad.

- At bench-only stops, additional waiting room near the bench should be provided (preferably protected by landscaping) to encourage bus patrons to wait at the bus stop.

Figure 37 provides an example of the circulation requirements at a bench-only bus stop with additional seating provided.

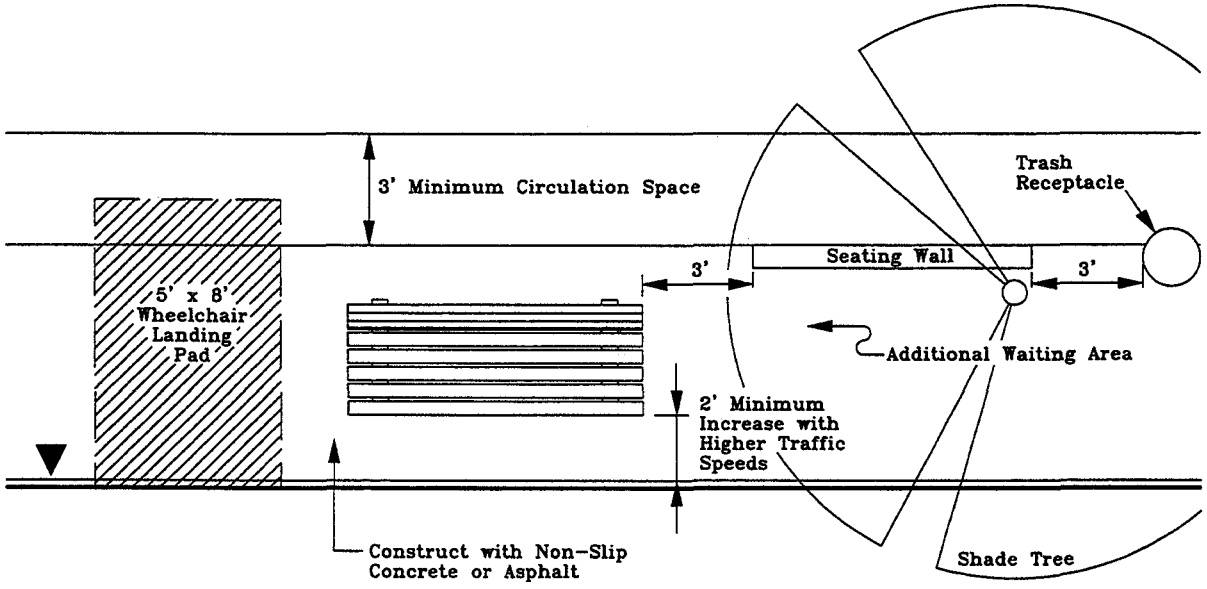


Figure 37. Conceptual Bench and Waiting Pad Design.

Chapter 4

CURB-SIDE FACTORS

AMENITIES—Route or Patron Information

Route and passenger information can be displayed in various ways. A flag sign is the most common method used by transit agencies to display information. Placement and design guidelines for flag signs are discussed in Chapter 3. Installation of schedule holders or schedule and route information on the shelters are also commonly used.

The actual displays mounted on the sign can include the transit agency logo, route numbers available at the stop, type of route (local or express), and destination for a limited number of routes. Detailed guidelines for the design of bus stop signs can be found in *TCRP Report 12*, "Guidelines for Transit Facility Signing and Graphics," and should be referenced for greater detail.

Schedule holders are included at sites with large passenger volumes. The schedule holders can be mounted on the flag sign or inside a shelter. According to "Guidelines for Transit Facility Signing and Graphics," information in Braille can be provided when a four-sided information holder is used. A route plaque and an information holder mounted to a sign post are shown in Figure 38.

Interior panels of shelters also can be used for posting route and schedule information. Side panels may be large enough to display the entire system map and can include backlighting for display at night. Shelters that lack side panels can display route and schedule information on the interior roof of the shelter. Some recommendations for route or patron information display are as follows:

- Provide updated information when changes are made to routes and schedules.
- Consider the quality and appearance of information displays. A visually poor route map conveys a negative impression of the system.
- Make information displays permanent. Temporary methods for displaying information (such as tape-mounting) create a cluttered, unsophisticated appearance at the bus stop.
- Follow ADA clearance, mobility, and visual guidelines for access of information by individuals with impairments.

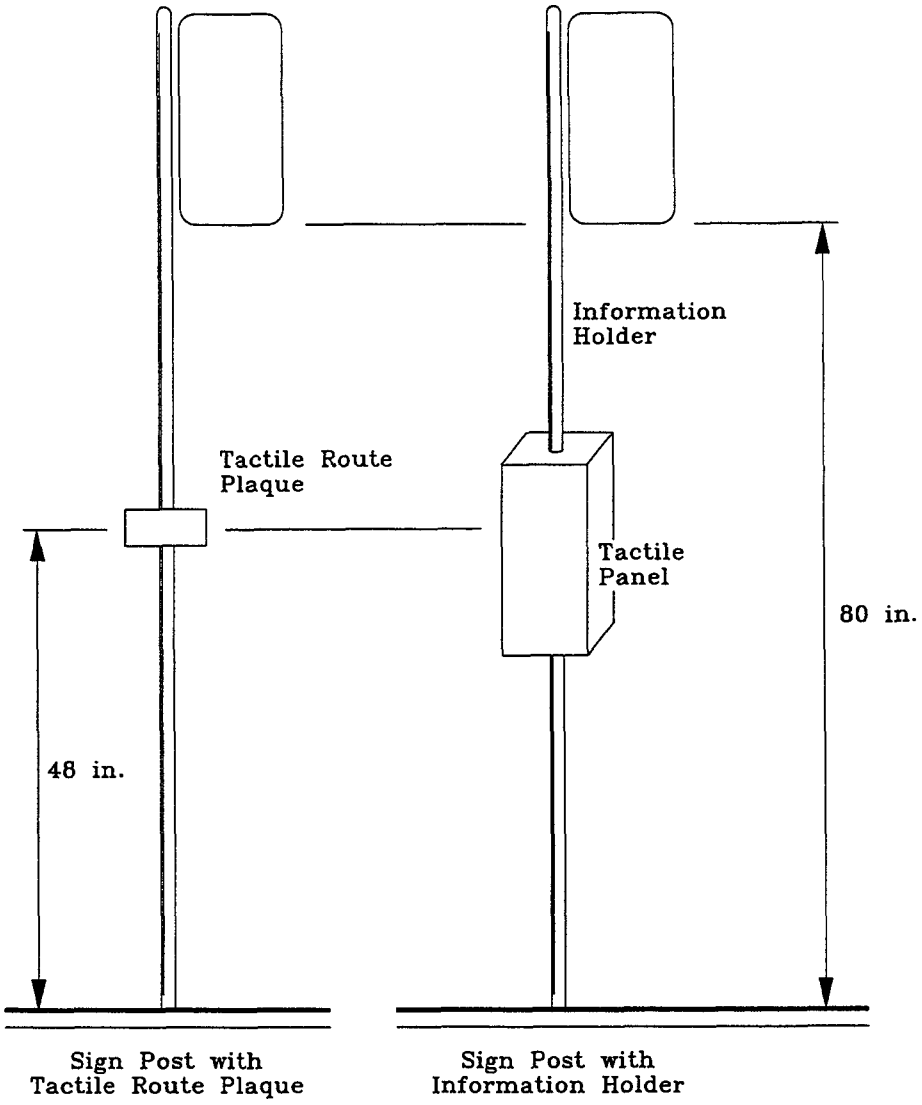


Figure 38. Examples of Passenger Information Holders.

Chapter 4

CURB-SIDE FACTORS

AMENITIES—Vending Machines

Vending machines can provide passengers with reading material while they wait for the bus. However, for local, non-commuter routes, vending machines can be undesirable for many reasons. The machines are often poorly maintained and reduce the amount of room for mobility and waiting (see Figure 39). Perhaps the greatest effect, though, is that trash accumulates at bus stops with vending machines. Trash removal is time-consuming and costly.

The existence of vending machines at or near bus stops does not appear to be the result of transit agency policy. Rather, it is a result of newsprint companies aggressively pursuing a high-profile site. Transit agencies have limited regulatory authority concerning the placement of vending machines.

Transit agencies, if given the opportunity, should review the need for the installation of vending machines at bus stops. The benefits to patrons of having the machines near the stop versus having to maintain trash receptacles and keep the area free of improperly disposed material should be reviewed. Vending machines at a bus stop should be anchored to the ground to reduce vandalism. ADA mobility guidelines should be followed for improved site circulation (e.g., the location of the vending machines should not obstruct the wheelchair landing pad area).

Figure 39. Image of Vending Machines at a Bus Stop.

CURB-SIDE FACTORS

Chapter 4

AMENITIES—Bicycle Storage Facilities

Bicycle storage facilities, such as bike racks, may be provided at bus stops for the convenience of bicyclists using transit. Designated storage facilities discourage bicycle riders from locking bikes onto the bus facilities or on an adjacent property. Proper storage of bicycles can reduce the amount of visual clutter at a stop by confining bikes to one area. Recommendations regarding bicycle storage facilities are as follows:

- Provide paved access to the bus stop and construct the waiting area with non-slip concrete or asphalt that is properly drained.
- Locate the storage area away from other pedestrian or patron activities to improve safety and reduce congestion.
- Coordinate the location of the storage area with existing on-site lighting.
- Do not locate the storage area where views into the area are restricted by the shelter, landscaping, or existing site elements, such as walls.

Many prefabricated storage methods are available, however, as bicycle prices have escalated in recent years, interest has grown in storing bikes in completely enclosed containers called bike lockers (see Figure 40) or taking bikes on the bus. Although the transit agency can obtain revenue from renting bicycle lockers to patrons, bike lockers are large and awkward to place next to bus stop shelters on sidewalks and present additional surfaces at a bus stop for graffiti. For these reasons, they can be expensive to maintain.

It appears bicycle storage is associated with the commuter market and should be installed when demand warrants, which is primarily at major suburban stops. Where substantial bike activity exists, such as in university towns, on-vehicle bike programs are a major asset. Regional demographics should be carefully reviewed prior to implementing such a program.

Figure 40. Example of a Bike Locker.

Chapter 4

CURB-SIDE FACTORS

AMENITIES—Trash Receptacles

Trash receptacles can improve the appearance of a bus stop by providing a place to dispose of trash. The installation of trash receptacles is typically a systemwide decision and the size, shape, and color reflect transit agency policy. Not all bus stops have trash receptacles. Low patron volumes may not justify the inclusion of this amenity at a bus stop; however, litter at a site may warrant the inclusion of a trash receptacle at an otherwise low-volume location.

Problems can arise when the receptacles are not regularly maintained or when the bus stop is next to a land use that generates considerable trash such as convenience stores and fast food restaurants. In such cases, transit agencies should work with these establishments to define maintenance responsibilities for the bus stop and the area around the businesses. Businesses and community groups typically are reluctant to agree to maintaining trash receptacles at public sites.

Recommendations regarding installing a trash receptacle at a bus stop are as follows:

- Anchor the receptacle securely to the ground to reduce unauthorized movement.
- Locate the receptacle away from wheelchair landing pad areas and allow for at least a 3-foot separation from other street furniture.
- Locate the receptacle at least 2 feet from the back of the curb.
- Ensure that the receptacle, when adjacent to the roadway, does not visually obstruct nearby driveways or land uses.
- Avoid installing receptacles that have ledges or other design features that permit liquids to pool or remain near the receptacle—this may attract insects.
- Avoid locating the receptacle in direct sunlight. The heat may encourage foul odors to develop.

Figure 41 shows the minimum circulation and separation requirements for trash receptacles at bus stops.

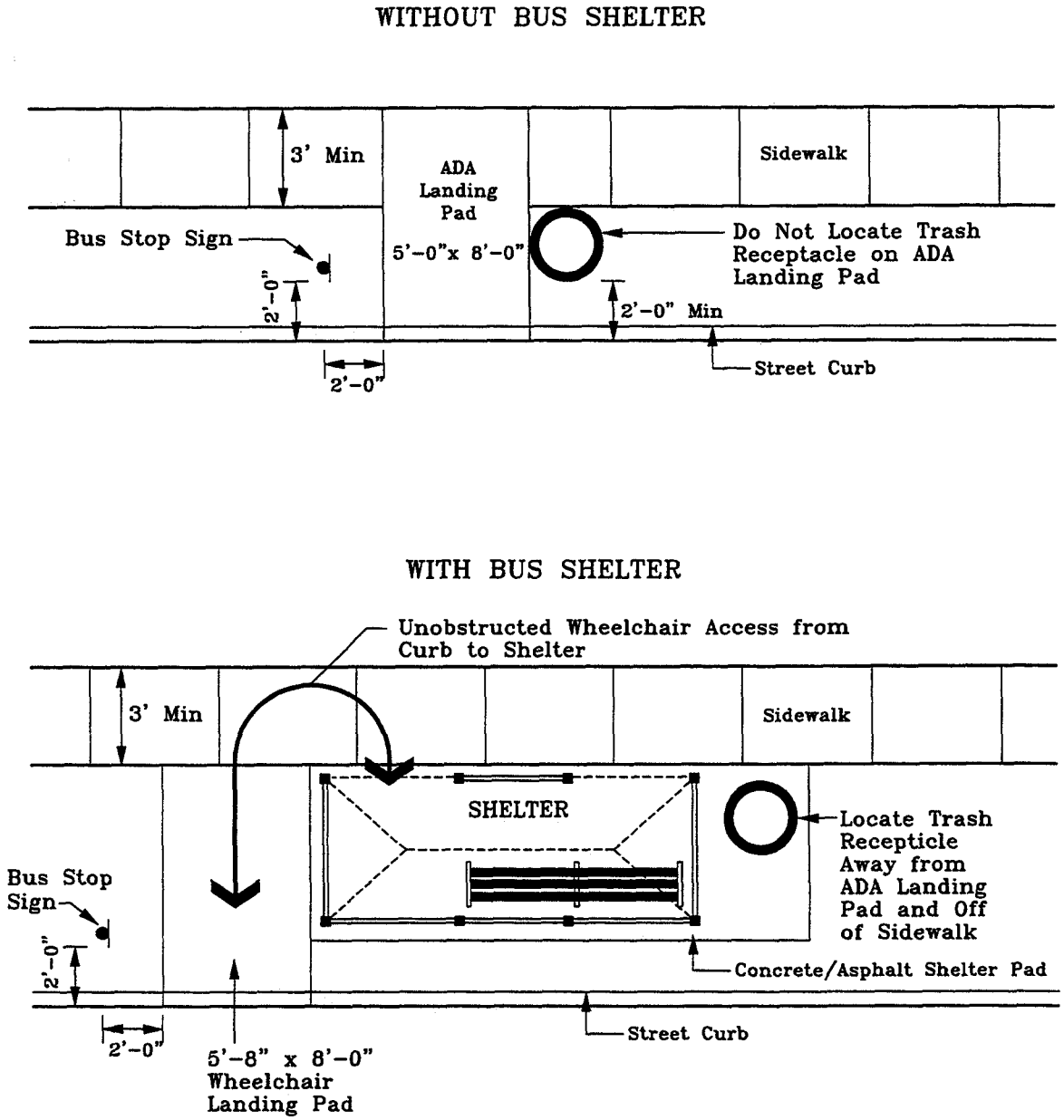


Figure 41. Trash Receptacle Placement Guidelines.

Chapter 4

CURB-SIDE FACTORS

AMENITIES—Phones

Phones at bus stops offer many potential benefits for bus patrons. Patrons can make personal and emergency calls while waiting for the bus. Phones also can provide real-time bus arrival information. Figure 42 shows a phone at a bus stop. Some transit agencies have explicit policies regarding the installation of phones at bus stops. Experience with phones at bus stops has been mixed. For example, inclusion of phones at bus stops can create opportunities for illegal or unintended activities, such as drug dealing and loitering, in and around bus stops. Loitering by non-bus patrons at bus stops appears to increase with the installation of phones; this may discourage bus patrons from using the facility. Transit agencies should review the potential consequences of installing a phone at a bus stop prior to installation.

When locating a phone at a bus stop, the following guidelines should be considered:

- Separate the phone and the bus stop waiting area by distance when possible.
- Follow general ADA site circulation guidelines.
- Remove the return phone number attached to the phone.
- Limit the phone to outward calls only.

Figure 42. Example of a Phone at a Bus Stop.

Proper storage for shopping carts at bus stops adjacent to commercial shopping centers is needed. Because such bus stops normally do not have storage facilities for shopping carts, carts often litter the area around the stop and along the sidewalk accessing the stop. The sight of haphazardly placed shopping carts around a bus stop is visually unappealing and can block sidewalk access. Figure 43 shows shopping carts abandoned at a bus stop.

Because the shopping carts are generated by the shopping center, agreements should be made between the land owner and the transit agency to remove the carts regularly. Frequently, however, the time between removals is too long and shopping carts accumulate at a bus stop. One solution is to install a storage facility near the bus stop to prevent random storage in and around the stop. Factors affecting installation of a storage facility include the location of the sidewalk, available right-of-way, utilities, landscaping, terrain, and cost. Any cart storage facility should follow the general site circulation guidelines and remain clear of the sidewalk and wheelchair landing pad area.

Figure 43. Shopping Carts Abandoned at a Bus Stop.

Chapter 4

CURB-SIDE FACTORS

AMENITIES—Lighting

Lighting affects bus patrons' perception of safety and security at a bus stop, as well as the use of the site by non-bus patrons. Good lighting can enhance a waiting passenger's sense of comfort and security; poor lighting may encourage unintended use of the facility by non-bus patrons, especially after hours. Lighting is particularly important in northern climates where patrons may arrive and return to the stop in darkness during the winter season. Illumination requirements are often a policy of individual transit agencies; however, installing lighting that provides between 2 to 5 footcandles is the general recommendation.

Cost and availability of power influence the decision to install direct lighting at a bus stop. Direct lighting is expensive and difficult to achieve at remote locations. When installing direct lighting at a bus stop, the fixtures should be vandalproof but easily maintained. For example, avoid using exposed bulbs or elements that can be easily tampered with or destroyed.

A cost-effective approach to providing indirect lighting at a site is to locate bus stops near existing street lights. When coordinating bus shelter or bench locations with existing street lights, the minimum clearance guidelines for the wheelchairs should be followed. Figure 44 is an example of coordinating a shelter with an existing street light.

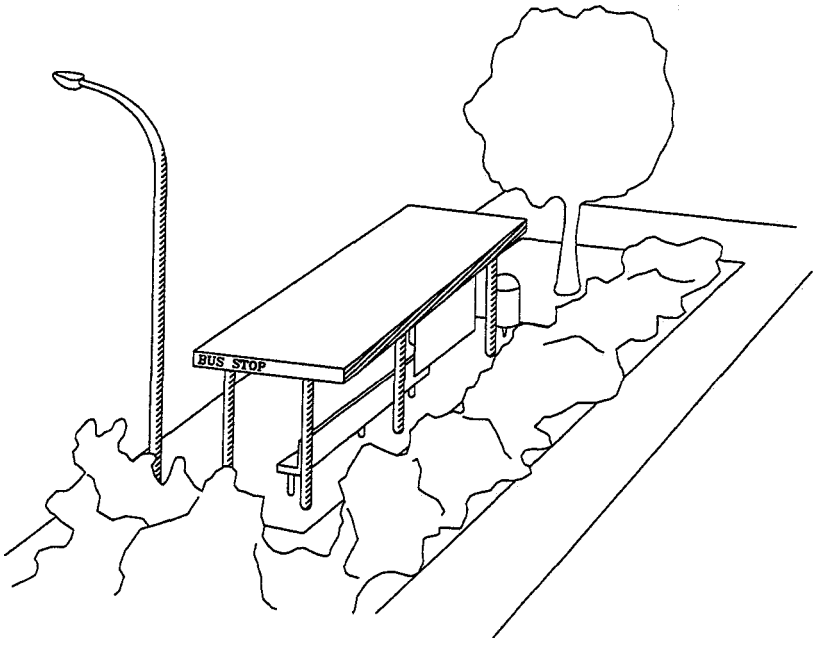


Figure 44. Example of Coordinating Shelter Locations with an Existing Street Light.

Passenger security is a major issue in bus stop design and location, because the design and location of the bus stop can positively or negatively influence a bus patron's perception of that bus stop. From the perspective of security, landscaping, walls, advertising panels, and solid structures can restrict sight lines and provide spaces to hide. Each of these items can be an integral part of the bus stop, either by design or by proximity of existing land uses. Therefore, the transit agency should carefully review which amenities are to be included at a bus stop and consider any factors that may influence security. Other sections of this document have discussed some of these concepts and should be referenced. Some guidelines regarding security at bus stops are as follows:

- Bus stop shelters should be constructed of materials that allow clear, unobstructed visibility of and to patrons waiting inside.

- Bus stops should be at highly visible sites that permit approaching bus drivers and passing vehicular traffic to see the bus stop clearly.

- 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 provide a visual barrier and should be avoided.

- Bus stops, whenever possible, should be coordinated with existing street lighting to improve visibility.

- Bus stops should be next to existing land uses, such as stores and businesses, to enhance surveillance of the site.

Chapter 4

CURB-SIDE FACTORS

AMENITIES—Advantages and Disadvantages

Amenity	Advantages	Disadvantages
Shelters	• Provide a place of comfort for waiting passengers • Provide protection from elements (sun, glare, wind, rain, snow) • Help identify the transit system • Can provide a venue for establishing lighting at a site • Can provide a space to install route and schedule information	• Require maintenance, trash collection • May be used by graffiti artists
Shelters (Advertising)	• Can be impetus for installing lighting at stop • Are often maintained by advertising company	• Can reduce sight lines if panels are improperly located • Must be compatible with local sign ordinances and land uses
Benches	• Provide comfort for patrons • Help identify the stop • Are a low-cost amenity when compared to installing a shelter	• Require maintenance • May be used by graffiti artists
Vending Machines	• Provide waiting patrons with reading material	• Increase trash accumulation at a site • May have poor visual appearance • Reduce circulation space • Can be vandalized
Lighting	• Increases visibility • Increases perceptions of comfort and security by patrons • Discourages "after hours" use of bus stop facilities by indigents	• Requires maintenance of lighting elements • Can be costly

CURB-SIDE FACTORS

AMENITIES—Advantages and Disadvantages

Amenity	Advantages	Disadvantages
Trash Receptacles	• Provide place to discard trash • Keep bus stop clean	• May be costly to maintain • May be used by customers of near-by land use (i.e., fast food restaurant) • May smell
Phones	• Are convenient for bus patrons • Provide access to transit information	• May encourage loitering at or near bus stop by non-bus patrons • May encourage illegal activities at bus stop
Route or Schedule Information	• Is useful to first time riders • Helps identify the bus stop • Can communicate general system information	• Must be maintained to provide current route or schedule information • May be popular surface for graffiti

Chapter 4

CURB-SIDE FACTORS

AMENITIES—Materials

Various materials can be used to construct a bus stop. The best materials are those that are weather-resistant, can withstand continual use, and can be easily maintained. The ease with which a particular material can be vandalized can reduce its desirability; easy-to-clean materials are desirable. Primarily, wood, metal, concrete, glass, and plastics are used at bus stops.

Wood, sometimes used for benches, is rarely used to construct other elements because it is easily vandalized and weathers badly.

Metal is frequently used to construct shelters, benches, bike racks, and trash receptacles. Aluminum, although fairly inexpensive and easy to work with, is soft and easily scratched. Its high recyclability makes it a target for theft by unscrupulous recyclers. As with any item or material, objects should be properly affixed to prevent/discourage unauthorized removal. Metal, in combination with a plastic coating, is a good material for benches, especially when a wire mesh design is used. The design resists everyday wear and tear and graffiti.

The best use of concrete at bus stops is in the paving. Concrete, an excellent non-slip surface, can be easily poured on site to construct sidewalks, waiting pads, and connections between the stop and the curb. Concrete is too heavy and cumbersome to use in other elements at a bus stop.

Plastic is used for paneling and roofing on shelters. The material is lightweight and can be installed with minimal effort. Clear plastic permits the interior of the shelter to be visible from a distance, which enhances security. Depending on the desired effect, plastic can be frosted to reduce the amount of sun entering the shelter or left clear to permit sun exposure. A major disadvantage of plastic is that it is easily damaged or destroyed by vandalism—the material can be scratched or kicked out from its holdings. Plastic declines over time by becoming translucent and scratched, and harsh chemical cleaners can expedite the decline.

Tempered glass is primarily used for side panels on shelters. Visually, the material is more pleasing than plastic and withstands environmental demands better than plastic. Unlike plastic, the material is not damaged by repeated cleaning; broken glass, however, can create a hazard for waiting passengers. Improperly anchored objects, such as vending machines and trash receptacles, should be avoided at bus stops with glass because they can be used to destroy glass panels or roofs.

Material	Advantages	Disadvantages
Wood	• Is used to construct benches • Is repaired or replaced easily	• Weathers easily • Can be vandalized easily
Metal (Aluminum)	• Resists weathering • Can be used to construct multiple elements at a bus stop • Can be inexpensive	• Can be scratched easily (vandalism problem)
Concrete	• Can be installed as a non-slip paving surface	• Is too heavy and cumbersome for use other than paving
Plastic	• Is lightweight • Allows unobstructed view into and out of shelter • Can be formed into different shapes	• Declines with exposure to sun and repeated cleaning • Can be scratched easily
Glass (Tempered)	• Withstands environmental demands better than plastic • Can be cleaned easily • Can be perceived as more attractive than plastic • Allows unobstructed view into and out of shelter	• Can be broken, which can present a safety hazard to patrons

Chapter 4

CURB-SIDE FACTORS

CURB-SIDE PLACEMENT CHECKLIST

This section of the guidelines lists topics that should be reviewed to enhance patron comfort, convenience, and security. The topics range from the general (such as locating a bus stop in the community) to the specific (such as preserving sight lines).

- **Location Within the Community:** The location of the bus stop should be coordinated with the business community and neighborhood. Businesses want to preserve clear views of storefronts and maintain open circulation spaces in and around the storefronts. Although improperly located shelters can obstruct business activities, bus stops can enhance both transit and business activities when sited properly.

  Homeowners are another influential voice in the community. Typically, they do not want stops in front of their properties. Efforts to maintain bus stops in residential neighborhoods may reduce the "not-in-my-backyard" attitudes.

  Coordination between governmental agencies can enhance or impede this process. Liability can be a major issue for governmental agencies and businesses. This is especially true when improvements are made to sidewalks at or near bus stops. Transit agencies can create their own regulatory hurdles to avoid liability. However, this action comes at the expense of the transit patron, the ultimate customer. Coordination and cooperation can improve this process.

- **Compatibility:** Bus stops should be located so as to limit conflicts with pedestrians and other activities. Bus stops that create conflict points with pedestrians and bicyclists or reduce the capacity of existing sidewalks should be avoided. Benches, shelters, and other bus-related facilities should be separated from pedestrian or bicycle facilities when space permits. Because bus stops are commonly placed near parking lots, bollards and/or a raised curb would prevent cars from damaging bus facilities (e.g., bus shelters) or interfering with bus activities and patrons.

  Bus stops should be located so as to provide safe separation of passengers and vehicles from nearby land uses. They should not be directly next to the curb, which puts patrons close to passing vehicles. This is especially true for stops on roads with high traffic speeds. The zone of comfort or separation for patrons from high speed traffic may be violated when the shelter or bench is too close to the edge of the roadway. The minimum acceptable offset for benches and shelters from the back face of the curb is 2 feet. This distance should increase with higher speed limits.

- **Direct Access to Bus Stop:** Landscaping, berms, security walls, large parking lots, and circuitous sidewalks can decrease the convenience of using transit by increasing the walking time between the origin or destination and the bus stop. Direct access to and from the bus stop is critical to the convenience of using transit. The transit agency can work with local jurisdictions or developers to ensure that direct sidewalks are installed near bus stops from the intersection or adjacent land uses. Defined paths or walkways can be installed through parking lots or landscaping to reduce walking times and improve safety.

- **Impervious Ground Surfaces:** Avoid locating bus stops on exposed soil, grass, or uneven ground. For passenger comfort and convenience, a waiting pad constructed of impervious non-slip material should be provided at the bus stop. This should be graded for proper runoff control and meet ADA requirements for cross slopes. The bus stop should be coordinated with existing sidewalks to provide defined and controlled access to the stop. In developing areas, the transit agency can coordinate bus stop location with sidewalk locations and installation through local jurisdictions or developers.

- **Proper Pedestrian Circulation:** Utility poles, fire hydrants, and street furniture can reduce the available space for bus patrons to maneuver. Avoid locating stops near items that may restrict proper movement in and around a bus stop.

  Appropriate spacing of items at a bus stop should also be maintained to allow proper access for wheelchairs and pass-by pedestrian traffic. Shelters, benches, utility poles, and other street furniture should not intrude on the ADA landing pad, which should be at least 5 feet (measured parallel to the curb) by 8 feet (measured perpendicular from the back face of the curb). At least 3 feet of clearance should be maintained to enable wheelchair access to and from the stop and around any transit amenities, posts, poles, fire hydrants, vending machines, or other fixtures that might be present. Ideally, high-volume stops should have clear pedestrian access from both bus doors.

Chapter 4

CURB-SIDE FACTORS

CURB-SIDE PLACEMENT CHECKLIST

- **Existing Street Furniture:** Selecting sites with existing street furniture can save the transit system money while providing patrons with amenities, such as benches, vending machines, and phones. The transit agency should review the condition of the amenities to make sure the items are properly maintained and free of graffiti or other signs of wear. The transit agency should also note the placement of any existing street furniture. When additional improvements are made to the site because of the installation of a bus stop, the location of existing street furniture may reduce circulation space and accessibility.

- **Environmental Treatments:** Existing site conditions can be used to enhance the environmental comfort of a bus stop. Sun/shade patterns provided by existing vegetation or structures can contribute to the comfort of waiting bus patrons. The final design of the bus stop shelter should also respond to the environmental demands of a site (e.g., sun/shade patterns, winds, and precipitation). Panel placement, orientation, and materials should be selected to provide maximum comfort to patrons. The site should also be well drained.

- **Security:** Perception of security at a bus stop can have a significant influence on the comfort level of patrons using that bus stop. To enhance the security of bus stops, regularly remove graffiti and trash (to discourage repeat occurrences), ensure indirect surveillance from nearby land uses and passing traffic, and avoid locating stops where there is opportunity for concealment. When landscaping is involved, use low-growing shrubs that preserve sight lines.

- **Lighting:** Bus stops may include lighting or be located near existing street lights that provide indirect lighting to enhance the security of a stop. Interior shelter lighting can be a critical amenity when patrons arrive and return in the dark. The interior lighting elements should be resistant to vandalism and be maintained regularly. Bus shelters without interior lights should, whenever possible, have translucent roofs.

  Pedestrian-oriented lighting should be encouraged in new developments or when major infrastructure work is being planned. Indirect lighting from nearby businesses can also enhance surveillance of the site from these land uses.

CURB-SIDE FACTORS

Chapter 4

CURB-SIDE PLACEMENT CHECKLIST

- **Sight Line:** The bus stop should be clearly visible for both safety and security reasons. Stops obscured by existing structures or vegetation are difficult for bus drivers to see. Passing vehicles may be unaware of the presence of pedestrians near or on the roadways; this increases the chance that accidents will occur. Right turns on red can increase the likelihood of pedestrian-vehicle conflicts. The bus stop site should be inspected carefully to detect any potential sight-related problems.

  For security reasons, sight lines should be preserved to maintain direct and indirect surveillance of the bus stop. Landscaping, walls, advertising panels, and structures can restrict sight lines and provide spaces to hide. Bus stops should be easily viewed from nearby land uses and passing traffic to enhance the security of the stop. Bus shelters should be constructed of materials that allow clear, unobstructed visibility of patrons waiting inside. Bus patrons also need to be able to observe their surroundings when inside the shelter.

- **Maintenance:** Proper maintenance of bus facilities is crucial to preserving a positive image of a transit system. Trash and graffiti should be removed as soon as possible to prevent further degradation of the facilities. A database containing maintenance schedules can be created to track the condition of the facilities, including pavement surface conditions; age of the facilities; history of damage; and condition of shelter, benches, or other transit amenities.

  Bus stop maintenance can be costly and time-consuming. Working agreements with local businesses or commercial centers can reduce the financial responsibilities of the transit agency. For stops next to convenience stores, the transit agency should try to obtain a working agreement with the local store or businesses to provide trash removal and general maintenance at the bus stop. This should include snow removal.

  Agreements with commercial-strip centers should also be obtained to remove used shopping carts from a bus stop regularly. Shopping carts abandoned around bus stops are visually unappealing and restrict movement through a site.

This page left intentionally blank.

GLOSSARY

TERMS AND DEFINITIONS

Chapter 5

accessway - a paved connection, preferably non-slip concrete or asphalt, that connects the bus stop waiting pad with the back face of the curb.

adaptive use - an individual's spontaneous, creative use of a facility or structure in ways that differ from or go beyond the intended use or the formal design.

advertising shelter - a bus shelter that is installed by an advertising agency for the purpose of obtaining a high-visibility location for advertisements. By agreement, the bus shelter conforms to the transit agency specifications but is maintained by the advertising company.

ADA - American's with Disabilities Act of 1990. The Act supplants a patchwork of previous accessibility and barrier-free legislation with a comprehensive set of requirements and guidelines for providing *reasonable* access to and use of building, facilities, and transportation.

amenities - things that provide or increase comfort or convenience.

bollards - a concrete or metal post placed into the ground behind a bus shelter to protect the bus shelter from vehicular damage.

bus bay - a specially constructed area off the normal roadway section for bus loading and unloading.

bus stop spacing - the distance between consecutive stops.

bus stop zone length - the length of a roadway marked or signed as available for use by a bus loading or unloading passengers.

curb-side factors - factors that are located off the roadway that affect patron comfort, convenience, and safety.

curb-side stop - a bus stop in the travel lane immediately adjacent to the curb.

detector - a device that measures the presence of vehicles on a roadway.

discontinuous sidewalk - a sidewalk that is constructed to connect the bus stop with the nearest intersection. The sidewalk does not extend beyond the bus stop.

Chapter 5

GLOSSARY

TERMS AND DEFINITIONS

downstream - in the direction of traffic.

dwell time - the time a bus spends at a stop, measured as the interval between its stopping and starting.

far-side stop - a bus stop located immediately after an intersection.

headway - the interval between the passing of the front ends of successive buses moving along the same lane in the same direction, usually expressed in minutes.

layover - time built into a schedule between arrivals and departures, used for the recovery of delays and preparation for the return trip.

midblock stop - a bus stop within the block.

near-side stop - a bus stop located immediately before an intersection.

nub - a stop where the sidewalk is extended into the parking lane, which allows the bus to pick up passengers without leaving the travel lane, also known as bus bulbs or curb extensions.

open bus bay - a bus bay designed with bay "open" to the upstream intersection.

queue jumper bus bay - a bus bay designed to provide priority treatment for buses, allowing them to use right-turn lanes to bypass queued traffic at congested intersections and access a far-side open bus bay.

queue jumper lane - right-turn lane upstream of an intersection that a bus can use to bypass queue traffic at a signal.

roadway geometry - the proportioning of the physical elements of a roadway, such as vertical and horizontal curves, lane widths, cross sections, and bus bays.

shelter - a curb-side amenity designed to provide protection and relief from the elements and a place to sit while patrons wait for the bus.

sight distance - the portion of the highway environment visible to the driver.

street-side factors - factors associated with the roadway that influence bus operations.

GLOSSARY

TERMS AND DEFINITIONS

Chapter 5

TCRP - Transit Cooperative Research Program of the Transportation Research Board.

upstream - toward the source of traffic.

waiting or accessory pad - a paved area that is provided for bus patrons and may contain a bench or shelter.

This page left intentionally blank.

APPENDIXES A-C

Appendixes A through C as submitted by the research agency are not published herein, but are available for loan on request to the TCRP.

Appendix A - Literature Search
Appendix B - Review of Transit Agencies' Manuals
Appendix C - Survey Findings