CHAPTER 4: DESIGN GUIDELINES

This chapter details uniform guidelines for the placement and design of bus-related facilities and amenities in Kaua'i County. The suggested guidelines are intended to identify specific design considerations and standards for transit facilities rather than to provide for the complete engineering design of each facility element. It is anticipated that the final design of an individual improvement in the future would be conducted in conjunction with other street improvements or proposed developments, compatible with these guidelines and the applicable jurisdiction's standards.

The guidelines for the provision and design of these transit facilities and amenities are based on the following key considerations:

- Basic bus operations and safety requirements
- Current engineering practices in Kaua'i County
- Current standards used by other transit operators In the United States
- Conformance in design of transit bus-related facilities and amenities to offer and encourage accessibility to persons with mobility and visual impairments, as per the American Disabilities Act of 1990 (USDOJ, 2010)
- The amenities necessary for attracting and maintaining transit patronage
- The compatibility of the Improvements with other roadway uses
- The anticipated benefits to developers or local agencies in providing transit services to their existing and future residents, tenants and customers

The guidelines provide criteria, dimensions, space requirements, typical layouts and designs for the following bus-related facilities and amenities:

- Bus Stop Locations
- Bus Turnouts
- Bus Stop Signs
- Bus Stop Benches
- Bus Stop Shelters

All design guidelines are based on the bus dimensions found later in the chapter.

4.1 Bus Stop Location

The following considerations affect the bus stop location criteria:

- Bus stop spacing
- Bus stop placement

- Bus stop roadway and intersection design
- Bus stop zone design

4.1.1 Bus Stop Spacing

Bus stop spacing is the linear distance between Individual bus stops. It is based on the type and density of surrounding land use and is influenced by the three basic considerations of maximum passenger convenience, maximum passenger safety and minimum traffic interruption. These basic considerations would expedite bus maneuvers, encourage compliance by bus drivers and reduce interference with through traffic.

Bus stops should be spaced such that passenger accessibility, convenience and safety are maximized, while minimizing undue delay and interruption to traffic flow. The Transportation Research Board's Transit Cooperative Research Program Report 19, Guidelines for the Location and Design of Bus Stops suggests that stop spacing should not exceed 500 to 1200 feet in Urban Areas, with a typical spacing of 750 feet. In Suburban or Rural areas, wider spacing of 600 to 2640 feet (with a typical spacing of 1250 feet may be appropriate. (TCRP, 1996).

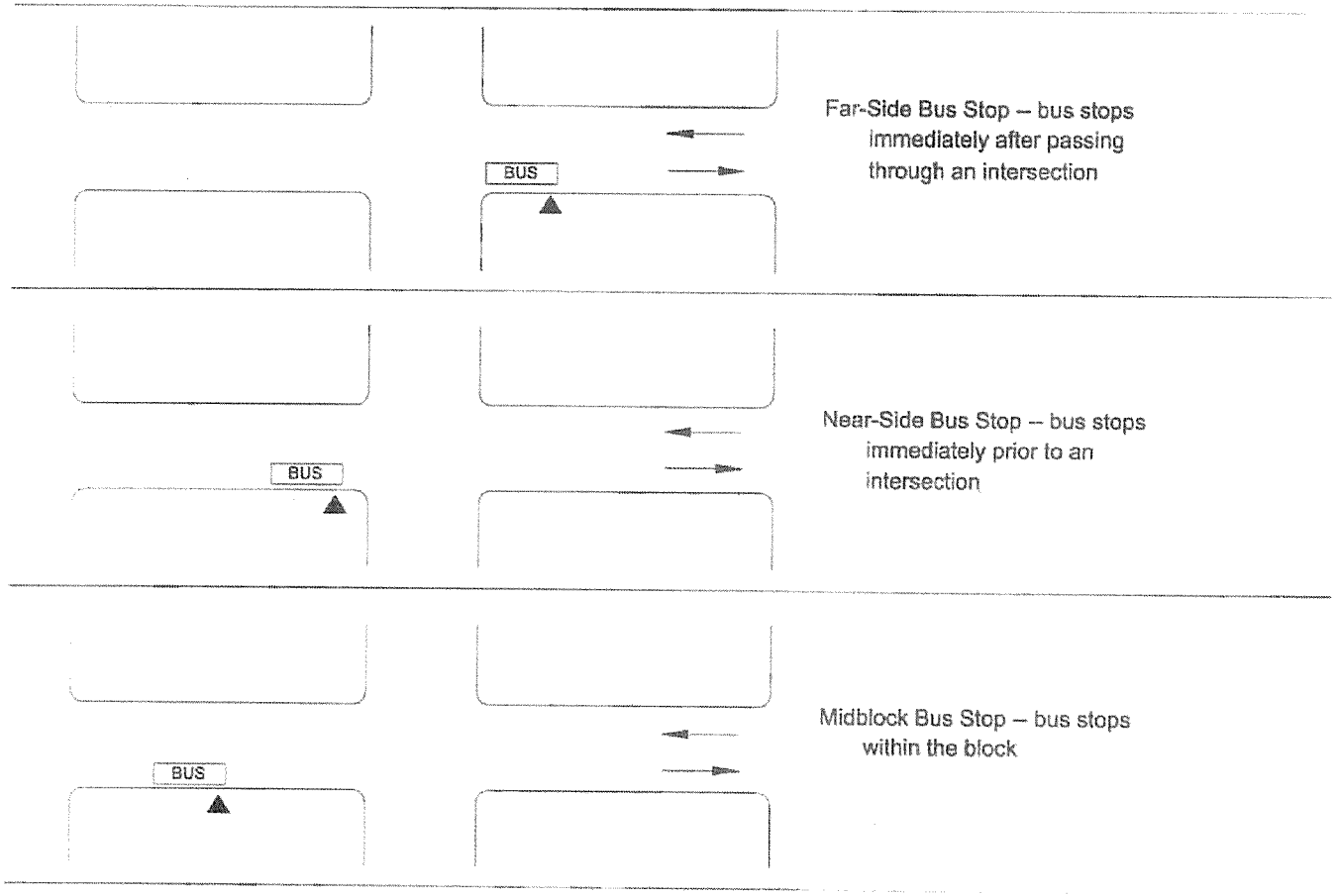
Within the County of Kaua'i, it is recommended that stops be spaced at approximately 1,300 feet apart especially within the residential subdivisions and in the commercial and office areas. In other areas of lower density, wider spacing of stops based on factors like availability of curb space, existing bus stop locations, convenience and safety of passengers, and proximity to destinations are recommended.

4.1.2 Bus Stop Placement

Bus stop locations should be standardized within each community to the extent that bus service requirements and traffic conditions permit. Bus stops are commonly located in the vicinity of intersections at near-side or far-side locations; and, in between intersections at mid-block locations. These stop locations involve a trade-off between locational consistency and conflict minimization. Many factors influence the location of bus stops and the choice of far-side, near-side and mid-block locations. They include widths of roads and sidewalks, bus routing patterns, directions of intersecting streets, intersection and roadway sight distance, types of traffic controls, traffic volumes and turning movements, availability of curb space, existing stop locations, convenience and safety of passengers including ADA compliance and proximity to passenger destinations.

Although near-side, far-side and mid-block bus stops can be used, it is recommended that far-side bus stops be encouraged, wherever possible. *Figure 1* shows types of on-street bus stops.

Far-side bus stops are preferable where sight distance or signal capacity problems exist, where buses have use of curb lanes during peak periods, where right or left-turns of



Source: TCRP 1996

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TYPES OF BUS STOPS

SCALE: NOT TO SCALE

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FIGURE 1

general traffic are heavy and wherever buses have to turn left. Buses can safely enter the traffic stream because of gaps created by a traffic signal, and passengers boarding and alighting are less likely to cross in front of the bus.

Near-side bus stops are preferable where traffic and parking conditions are not critical and where curb parking is permitted during peak periods. They are recommended when an intersection is controlled by a stop sign or in locations when the accumulation of buses at a far-side stop would spill over into the intersection (Darnell and Associates, 2006). From the driver's point of view, they make it easier for the bus to rejoin the traffic stream, particularly when curb parking is permitted during peak periods of travel. Bus stopping on approaches can use the distance of the intersection to reenter the main traffic flow.

Mid-block stops are generally applicable in areas where traffic, physical or environmental conditions prohibit near or far-side stops, or other major generators exist along a long block within the community. Mid-block stops should be used to minimize walking distance where long block lengths exist. However, mid-block stops could also encourage pedestrian jaywalking and could remove curb parking spaces.

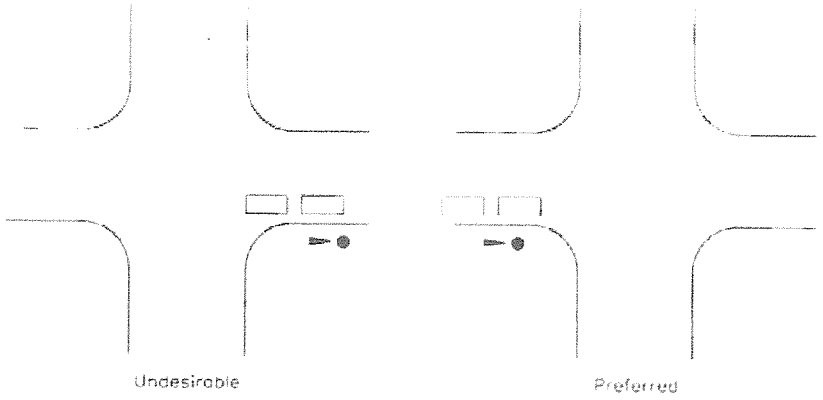
Bus stop locations near schools (particularly primary schools) should be placed in an area where it can be visually monitored by school personnel and/or crossing guards to increase safety and security. Mid-block stops near schools are not recommended in such a location. (KFH Group, 2009).

Figure 2 shows special considerations in the placement of bus stops. Bus stops should be located so that there are no sight restrictions or impedances along the main roadways and at intersections. These sight distance requirements shall be determined using the *Hawaii Statewide Uniform Design Manual for Streets and Highways*.

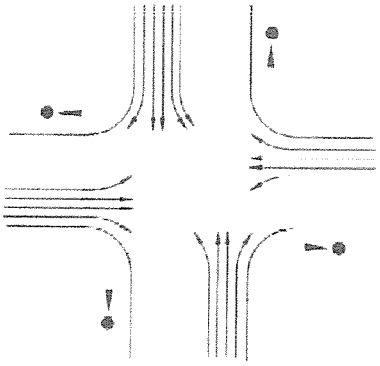
Bus stops are commonly located at intersections. Driveways leading to gasoline stations and other developments are also common at intersections. Bus stops, if possible, should not be located close to driveways. However, if the situation cannot be avoided, the following should be considered:

- Attempt to keep at least one exit and entrance driveway open for vehicles accessing the development while a bus is loading and 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 forced to wait for a bus in the middle of the driveway.
- Locate the stop so that patrons board or alight directly from the curb rather than from the driveway.

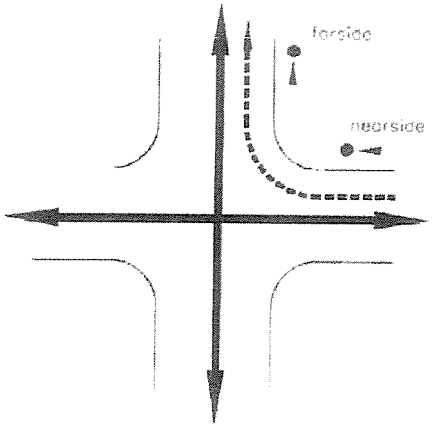
Figure 3 shows both desirable and undesirable situations where either visibility is restricted or the only driveway into a development/parking area is blocked.



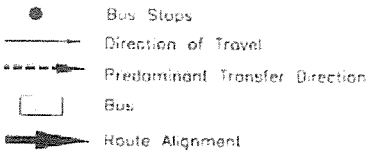
D. Nearside Stop When Bus Accumulation Exceeds Farside Bus Zone



E. Farside Stops at Complex Intersections



F. Farside/Nearside Stops to Minimize Pedestrian Street Crossings



Source: Kaua'i Bus Stop Location and Design Study by Kaku Associates, 1998.

SSFM INTERNATIONAL SSFM International, Inc. 501 Sumner Street, Suite 620 Honolulu, Hawaii 96817	SPECIAL CONSIDERATION IN THE PLACEMENT OF BUS STOPS		FIGURE 2
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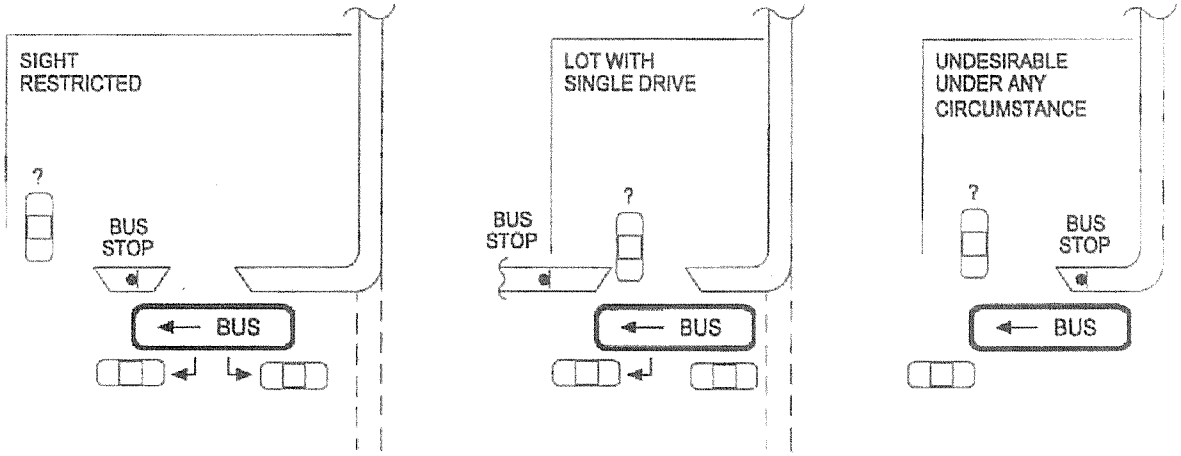
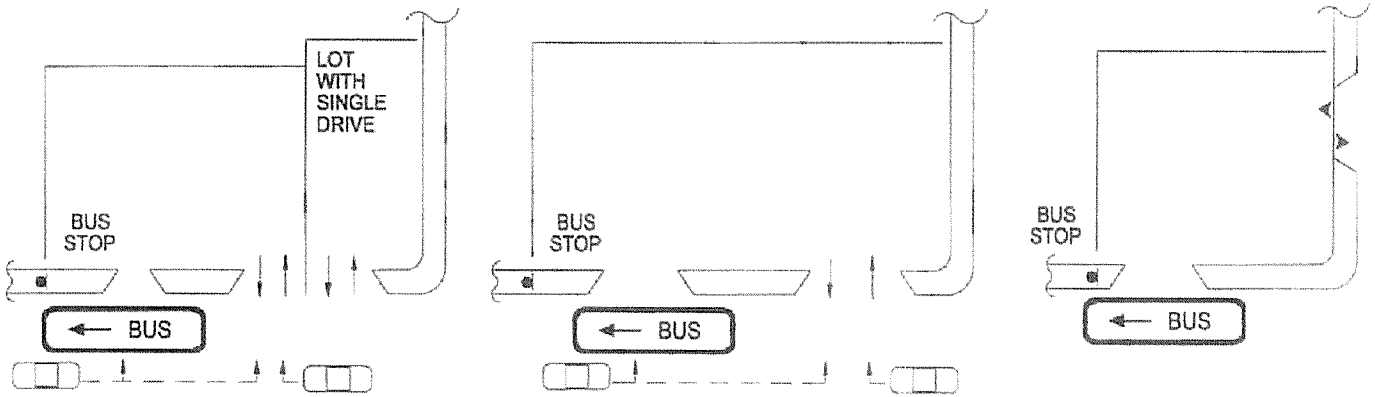
UNDESIRABLE DRIVEWAY ARRANGEMENTS



ACCEPTABLE DRIVEWAY ARRANGEMENTS



Source: TCRP 1996 and Kaua'i Bus Stop Location and Design Study by Kaku Associates, 1998.

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DRIVEWAY LOCATIONS NEAR BUS STOPS

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FIGURE
3

At new developments where it is feasible to do so, consideration should be given to providing bus stops close to building entrances within the development (which may be off the main transit route), to relieve transit users from having to cross parking lots or other large open auto-oriented areas between the stop and the intended destination. This consideration should evaluate the impact of bus stops within the development on overall bus travel time and ease of bus navigation within the development.

To promote good public relations, it is desirable that bus stops be placed where they will minimize the annoyance to the adjacent residents or business owners. Some businesses support having a bus stop in front of their establishment, while residents may object to a bus stop in front of their home, especially if the stop is used for layovers. Efforts should be taken to minimize the impact to each property owner, but vehicle and pedestrian safety should be the over-riding factor in determining the final bus stop location.

Other engineering and site location considerations for bus stops:

- Bus stops should not be located over the crest of a hill, immediately after a road curve to the right, or at other locations that limit visibility of the stopped bus to oncoming traffic. (KFH Group, 2009)
- Bus stops should be located such that the bus driver has clear visibility of passengers, and passengers should have a clear view of the oncoming bus without having to step into traffic.
- Drainage should be considered as well. Where feasible, passengers should not be required to step over grates, catch basins, or other potential tripping hazards. Drainage facilities (such as grates) located near or within pedestrian paths of travel shall be designed to ADA standards.
- Bus stops should be designed to minimize crowding and protect passengers from passing traffic.
- Bus stops should be located 75 feet ±25 feet from the point of tangency of the intersection curb return

4.1.3 Bus Stop Roadway and Intersection Design

Roadways and intersections with bus traffic and bus stops should be designed to accommodate the size, weight and turning requirements of buses. The following bus clearance requirements in roadway design are proposed (TCRP, 1996):

- Overhead obstructions should be a minimum of 12 feet above the street surface. Trees should be trimmed at least 12 feet above the roadway pavement for the length of the bus stop. (LSC Transportation Consultants, 2007). In the case of new development, plantings should be high-canopy to reduce trimming maintenance.

- 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 at least 12 feet in width or 14 feet curb lane including gutter.
- The typical maximum grade for a 40-foot bus is approximately 6 to 8%.

In locations with curbs, an appropriate curb height for efficient passenger-service operation is between 6 and 9 inches. If curbs are too high, the bus cannot move too close to it, and wheelchair lift operations could be impacted. If curbs are too low or not present, elderly persons and passengers with mobility impairments may have difficulty boarding and alighting. Effective use of low-floor buses is also influenced by curb height (TCRP, 1996)

Figure 4 shows typical placement of on-street bus stops along roadways.

The corner curb radii used at intersections affect bus operations when the bus makes a right turn. The design of corner curb radii is based on the following elements:

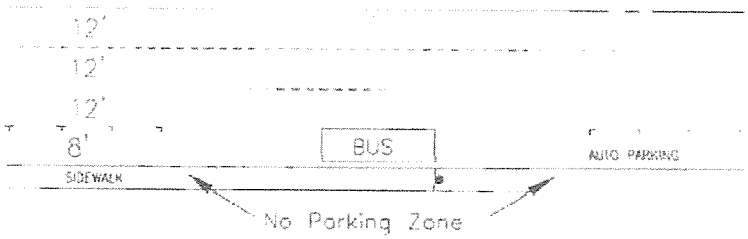
- Design vehicle characteristics, including bus turning radius
- Width and number of lanes on the intersecting street
- On-street parking
- Angle of intersection
- Operating characteristics – speed and speed reductions; and
- Pedestrians

Figure 5 shows appropriate corner radii for transit vehicle and various combinations of lane widths. This figure can be used as a starting point; the radii values can be checked with an appropriate turning radius template before incorporating into a final design.

4.1.4 Bus Stop Zone Design

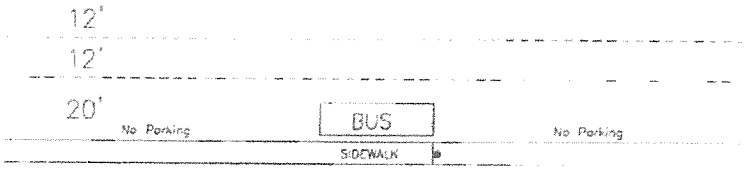
A bus stop zone is the portion of a roadway marked or signed for use by buses when loading or unloading passengers. The following requirements apply for bus stop zones (TCRP, 1996):

- At near-side bus stops, the length of the bus stop zone should be a minimum of 100 feet with a 60 foot no-parking zone to the rear of the stop
- At far-side bus stops, the length of the bus stop zone should be a minimum of 90 feet with a 50 foot no-parking zone to the front of the stop
- At far-side bus stops after turn, the length of the bus stop zone measured five feet after the end of radius, should be a minimum of 90 feet



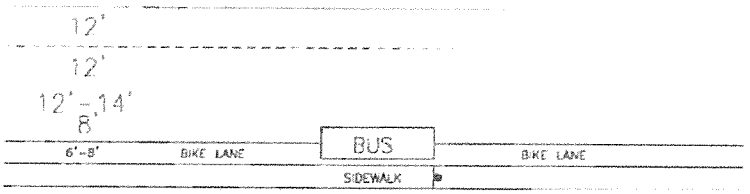
CASE 1 : BUS STOP IN PARKING LANE

(IF COMBINED WIDTH OF PARKING AND OUTSIDE TRAVEL LANES IS LESS THAN 20', TURNOUT MAY BE NECESSARY.)



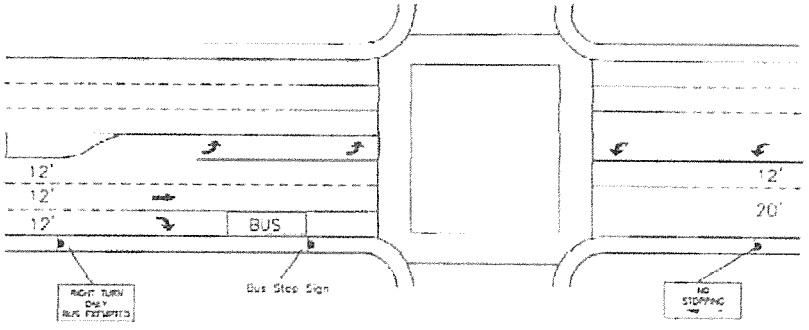
CASE 2 : BUS STOP IN EXTRA -WIDE CURB LANE

(IF CURB LANE IS LESS THAN 20', TURNOUT MAY BE NECESSARY.)



CASE 3 : BUS STOP IN BIKE LANE

(IF COMBINED WIDTH OF BIKE LANE AND OUTSIDE LANE IS LESS THAN 20', TURNOUT MAY BE NECESSARY.)



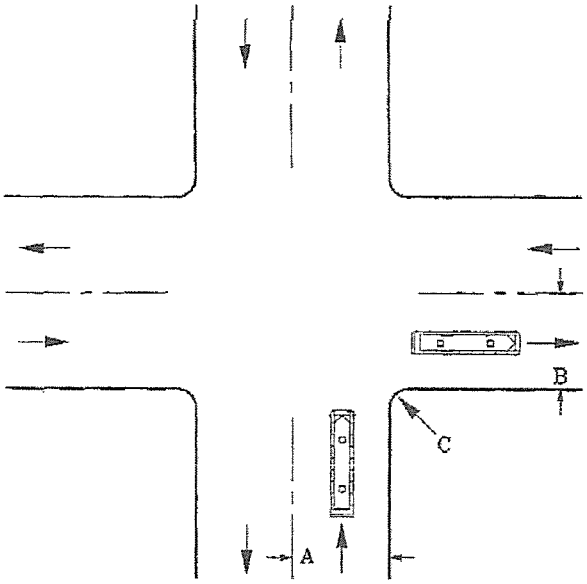
CASE 4: BUS STOP IN RIGHT TURN LANE

Source: Kaua'i Bus Stop Location and Design Study by Kaku Associates, 1998.

SSFM INTERNATIONAL SSFM International, Inc. 501 Sumner Street, Suite 620 Honolulu, Hawaii 96817	TYPICAL PLACEMENT OF ON-STREET BUS STOPS		FIGURE 4
	SCALE: NOT TO SCALE	DATE:	

STREET-SIDE FACTORS

ROADWAY AND INTERSECTION DESIGN-INTERSECTION



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.		

Recommended Corner Radii.

Source: TCRP 1996

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STREET -SIDE FACTORS
ROADWAY AND INTERSECTION DESIGN-INTERSECTION

SCALE: AS SHOWN DATE: DATE

FIGURE 5

- At mid-block bus stops, the length of the bus stop zone should be a minimum of 150 feet

Figure 6 illustrates typical dimensions for on-street bus stops.

Pavements need to be able to support repetitive bus axle loads of up to 25,000 pounds (TCRP, 1996). Bus parking pads should be a minimum of 10 feet in width and preferably 12 feet in width. Stops that are typically served by four or more buses per hour should be made of concrete.

Parking should be restricted in bus stop zones, either through signage or curb markings or both.

4.2 Bus Turnouts

Bus Turnouts are areas for buses to stop outside of the traffic lane. TRB recommends turnouts for a number of locations, particularly if traffic in the curb lane exceeds 250 vehicles in the peak hour, traffic speed is greater than 40 mph, passenger volumes exceed 20 to 40 boardings an hour, peak period dwell time exceeds 30 seconds per bus, layovers are expected, sight distances justify a turnout, etc. (TCRP, 1996). Bus turnouts should be generally placed on the far-side of intersections to provide safe boarding and unloading of bus passengers and to take advantage of traffic gaps at signalized intersections.

Bus Turnouts are recommended for streets without curbs and gutters. All bus turnouts would need a deceleration, standing and acceleration lane where the buses are clear and separated from the through-traffic lanes.

For bus stops located on County facilities where bus turnouts are required, the turnout should be constructed consistent with the County of Kaua'i, Department of Public Works' standards. Figure 7 details the pavement details and dimensions for both collector streets and minor streets.

For bus stops located on State facilities where bus turnouts are required, the turnout should be constructed consistent with the State of Hawai'i, Department of Transportation's standards.

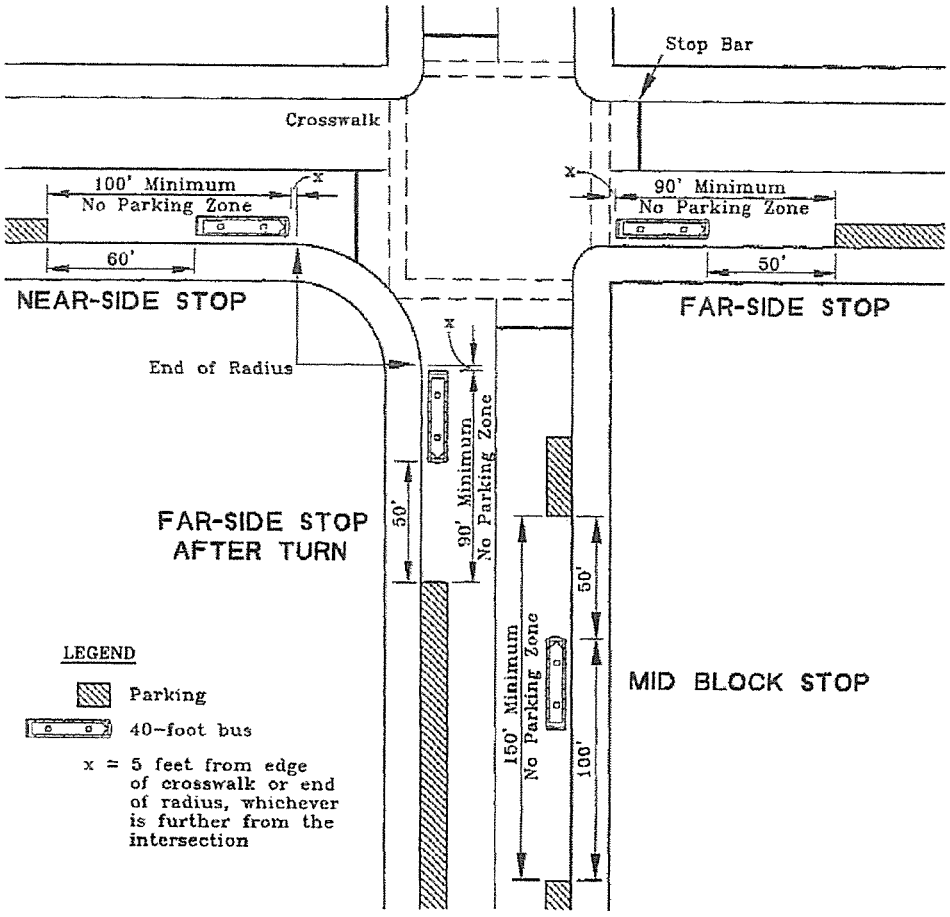
Figure 8 details the pavement details and dimensions for turnouts along state facilities.

4.3 Bus Stop Design and ADA Compliance

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. All new bus stops need to comply with the ADA.

STREET-SIDE FACTORS

BUS STOP ZONE DESIGN TYPES - CURB SIDE STOP ZONE DIMENSIONS



Notes:

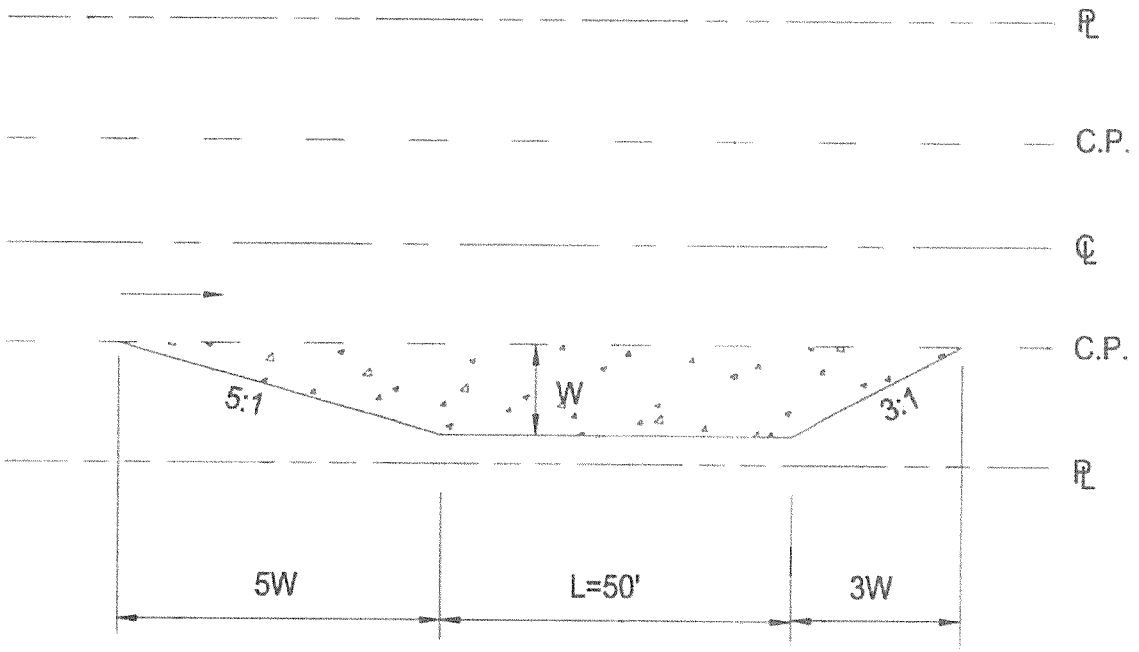
1) Add 20 feet to bus stop zones for an articulated bus.
2) Increase bus stop zone by 50 feet for each additional standard 40-foot bus or 70 feet for each additional 60-foot articulated bus expected to be at the stop simultaneously. See Table 3 for the suggested bus stop capacity requirements based on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

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

Source: TCRP 1996

SSFM INTERNATIONAL SSFM International, Inc. 501 Sumner Street, Suite 620 Honolulu, Hawaii 96817	STREET -SIDE FACTORS BUS STOP ZONE DESIGN TYPES- CURB-SIDE BUS STOP ZONE DIMENSIONS		FIGURE 6
	SCALE: NO TO SCALE	DATE:	

BUS TURNOUT



For Collector Streets

W, minimum = 10 feet (for speeds below 30mph)
W, desirable = 12 feet

Note:

desirable = Turnout shall be constructied with 4" thick concrete pavement with 6x6 -6/6 wire fabric

Source: County of Kaua'i Department of Public Works - Memorandum of Stamdards for Bus Stop/Shelters

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BUS TURNOUT AT STOPS ON COUNTY FACILITIES

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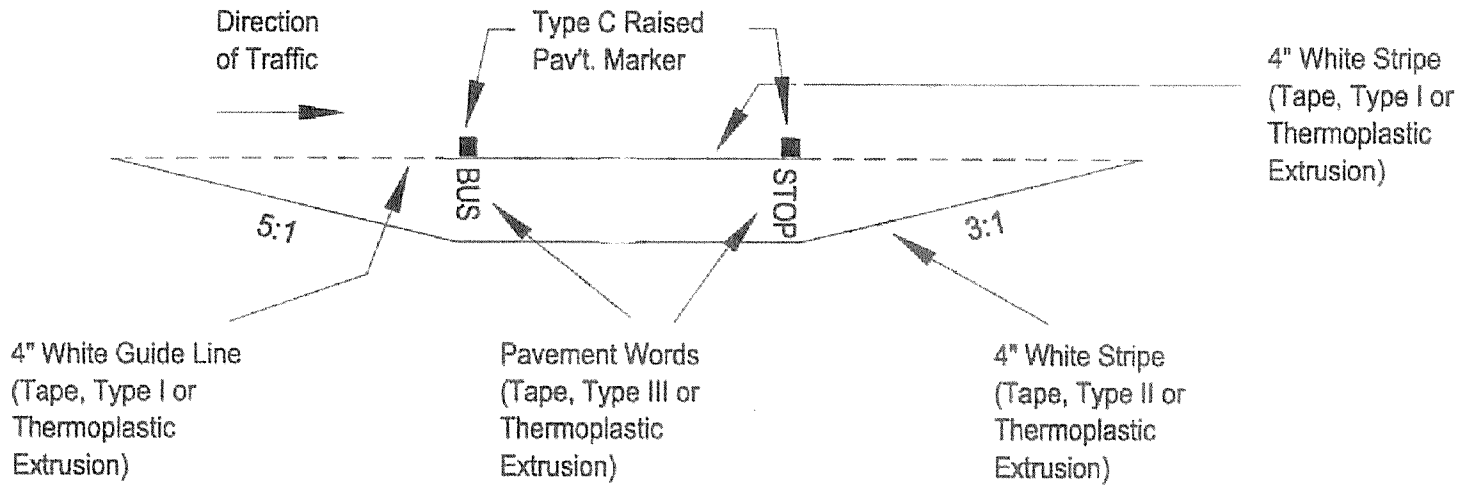
FIGURE 7



NOTE:
SEE FIGURE 7 FOR DIMENSIONS

Source: State of Hawaii, Dept. of Trans., Highways Division - Kaua'i District

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BUS TURNOUT AT BUS STOPS ON STATE FACILITES

SCALE: NOT TO SCALE

DATE:

FIGURE
8

Basic design principles that encourage accessibility are discussed in the sections that follow.

4.3.1 Obstacles

All the paths planned from the alighting point at the bus stop to destinations off the bus stop premises should be examined to determine if any protrusions or obstacles exist that would restrict wheelchair movements. If any protrusions exist and they are higher than 27 inches or lower than 80 inches, a person with vision impairment may not be able to detect an obstacle with a cane and the 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. It is suggested that the transit agency work closely with all the parties involved to offer better accessibility to people with disabilities.

A convenient pedestrian pathway/accessway to and from adjacent developments should be provided.

4.3.2 Surfaces

Surfaces should be stable, slip-resistant and firm. Such provisions would be beneficial to all transit users, but especially for those with disabilities. Abrupt changes in grade should be avoided and where they cannot be eliminated, beveled surfaces should be provided. Any drop greater than 1/2 inch or surface grade steeper than 1:20 requires a ramp.

4.3.1 Landing Areas

The "Landing Area" is the location where passengers alight or board a bus, and incorporates the location of lifts and ramps. The dimensions of this area are critical for wheelchair users and other disabled passengers. The minimum landing area should be at least 5 feet parallel to the street and at least 8 feet perpendicular to the street at the bus' front door. At the bus' back door, this area should be at least 10 feet parallel to the street and 8 feet perpendicular to the street. Benches, trash receptacles, and other obstructions should not be located in the landing areas.

The slope of the landing area must be parallel to the slope of the roadway in order for the bus wheelchair lift or ramp to be effectively deployed. If there is an adjacent sidewalk, the landing area slope should match the sidewalk's slope and allow drainage. The slope should not exceed 1 foot vertical over 20 feet horizontal (5%), and the cross slope should not exceed 1 foot vertical over 50 feet horizontal (2%). It is preferable that

the landing area be elevated above street level for pedestrian safety. For stops served by low-floor, ramp equipped buses a standard curb provides an acceptable ramp slope.

Wheelchair lifts can extend up to four (4) feet from the side of the bus. Therefore, sufficient clear space is needed to maneuver a wheelchair on and off the bus and to the adjacent sidewalk. Bus passenger pads must have a smooth finished surface to accommodate wheelchairs. The slope of the pad, including the wheelchair loading areas, should match the slope of the adjacent sidewalk and allow drainage (2% maximum as per ADA guidelines). If a shelter is provided, an accessible route must be provided between the shelter and the boarding and alighting area.

Prior to the provision of bus stop amenities, it is worth noting that in order to address ADA requirements for passenger boarding areas at bus stops, the following design guidelines should be used:

- Minimum door clearance ("landing pad"): Front Door - 5'X 8'; Rear Door - 10'X 8'.
- Maximum slope of boarding area: 1 foot vertical over 20 feet horizontal (5%).
- Maximum cross slope of boarding area: 1 foot vertical over 50 feet horizontal (2%).
- Minimum clearance in boarding area: Horizontal - 3 feet; Vertical - 6 feet 8 inches.
- Surface material should be slip-resistant, stable and firm.
- Overall boarding area should be 40 feet in length.

Where a sidewalk is physically separated from the bus stop by grass or other landscaping, the landing area should be designed as described above and a paved ADA-compliant connecting link should be provided between the landing area and the sidewalk.

Figure 9 shows a design approach to a bus stop with a shelter that would meet ADA requirements.

4.4 Bus Stop Signs

Bus stop signs identify the location of bus stops. 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.

The Kaua'i Bus stop signs should be placed at all authorized bus stops. The signs should be placed at the location where people board the front door of the bus and be oriented to provide maximum visibility. The bus stop sign shows the area where passengers stand while waiting for the bus and also serves as a guide for the bus operator in positioning the vehicle at the stop.