5. Off-Line Transit Facilities

This chapter addresses park-and-ride lots and transit centers; transit facilities that are located adjacent to highways and streets to provide access to transit or between transit services. All off-line transit facilities include elements related to bus circulation and passenger interface, and these elements are addressed in section 5.2. Park-and-ride lots and many transit centers also include elements related to automobile parking and pedestrian and bicycle access; these are addressed in section 5.3. Guidelines for integrating off-line transit facilities with surrounding neighborhoods are included in section 5.4.

Many factors must be considered when designing a successful off-line facility. At the site-specific level, these include the general site layout, pedestrian circulation routes within the design, and the intermodal platform design. Each element is essential to the facility’s success.

5.1. Planning and Design Considerations

5.1.1. TYPES OF OFF-LINE TRANSIT SERVICES AND FACILITIES

The term “off-line facility” identifies any transit facility that requires the transit vehicle to leave the through roadway (be it an HOV lane, a busway, or a general traffic lane) to facilitate a modal interface (i.e., connect with other transit routes at an inter-modal transfer point, pick up or distribute passengers, etc.). Off-line facilities provide important opportunities to congregate users to assure adequate use of the adjacent transit service(s) and corridors. They provide an opportunity for passengers to transfer between transportation modes (i.e., between single occupancy vehicles and carpools, between local transit routes and express routes, between bus and rail).

This chapter addresses four types of off-line facilities.

- **Transit Centers**: Also known as transit stations or terminals, transit centers are locations where intermodal connections between different transit modes or between crossing transit routes are facilitated.

- **Park and Ride Facilities**: These off-line facilities typically provide places where transit patrons or carpool participants can park their car during the day, using transit or carpool or vanpool opportunities to access distant travel destinations. Park and Ride facilities may be served by one or more transit routes or may be designed for carpool/vanpool use only. This latter option is sometimes referred to as a park and pool facility to differentiate it as a place not served by transit.

- **Combined Transit Centers and Park & Ride Facilities**: These facilities combine the transit center concept as defined above with parking capacity provided by a park and ride element.

- **Multi-Use Shared Facilities**: These facilities can provide for both transit center and park and ride facilities, but can also include retail space (both formal and informal), integrated housing, public open space and other elements as desired or agreed upon by the transit provider, public, and developer.
5.1.2. JUSTIFICATION AND NEED FOR OFF-LINE TRANSIT TREATMENTS

The justification and need for off-line transit services is the result of transit demand in the area of the proposed facility. The junction of major roadway facilities, transit lines and services, areas of high-density development and land-uses are all locations that typically suggest the need for off-line transit services. Another indicator of need for off-line transit treatments are informal park and ride activities along bus routes or near stops.

5.1.3. DEMAND ESTIMATION

Refer to Chapter 2.2 for a discussion of demand estimation techniques common to all transit facilities. For park and ride lot demand estimation, see [2].

5.1.4. PLANNING AND DESIGN PROCESS

Site-Level Location and Design Studies

Once a regional system plan has been developed, planning and alternatives analysis for individual park-and-ride facilities can be conducted within the framework outlined during the broader system planning effort. Within the system plan, general locations for individual facilities will have been identified. During the alternatives analysis process, site-specific issues will be evaluated, often focusing on several specific locations/sites within the general location identified by the system planning process.

Choosing the optimum site within a generalized service area for a park-and-ride facility will depend on a number of competing interests and community goals. These factors are evaluated on a site-by-site basis. Individual site-specific locations are compared and evaluated to select a preferred park-and-ride location. In brief, a site-specific alternatives analysis process would include:

- Determination of site availability
- Site evaluation, ranking, and selection of a preferred site from a range of local alternatives
- Site-level demand forecasts (i.e., demand estimates for a specific location)
- Conceptual design, including allowances for public art and unique architectural elements to be incorporated into final design.
- Analysis of location-specific (site-specific) environmental impacts, including:
  - Traffic study/access analysis
  - Air and noise and vibration quality
  - Drainage analysis
  - Geotechnical/civil analysis
  - Hazardous waste mitigation plans (if necessary)
  - Historical/cultural resource impacts
- Developing and conducting a public involvement program centering around a specific site
- Pursuing and securing adequate funding resources
- Preliminary and final design and engineering

A successful site-level alternatives analysis process should eventually lead to a design report (supported by the necessary environmental documentation) and facility concept that is embraced by the community and by all the participating agencies. The time required to complete a site-level study will vary, depending on the complexity of the issues involved in the analysis, community support, and agency participation. Regardless of the time required, the resulting facility plan will be more inclusive if based on a community-oriented process. Community support built at the system-level and site-level planning stages will carry over into the construction, operation, and use of the facility.

**Figure 5-1**

*Park-and-Ride Site-Level Study Process*

Reference: [2]
A simplified site-level study process is identified in Figure 5-1, which illustrates the relationship of the site-level analysis with system planning efforts. As with the system planning process, a continuous public involvement process is identified throughout the duration of the project. The public involvement process incorporated at the site-specific level will be more focused than at the systems level, and will require greater interaction among the planning and design teams and the affected community.

5.1.5. **FINAL (DETAIL) DESIGN AND CONSTRUCTION**

Final or detail design and construction may immediately follow the site-specific alternatives evaluation and preliminary/conceptual engineering design phase of the facility implementation process, or it may be postponed until funding can be secured. Design options to traditional construction such as joint use parking facilities, facility leasing, and staged construction should be evaluated for potential advantages in expediting the implementation process. Leased and joint use lots, although not always in the best locations from the perspective of the park-and-ride system plan, can be used as test markets for expanded public investment in the form of a permanent park-and-ride facility. Likewise, the staged construction of public lots can be used to minimize the financial exposure of the implementing agency, since construction of subsequent facility phases can be delayed if required.

Construction techniques should minimize the required public expenditure while at the same time provide for a long life cycle in terms of structures and materials used in the site development. This approach will reduce the operation and maintenance costs of the facility and prolong its usefulness.

5.2. **Bus – Passenger Interface Elements**

Both transit centers and park-and-ride lots include areas related to bus operations and passenger service. These elements are addressed in this section. Some transit centers, and all park and ride lots also include parking and access components, which are addressed in section 5.3.

5.2.1. **BUS CIRCULATION & PASSENGER LOADING AREAS**

**Bus Loading Area**

The bus loading area is where transit vehicles dock and circulate and where passengers board and alight. Design of the bus loading area must incorporate both vehicle and passenger needs.

In most stations, the bus loading area integrates the bus bays with the platform area to facilitate the loading and unloading of passengers near or adjacent to the station building. Sizing of the bus bays will depend on the transit operation, including independent or dependent vehicle arrival and departure requirements of buses.

For small transit stations, the number of bus bays is relatively low, ranging anywhere from 2 to 4 bays, with a fairly simple access and layout configuration. For larger terminals, numerous bays and more sophisticated designs are applied. For example, before BART was opened, the Transbay Bus Terminal in downtown San Francisco had 37 berths serving 13,000 peak-hour passengers.
Transit vehicle parking space requirements will be based on the maximum number of transit vehicles requiring independent pull-in and pull-out space at the facility. If all coaches operate independently and access the transit facility simultaneously (for example, under pulse scheduling), curb space sufficient to park all vehicles must be provided. On the other hand, a reduction in costs can be achieved if bus arrival and departure can be staggered and individual bus bays shared. Care should be used to assure the reliability of each intersecting bus route if staggered through a single transit center, especially if transfers are expected between routes. Automated bus location systems, active fleet management, and real-time passenger information systems can be used to facilitate dynamic use of limited platform space, thereby optimizing station efficiency.

Figure 5-2 illustrates the different types of bus bay configurations integrated into station design. Four types of bus loading configurations are typically applied:

- **Linear (curb-side):** these bays can operate in series and have capacity characteristics similar to on-street bus stops.

- **Sawtooth:** This loading configuration is popular in urban transit centers, and designed to permit independent movements into and out of each bay.

- **Angle:** This loading type is limited to one bus per bay, and requires buses to back out. This is often used for inter-city coach terminals, with long dwell times, single-door entry, and luggage loading requirements.

- **Drive Through:** Drive-through angle bays do not require buses to back out of the bay and may accommodate multiple vehicles.

Reference: [1]
Figure 5-3
Bus Loading Area (Berth) Examples

Reference: [1]

Design Issues

- Bus loading zones should be flexible and designed to accommodate potential future growth.
- Passengers should be accommodated at a reasonable level of service.
- The facility should accommodate a range of bus types depending on the intended facility program, e.g., spaces for articulated coaches, standard coaches and smaller vehicles or vans.
- Bus loading zones should reinforce safe pedestrian movements and easy vehicle operation.
- All loading zones should be located in a common area within the facility.
- All buses owned by the agencies using the facility should be able to operate within the bus roadway, with the understanding that the types of vehicles that will operate in the loading area may vary depending on system changes and growth.
The most common designs used for bus loading areas are linear platforms or sawtooth platforms. Either platform type may be configured in a loop, to save space and allow buses to leave the transit station in any direction. A flexible platform design may be considered - one that allows a transit agency to modify the bus edge between sawtooth and straight edge, depending on operational circumstances and site constraints. This can be achieved by casting the bay teeth as movable paving segments on top of a crushed rock base, so that the transit platform can be reconfigured at little cost and time to meet the changing needs.

A desirable inside bus turning radius of 12 m (40’) and an 18 m (60’) outside radius shall be used where space is available. Most buses can depart from a stopped position by turning front wheels up to 40 degrees, however the transit vehicles to be used will need to be taken into consideration.

The National Transportation Safety Board recommends that transit facility designs that incorporate sawtooth-type bays (or other types of bays that direct buses toward pedestrian-occupied areas) also provide for positive separation of the roadway and pedestrian areas. These positive separation elements (such as bollards) should be sufficient to stop a bus operating under normal parking area speed conditions from progressing into the pedestrian area.

Reference: [3]
Passengers who are waiting to board buses at the facility will need to be accommodated within a queuing area. This area needs to be sufficiently large so that passengers can queue comfortably. Ten square feet per passenger is recommended. The waiting area should be inviting, safe, and easily maintained. The passenger areas should provide for wind and rain shelter as required by the climate and specific site location. A minimum of ten feet clear distance between the doors of a coach and any obstruction is required to assure ADA lift operation and general queuing of passengers. Figure 5-4 shows the basic cross sectional dimensions at a bus stop while Figure 5-5 shows a facility with enhanced weather protection.

Cross-sectional design for bus related streets and on-site access roadways is important should aim to reduce the hazard of water pounding and minimize discomfort and inconvenience to passengers. Adequate consideration of pavement design is required to minimize the long-term maintenance cost to the implementing transit authority and to minimize pavement surface degradation.

For both cross-sectional and pavement design, local standards should be referenced for specific conditional requirements and applicable codes. For cross-sectional design, a minimum of a percent cross-section slope is recommended, terminating in a curb and gutter design to allow for adequate drainage. In areas that typically

Figure 5-5
Rain Protection

Reference: [3]
receive substantial amounts of snow or frost, gutter and drainage system design should not create opportunities for icing in winter and subsequent drainage problems from melting snow.

Pavement designs for bus facilities should account for the axial loads typically carried by transit vehicles. At locations where transit vehicles are expected to stop and load passengers, a bus loading pad should be provided to accommodate the additional stresses exerted by the dynamic axial loads caused by stopping and starting.

**Sawtooth Bus Bays**

*Design*

**Figure 5-6**

*Saw-Toothed Bus Bay Design*

![Diagram of Saw-Toothed Bus Bay Design]

The best loading/unloading berth layout for buses is as follows:
- Saw-tooth berth for a 40’ or 35’ standard bus.
- Saw-tooth berth for a 60’ Articulated Bus.

**Reference:** [2]
Application

Figure 5-7
Saw-Toothed Bus Bay Application

Reference: [2]
**Linear Bus Bays**

*Design*

**Figure 5-8**

Linear Loading Area Dimensions

<table>
<thead>
<tr>
<th></th>
<th>Pull-Out</th>
<th>Standard</th>
<th>Articulated</th>
<th>Pull-In</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OFF-STREET PARKING</strong></td>
<td>3.7m (12')</td>
<td>6m (2')</td>
<td>18.3m (60')</td>
<td>12.2m (40')</td>
</tr>
<tr>
<td></td>
<td>9.2m (30')</td>
<td>18.3m (60')</td>
<td>12.2m (40')</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Travel Lane</td>
<td>58.5m (192')</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Pull-Out</th>
<th>Standard</th>
<th>Articulated</th>
<th>Pull-In</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ON-STREET PARKING</strong></td>
<td>3.7m (12')</td>
<td>6m (2')</td>
<td>18.3m (60')</td>
<td>12.2m (40')</td>
</tr>
<tr>
<td></td>
<td>12.2m (40')</td>
<td>12.2m (40')</td>
<td>18.3m (60')</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Travel Lane</td>
<td>61.6m (202')</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Reference: [3]

*Application*

**Figure 5-9**

Linear Bus Bay Application

Reference: [2]
Bus Loop

Design

Figure 5-10

Bus Loop Design

Reference: [2]
Para-Transit Loading Area

Para-transit service may be provided specifically for disabled users, but may also be provided for elderly passengers or others who require additional time or door-to-door service. Para-Transit vehicles are typically smaller than standard transit vehicles, therefore the design of the para-transit loading area should be completed in conjunction with service plans for para-transit service. The para-transit loading area is where passengers of paratransit service board and alight transit vehicles.
Design Issues

- Patrons of paratransit with a range of disabilities should be accommodated at a reasonable level of service, likely with more space allowed per passenger than for typical transit riders.
- Paratransit loading zones should be located in a common area within the facility.
- The paratransit loading zone should allow a wheelchair lift to be used.
- Loading zones should reinforce safe pedestrian and wheelchair movements and as well as easy vehicle operation.

Figure 5-12

Para-transit Loading

Reference: [3]
All bus loading zones should provide wheelchair access for paratransit patrons, and only as a last resort should a zone be considered non-accessible. The loading area should allow a wheelchair lift to be used by the type of vehicles expected to operate at the facility. The design should include curb cuts and ramps where applicable to allow disabled passengers to move across grade differences. Flagstop areas should not be used by full size transit buses for accessible service. Zones should be established if the route is to become accessible. Individual drivers should determine whether a flag stop is accessible.

**Sizing**

A clear paved loading area measuring a minimum of 3m (10’) in length by 2.5m (8’) width is needed. A minimum of ten feet clear distance between the doors of a coach and any obstruction is required to assure ADA lift operation and general queuing of passengers.

### 5.2.2. PUBLIC AREAS

Public areas are places in a transit facility where customer-related activities occur. All features provided to the public need to be accessible, such as seating, kiosks, vending machines and parking. Public areas include:

- Passenger Waiting
- Passenger Amenities
- Short-Term Parking (Kiss and Ride)

#### Passenger Waiting

The passenger waiting area is where a majority of passengers congregate within the facility, where queuing for transit vehicles occurs and passengers wait.

**Design Issues**

The passenger waiting area should:

- Efficiently, conveniently organize space and provide customer amenities.
- Provide a safe and well-lit place that is readily observable for security reasons.
- Provide area/spaces for customer information.
- Include provisions that allow customers to sit or lean.
- Adequately protect customers from undesirable weather. Refer to “Weather Protection” for specific requirements.
- Be sized to consider future expansion.

The facility must meet the functional needs of customers and provide a setting that is perceived by customers as safe and desirable. Passenger accommodation should complement the character of the community while creating an environment that enhances the transit experience. To achieve this, designers should create architectural solutions that enhance the user’s and non-user’s perception of transit while integrating the facility into neighborhoods in a manner that engenders a sense of community.
Certain spaces are recognized as important for passenger accommodation. These include:

- The general waiting area for people waiting to board the transit vehicle
- An amenity core in which customer services and amenities are concentrated
- Pedestrian paths and entrances that connect spaces within the facility and with surrounding areas.

**Figure 5-13**

Waiting Area Components Associated with Bus Loading Area

Reference: [3]

**Sizing**

The number of components placed within the waiting area depends on the maximum number of people waiting for the transit vehicle. The following components are generally recommended, but may not be suitable for every facility. Specific components and quantities and should be determined on a project-by-project basis, to meet each facility’s specific needs:
- **Seating**: A minimum of one bench for each bus loading location is recommended in some references. Benches may need to be protected by wind screens.

- **Leaning rails**: A minimum of one rail for each bus loading location is recommended in some references. Leaning rails may need to be protected by wind screens.

- **Trash/recycle receptacles**: A minimum of one pair of receptacles for each bus loading location is generally recommended.

- **Clock**: This amenity is helpful to patrons and bus riders in keeping routes on schedule.

**Figure 5-14**

Amenity Core Placement Options

Reference: [3]
Passenger Amenities

An amenity is defined as a customer-oriented service that makes a passenger’s journey more enjoyable. Common amenities include machines that dispense goods, vendors selling food and drink, customer information/service booths, ATMs, public telephones, and security offices.

Amenities are generally located in a central location within the facility. By centralizing most amenities in the core, passengers will intuitively know where to find any amenity. The amenity core must be easily monitored by security personnel. CCTV surveillance is desirable to provide security and monitoring of operation.

Sizing

The sizing of this centrally located area depends on the number of amenities to be offered, which depends on the peak number of patrons present at the facility. The following general guidelines exist, but each facility’s specific operational characteristics should be taken into consideration when considering the inclusion of the following amenities.

- **Food and Beverage Vending Machines**: One machine per fifty people present or a minimum two per facility.
- **Newspaper Vending Machines**: One eight-unit array and new vending tie-down area of 10 square meters per 50 people, or a minimum of one per facility. At on-street or freeway bus stops one array should be provided.
- **Kiosks/Information Display**: One location per 100 people present
- **Convenience Shop**: One per 200 people present
- **Public telephones**: One phone per 50 people present or a minimum of two per facility. Although the use of cell-phones has certainly reduced the need for public telephones, at least 1 public telephone in the passenger waiting area is recommended for passenger safety.
- **Patron phones**: One phone per 50 people present or a minimum of two per facility

Short-Term Parking (Kiss and Ride)

Short-term parking is a location for automobiles to drop off and pick up passengers close to the transit loading area. These areas are especially important at facilities where there is no park-and-ride area, or where the park-and-ride area is not large enough to meet demand. Drop-off zone layout can vary widely, from on-street loading zones to multi-island pick up points. Some short-term waiting space should be available for cars to wait to pick up arriving passengers.

Design Issues

The following design issues may warrant consideration, depending on individual facility characteristics and needs:

- Passenger drop-off zones’ ability to accommodate a wide range of vehicle types and operations, including standard and compact automobiles, vans and shuttles.
Sizing drop-off zones to accommodate the number of waiting vehicles expected to be present during the PM Peak period. Signage or enforcement to ensure a short vehicle stop at drop-off zones should be considered.

Conveniently locating drop-off zones with respect to the transit loading zones.

Conveniently locating drop-off zones with respect to vehicular access to the facility.

**Sizing**

The size of the drop-off area will depend upon the expected number of autos dropping or picking up passengers at the facility. Some short term parking and most morning drop-off mode shifts use straight curbs where it is not desirable for vehicles to back up. Most evening pick-up requires a percentage of vehicles to wait for people yet to arrive by transit. A ratio of 3 pull-in/back-up stalls per 1 curb side drop off stall is applied in some settings unless specifically modified by transportation planners.

5.2.3. OPERATIONAL SUPPORT AREAS

Operational support areas are operator rooms and facilities needed for staff and the operation and maintenance of bus transfer facilities. These may include:

- Transit Vehicle Layover Area
- Driver’s Amenities
- Supervisor’s Office / Security Office
- Customer Service Office
- Staff Parking

**Transit Vehicle Layover Area**

The layover area provides parking for transit vehicles during breaks, driver changes, or time required to meet schedule needs. The following design issues may warrant consideration, depending on individual facility characteristics and needs:

**Design Issues**

- Provision of layover parking areas where a maximum number of transit routes can be accommodated, generally at transit centers or park-and-ride lots. However, layover areas may be located anywhere along a route where buses dwell a longer time than it takes to load and unload passengers.

- On street layover locations’ ability to accommodate vehicle turn-around space on the adjacent street system.

- The size of the layover parking area. Generally, this is based on the maximum number of buses laying over concurrently.

- At transit centers, it is generally recommended that layover parking be located near operator comfort stations, staff facilities, and vehicle operating areas.
The design of the layover parking area should reflect the type of vehicles expected to operate at the facility, with the understanding that the types of vehicles laying over may vary depending on system changes and growth. Sizing of the layover area will depend on the transit operation scheduling, which may include independent or dependent vehicle arrival and departure. Generally, layover areas should be designed to accommodate two articulated buses with adequate pull-in and pull-out dimensions.

At transit centers and park-and-riders, location of the bus layover area should be on the inbound roadway to the passenger loading area. This configuration allows drivers to drop-off passengers, circulate to the layover area, and then pick-up passengers on their way out of the layover area.

**Sizing**

The size of individual bus layover areas is a function of vehicle size, which ranges from 8.5m (28') vehicles to 18m (60') articulated coaches and the number of vehicles expected to use the facility at one time. Generally, it is expected that multiple buses will use the layover simultaneously and would depart the facility on a somewhat independent basis. Meaning, space for departing buses to pull out and pass forward buses, would need to be included in the design. Specific arrival and departure schedules, the number of expected vehicles laying over, and vehicle sizes need to be determined prior to detailed design of each facility.

**Geometry**

Bus lanes in the layover area should be 3.6 meters (12 feet) in width and allow 40 to 18m (60') of straight curbline for each bus. A desirable pull-in length of 60 feet and a pull-out length of 40 feet should be accommodated where space is available. However, pull-out dimensions may be reduced if buses are merging back into a bus-only lane. Actual lengths should be determined by the operating transit agency on a site by site basis.

A desirable inside bus turning radius of 12m (40') and a 18m (60') outside radius shall be used where space is available. Buses can depart from a stopped position by turning front wheels up to 40 degrees. Refer to Figures 2-9 through 2-12 for turning requirements for different bus types and lengths. Where space limitations do not allow desirable radius, a smaller radius is possible and will be considered on a site-by-site basis.

**Layover Space**

Depending on the transit service route structure and operator requirements, it may be necessary to accommodate out-of-service buses in a layover area within the park-and-ride facility.

Layover provisions should be made at a location separate from the passenger loading area so that buses are not forced to lay over at the platform. This will reduce passenger confusion and frustration with transit vehicles not leaving the park-and-ride transit stop promptly upon loading. The layover layout should allow buses to re-enter the internal transit stream and pick up passengers after the layover is complete.

Dimensions for adequate layover space should be determined by the number of buses to be stored at the layover space and the physical dimensions of the critical design vehicle. The length of layover space required would also be determined by the scheduled overlap of layovers and by sight clearance requirements.
Typical layover spacing is similar to the dimensions required for linear bus loading zones, shown in Figure 5-8, and requires:

- 12 to 18m (40- to 60-foot) layover length per dwelling transit vehicle
- 18m (60 feet) for pull in
- 12m (40 feet) for pull out (when buses are expected to merge with general traffic)
- 6m (20 feet) for pull out, 9m (30 feet) for articulated buses (when buses are able to enter a restricted lane (e.g., a bus-only lane at low speeds)
- 55m (180 feet) total for single bus layover
- 60cm (2-foot) clearance between buses
- 3.2m (12-foot) layover stall width

**Driver’s Amenities**

Transit facilities often include such amenities as non-public restrooms and break rooms for use by operators and transit staff. In most locations operators will take breaks on their coaches. In some major facilities a fully-equipped operator break room is required that includes table, chairs, lockers, sink, cooking appliances, refrigerator, coat rack, vending machines, and an information panel. Operator break rooms should be locked to allow operators a non-public place to rest.

**Design Issues**

- Staff restrooms should be provided at facilities with transit staff on site or where transit vehicles layover.
- The number of stalls and sinks shall be based upon the maximum number of staff personnel on site and/or the number of buses laying over concurrently.
- The location of staff restrooms should be near the staff facilities and vehicle operating area.
- A break room should be located at major facilities where staff are scheduled to take breaks.
- The break room should be outfitted with furniture and appliances necessary to rest and eat meals.
- The size of the break room should be determined by the expected number of staff taking breaks at one time.
- The break room should be located near the amenity core, near staff facilities and vehicle layover areas.

**Sizing**

The size of the staff restroom will depend upon the number of buses laying over and/or stopping at the facility at a time. Operators should not be delayed having to wait to use the restroom. Costs are expected to be high if comfort stations need expansion. Therefore, sizing the comfort station large to begin with would reduce the likelihood of a costly expansion.
Where unisex restrooms are required they should be equipped with one toilet, one sink and one urinal. Often two unisex restrooms are provided at transit facilities where restroom use is limited to one person and demand suggests a second restroom. This is done so that two drivers can use restrooms at the same time regardless of gender. Where the transit facility includes a layover, restrooms should be provided adjacent to the layover location.

The size of break rooms will depend upon the maximum number of operators expected to use the room at one time and the number of lockers required. Because the break room is likely to be built as a permanent structure it will be difficult and costly to expand. Therefore, building break rooms that serve larger staffs will likely be required at the facility. The designer will provide layouts identifying fixture, finishes and furniture consistent with the number of staff estimated to simultaneously use the facility and require lockers.
**Supervisor’s Office / Security Office**

A supervisor’s office provides space for site and/or road supervisors and security personnel to perform paperwork and observe the facility. It is likely to be required only at larger transit facilities. Supervisor’s offices can be fairly simple, equipped with a table and chair. Some storage area for files and supplies should also be included. The supervisor’s office should have adequate windows that allow expansive views of bus operations and public areas. Security offices have many functions. First, it gives the security officer a place to rest during their shift without having to leave the facility. Second, the office gives a “secure” feeling to the facility. Third, security offices are the place where security equipment, such as CCTV viewers and intercoms, can be located.

**Figure 5-16**

**Supervisor’s Office / Security Office**

Reference: [3]
**Design Issues**

- A supervisor’s office should be provided at any facility that has a full-time supervisor on site.
- A security office should be provided at any facility that is to be patrolled by full-time personnel.
- Supervisors and/or security personnel should be able to monitor transit operations and public space from the office.
- The size of the office should be such that all supervisors and/or security personnel can sit down concurrently.
- The location of the supervisor’s office should be near the amenity core while remaining centrally located in respect to transit operations.
- Provide storage for files, supplies and customer information materials.
- Supervisor’s office and security office should be combined wherever possible.

**Sizing**

The initial size of the office will be based upon the number of supervisors and/or security personnel needed on site at one time. The number of personnel on site is likely to remain fairly constant over time, however, if more are needed on site, expansion of the existing structure could be costly. If a facility is expected to require additional personnel in the future, it is recommended that the extra space be included in planned buildings. The additional space could be used as storage until the space is needed for personnel.

**Customer Service Office**

Customer service representatives at a facility can answer questions to help passengers reach their destination. Representatives can sell fare media, hand out service information and provide a minimal amount of security. Kiosks for interactive terminals such as real-time bus schedules and pay-email/Internet machines should also be considered. A customer service office is a small office, including adjoining window and queuing areas, for customer service agents to serve patrons. It is likely to be required only at a few larger transit facilities in the region.

**Design Issues**

- Customer service booths should be provided at major transit transfer facilities or destination locations with significant numbers of passengers who need questions answered.
- The number of booths should be determined by the number of modes and the extent of services provided. The extent of service hours will depend on service provided and staffing availability.
- Customer service booths should be located within the Amenity Core, in close proximity to locations where customers are likely to wait.
Figure 5-17
Customer Service Booth

Reference: [3]

Sizing
The size of customer information offices at each facility will be based on staffing and customer needs.

Staff Parking
As transit centers and many park-and-ride lots are highly accessible by alternate mode of transportation, staff parking is rarely discussed in transit center or park-and-ride design publications. It is expected that parking provisions may come in the form of a designated space, public park-and-ride space, or sufficient vehicle accommodation in the bus layover area. Staff parking provides a place for transit center staff and/or drivers to park personal/private vehicles.

Design Issues
- Surface parking facilities should conform to the standards of the agency responsible for maintenance and operation.
- Staff parking areas should accommodate a wide range of vehicle types and operations, including standard automobile, compact automobile, and van.
- Surface parking development standards, including landscaping, wherever possible, shall be as stipulated per local ordinance, supporting safe, secure operation of the facility.
- Parking designated for use by the elderly and handicapped will be located close to the transit building or vehicle access and should not require crossing traffic lanes.
Sizing

The size of a transit center staff parking area will depend upon the ultimate staffing needs of the transit center, the accessibility of the transit facility by alternate modes, the availability of public park-and-ride lot parking, and the possibility of parking within the bus layover area. Signage and Pavement Markings

5.2.4. SECURITY CONSIDERATIONS

An important concept in providing for the transit user is to assure a safe and secure environment within the park-and-ride facility. Safety and security are essential if a park-and-ride facility is to be successful. Both safety for the passengers accessing the facility, and security for parked vehicles during the day, are crucial to success. Numerous techniques for assuring a level of real and perceived safety are available, ranging from design approaches to surveillance and control.

Providing a “defensible space” is a concept that encourages public areas to be designed in a manner that provides a sense of personal safety, while discouraging opportunities for criminal activity [2]. A defensible space design can be achieved through specific design options, as well as through policy implementation, such as increasing police presence and community activity within the lot. This is reflected in Crime Prevention Through Environmental Design (CPTED) is a branch of situational crime prevention. Its basic premise is that the physical environment can be changed or managed to produce behavioral effects that will reduce the incidence and fear of crime, thereby improving quality of life and enhancing profitability for businesses. CPTED principles include:

Natural Surveillance

- The placement and design of physical features to maximize visibility. This includes building orientation, windows, entrances and exits, parking lots, walkways, guard gates, landscape trees and shrubs, fences or walls signage and other physical obstructions.
- The placement of persons and/or activities to maximize surveillance possibilities.
- Lighting that provides for nighttime illumination of parking lots, walkways, entrances and exits.

Natural Access Control

- The use of sidewalks, pavements, lighting and landscaping to clearly guide the public to and from entrances and exits.
- The use of fences or landscaping to prevent and/or discourage public access to or from dark and/or unmonitored areas.

Territorial Reinforcement

- The use of physical attributes that express ownership of property, such as pavement treatments, landscaping, art, signage, screening and fences.
Maintenance

- The use of low maintenance landscaping and lighting treatment to facilitate the CPTED principles of natural surveillance, natural access control and territorial reinforcement.

Implementation of CPTED principles 1 through 3 is handled through the site plan review and approval process addressed by the policy. Implementation of this principle depends primarily on individual property owner initiative, and secondarily on code enforcement.

Defensible Space

In the broader sense, important concepts in developing a defensible space include to:

- Provide a direct and unobstructed view of major destination points.
- Encourage adjacent land uses and businesses to maintain large windows facing the park-and-ride facility, creating a perception of the lot being under visual inspection at all times.
- Choose landscaping and street furniture that do not obstruct the view of the lot from the street.
- Minimize the expanse of the lot, so that the entire lot can be seen from the transit interface location.
- Locate or design the park-and-ride facility to be an integral part of the surrounding community so that it does not become isolated.
- Provide adequate illumination on-site.
- Locate on-site passenger amenities so that they maximize the comfort and accessibility for the patron while not obstructing sight lines from adjacent streets.
- Provide adequate signage, both on-site and on surrounding streets, to identify the facility and the regulations protecting it.

Encourage a Police/Security Presence In and Around the Park-and-Ride Facility

- Establish a policy of frequent police drive-throughs
- Provide space for a police substation or police information and community outreach center within the design of the park-and-ride facility
- Provide emergency and/or pay telephones within the facility, with clearly identified emergency procedures
- Provide a continuous police presence in the form of a security guard, observation cameras, etc. (see subsequent items)
- Encourage and support a community “Crime Stoppers” program in the vicinity of the park-and-ride facility, with the transit operator a participant in the program
- Provide space for mobile vendors to access the site (e.g., book mobiles, rummage donation vehicles, etc.) to create a sense of on-site activity
Increase Activity Within the Facility

- Provide activity-generating services on-site
- Concentrate activity into defined visible areas
- Establish off-hour waiting areas
- Provide windows to look onto pedestrian pathways
- Encourage employees in surrounding businesses to maintain surveillance of the site
- Schedule routine maintenance activities at the park-and-ride lot during off-peak periods (e.g., during the middle of the day and evenings)
- Use the park-and-ride facility for midday layover and transfer operations
- Encourage round-the-clock service
- Encourage a community sense of ownership for the park-and-ride and transit facility

Consider Implementing Security Devices

- Consider providing surveillance cameras, protected from tampering and linked to a remote surveillance site
- Consider providing voice activated, two-way communication between the main pedestrian and passenger loading areas and the security patrol, via security camera
- Consider providing on-site security patrol during peak and off-peak periods
- Assure that all pedestrian and driveway access to the park-and-ride lot can be controlled to minimize or eliminate unauthorized activity
- Provide fencing and pathway bollards to control vehicle and pedestrian access
- Provide warning signs advising patrons to remain cautious
- Establish a strict enforcement policy of arresting and removing unauthorized users of the park-and-ride facility, based on local trespass laws.

Specific information on selected security devices follows.

Public Address System

The public address system serves two purposes. First, service announcements can be made to keep patrons informed. Second, messages can be broadcast during an emergency to keep people calm and instruct them what to do to remain safe. Security personnel can also use the public address system to deter persons wishing to commit a crime. Employees, both on site and at a remote location, should be able to make announcements over the public address system.

The system consists of a series of speakers located throughout public areas which can carry recorded and real-time announcements produced on site or at a central location. Some agencies use the speakers to play background music during off-peak times, and commercial use is possible (e.g. in a cross-promotion program, playing a sponsoring radio station at transit facilities in return for broadcast transit advertising).
Design Issues

- Public address systems should have the capability to be activated from a central office or controlled by on-site personnel.
- The public address system should be heard throughout the entire waiting area.
- Public address announcements should also be broadcast on changeable signs.

Figure 5-18

Emergency Phone

Reference: [3]
Emergency Telephone/Panic Buttons

Emergency telephones and panic buttons alert security personnel of possible emergencies. Panic buttons should include a speaker and microphone so that patrons can speak to personnel. Telephones and panic buttons should be located where they can be viewed by closed circuit television so that personnel can determine the severity of the emergency.

Figure 5-19

Emergency / Panic Button

Reference: [3]

Design Issues

- Emergency telephones and panic buttons should be placed no more than 45m (150’) apart or 30m (100’) from bus loading zones.
- Panic buttons shall emit an audible alarm and flashing light and alert security personnel. The audible alarm and flashing light shall be strong enough to command the attention of people within 60m (200’).
Emergency telephones and panic buttons should be located such that they are noticeable, accessible and functional to all users, including those in wheelchairs.

Panic buttons should be of the “press and hold” type, to reduce misuse and false alarms.

Every emergency phone and panic button should be within the range of a security CCTV camera.

Phones should be well maintained and tested. Remote testing capability is preferable. Response to emergency phones and panic buttons should be swift.

**Closed Circuit Television**

Television cameras located throughout the facility designed to allow security personnel to observe and record visual images. A system of closed circuit televisions can perform several functions. First, they allow security personnel to observe the facility from a central location. Second, images can be stored for prosecution purposes. Third, crime is less likely to occur if the facility is being “watched” by video cameras.

Note that security personnel at a control center cannot be expected to be watching all the cameras all the time; apart from providing an “overview” function, closed circuit television is primarily a tool for confirming incidents that have been reported through other media (telephone, panic button, bus driver radio, etc.), formulating an appropriate response, and providing recorded information after-the-fact to aid in arrest and prosecution.

**Design Issues**

- CCTV images should allow continuous viewing by security personnel and be recorded.
- The placement and capabilities of cameras should eliminate “security blind spots” in the facility.
- Cameras should have resolution high enough to discern facial features.
- All public places should have cameras.
- Cameras should be in sight so all parties know that they are being recorded.
- A storage system should be used that keeps the images from all cameras for a defined period (typically one or two weeks).

Careful consideration should be given to the storage medium used; multi-image videotapes from a large number of cameras can require a substantial management and storage effort, while more-efficient digital storage media requires confidence that digital images can be used as evidence in legal proceedings.

**Lighting**

Lighting should accomplish several things for a facility. First, lighting should enable safe pedestrian travel at night and periods of low atmospheric light. Second, criminals should not be able to lurk in the shadows. Third, patrons should enjoy the visual appearance of the facility at night.
Lighting should be located throughout the facility to guide patrons safely during all operating times and reduce the threat of criminal behavior.

**Design Issues**

- Lighting should be intense enough to be sufficient for patrons with restricted sight to safely navigate through the entire facility.
- No shadows should exist in public areas.
- Lighting should be on during periods of low light during the day and should adhere to national and local lighting standards.
- The safety of the facility should be enhanced by the lighting.

Designers should consult the IES Lighting Handbook for specifics on lighting levels.

### 5.3. Parking & Access Elements

#### 5.3.1. Separation of Modes

Individual access and service modes should be organized within the park-and-ride facility to minimize conflicts and maximize the efficiency of the various operations. This can be achieved by providing separate access driveways for transit and non-transit modes and providing separate access for short-term waiting / kiss-and-ride activities. A number of potential schematic layout concepts can be developed that provide these features.

Transit access for the site should be provided so that transit operations are maximized for efficiency. This may require a transit loop or drive-through area within the park-and-ride facility. It also often requires allowance for a transit layover. Drop-and-ride activities (i.e., "kiss-and-ride") should not impede pedestrian paths or interfere with visibility between the transit loading zone and the parking lot. Several prototype lot layouts are presented in Figure 5-20.

#### 5.3.2. Pedestrian and Bicycle Accommodations

A park-and-ride facility consists of essentially three elements: facilities to accommodate the private automobile, passenger facilities, and pedestrian access space. For a park-and-ride facility to operate efficiently, all three elements must work in concert to provide a smooth intermodal transition from the private automobile to the transit system, via the pedestrian mode. In addition to providing for pedestrian movements within the transit facility, non-motorized modes of access and egress must be accommodated within this three-part system.

In selection of such design concepts, pedestrian access between the parking lot and the primary service mode (i.e., transit) should provide for convenient access with minimal walking distances (less than 150 meters (500 feet) is preferred). Acceptable walking distances for various applications are presented in Table 5-1.
Pathways through Parking Areas

Pedestrian paths within the park-and-ride lot must be clearly distinguishable throughout the facility. Conflicts between pedestrians and automobiles and between pedestrians and transit vehicles should be minimized. Raised pedestrian paths and sidewalks are preferable to parking aisles, although raised paths are not always possible.

Pedestrian pathways should generally allow for direct travel between the point of entry into the park-and-ride lot and the transit loading area. In most cases, this can be achieved by orienting the parking stalls perpendicular to the transit boarding area. This allows pedestrians to use the aisles between parking stalls to walk directly to the
boarding area. Alternatively, raised pedestrian pathways between facing stall rows can be provided for direct access to the boarding area. Parking stalls that radiate outward from the transit facility are even better; however, this may prove difficult for parking patrons. For pedestrian paths crossing vehicle routes, the pedestrian pathways should provide maximum visibility. This can be done by either varying the pavement medium or by raising the pedestrian path above the driving surface. In the latter approach, the pedestrian path can be used as an enlarged traffic bump (or hump), raising the pedestrian above the paved surface and providing a traffic calming device as well.

Pedestrian access between the transit loading zone and the farthest reaches (and specifically the outer street corners) of the park-and-ride lot should be examined. At these corners, pedestrian crosswalks are often provided for crossing adjacent streets, and patrons accessing the park-and-ride facility from these points will tend to walk directly from the corner to the transit facility, especially if their bus has just arrived. Every effort should be made to accommodate these movements. Elimination of barriers (such as landscaping) will minimize costly plant replacement due to pedestrians trampling shrubbery and will also increase pedestrian safety.

In an ideal design, pedestrian flow lines should not be blocked by landscaping or other impediments that would inhibit direct pedestrian access from the farthest point in the lot to the transit loading zone.

**Pedestrian Waiting Areas**

The intermodal transfer facility or boarding area also requires special attention within the park-and-ride facility. Curb spaces immediately adjacent to transit loading areas should be free of all barriers. Bus stop signs and street furniture, as well as other passenger amenities, should not interfere with transit loading, patron queuing, or pedestrian access.

---

**Table 5-1**

Walking Distance Under Normal Conditions

<table>
<thead>
<tr>
<th>Walking Distance</th>
<th>Under 300 m (750 ft.)</th>
<th>300 m (750 ft.) Average</th>
<th>152 to 305 m (500 to 1,000 ft.)</th>
<th>400 to 533 m (1,320 to 1,750 ft. or 1/4 to 1/3 mile)</th>
</tr>
</thead>
</table>

Reference: [2]
All pedestrian facilities must be designed to meet the requirements of the Americans with Disabilities Act. At a minimum, pedestrian spaces should be provided with wheelchair ramps and curb cuts, textured pavement surfaces, and a barrier-free path between handicap parking spaces and the transit terminal. Adequate space for full deployment and loading of vehicle lifts should be provided adjacent to each bus platform. Additional amenities such as Braille signage and audible signals should be considered as aids to visually impaired patrons.

Passenger waiting and queuing areas should have a minimum of 1 square meter (10 square feet) per person, calculated for the peak pedestrian load expected, and based on the number and timing of transit vehicles serving the platform [2]. Alternatively, if pedestrian demands are expected to be high, a pedestrian time-space approach can be used to analyze the space needed for the specific intermodal transfer operations occurring at the transit station [2].
The minimum pedestrian space developed either through the minimum standard of 1 square meter (10 square feet) per person or through a time-space analysis should be in addition to space allotted for public amenities, information kiosks, newsstands, etc. Paving surfaces should provide good traction to reduce the risk of slipping and falling. Smooth, high polished surfaces should not be used in wet climates. Pavement textures, colors, and paving block shapes should be varied to provide a more interesting pedestrian environment and a unique identity to a station or park-and-ride location, and to delineate restricted areas. Varied paving textures can also be used to organize the pedestrian waiting areas to encourage efficiency in pedestrian boarding operations.

The location of the passenger facilities should be determined by several factors, including: access constraints, the need for on-street or off-street location, and the transfer demand expected. For the typical park-and-ride facility, the pedestrian shelter or canopy should be placed between the parking lot and the transit access roadway. Transit vehicles should generally circulate counter clockwise so as to minimize the need for passengers to cross transit pathways. As transit-to-transit transfer demand increases (such as in the case of a transit center coupled with a supporting park-and-ride facility), a center island design concept should be considered to minimize the hazards to transferring passengers. In this latter case, the transit vehicles should circulate in a clockwise manner so that vehicle doors are presented to the inside platform. In choosing either an inside island or outside loading configuration, the goal is to reduce, as much as possible, the total likely number of pedestrian crossings of bus paths.

**Figure 5-22**

**Passenger Facility Location**

*Note: The structures shown on the loading platform may be either minimal transit structures or major architectural type facilities. They may consist of a single canopied/building structure or multiple individual shelter units.*

**Reference:** [2]
**Bicycle Accommodation and Storage**

In addition to the traditional pedestrian mode of access, bicycle access should be actively planned for and incorporated within the design of the park-and-ride lot. Planning for proper storage and access of bicycles at the park-and-ride lot is important not only to support this mode of access, but to prevent damage to the transit facility by improperly stored bicycles. Lack of adequate bicycle storage and security devices can lead some bicyclists to chain their bikes to support posts, pedestrian hand rails, and trees, leading to significant damage and maintenance costs for the facility.

**Figure 5-23**

*Figure 5-23 Bicycle Accommodation*

> NOTE: These represent generic designs. Unique bicycle storage designs can be developed providing artistic/architectural qualities.

Reference: [2]
Example bicycle racks and storage facilities are presented in Figure 5-23. Devices chosen should:

- Support the frame of the bike
- Allow at least one wheel along with the frame to be locked to the rack
- Allow the cyclist the option of using either a U-lock or cable with padlock
- Be easy to understand without instruction

Bike lockers are typically preferred to bike racks as they provide maximum security and protection from the elements. Bike lockers can be leased or assigned to individual cyclists to control misuse of devices.

5.3.3. **BUS ACCESS REQUIREMENTS**

Transit service provided to the park-and-ride lot will determine many of the design parameters of the facility. Transit service and access to the lot is of equal importance to pedestrian access. Specific transit design parameters for individual park-and-ride facilities will depend on the vehicles accessing and serving the park-and-ride lot and the on-site transit operations requirements.

Bus access should be separated from general auto access to the park-and-ride facility. Sometimes this is not entirely possible for the entire access route. However, the bus loading area should always be separated from general purpose traffic when the transit terminal is off-street.

**Transit Vehicle Maneuverability and Access Requirements**

Transit vehicle maneuverability is an important element in the design of roadway and transit access elements of the park-and-ride facility. In designing for a park-and-ride lot, the access route between the primary travel corridor and the lot should be considered as a single system, along with the park-and-ride facility, for design and operations. Transit turning templates are provided in Chapter 2. Maneuverability issues include:

- Turning radii and the design of adequate curb returns
- Acceleration capabilities of transit vehicle and maximum negotiable grades
- Provision of adequate clear sight distances at intersections

**Turning Radii and Design of Curb Returns**

Because of their increased mass, buses require greater distances to accelerate to required travel speeds, and likewise, greater distances to break and stop. The design of on-ramps to freeways and other arterials serving the park-and-ride lot should incorporate appropriate allowances for the reduced maneuverability of this vehicle.

Typically recommended maximum grades should not exceed 12 percent, with a preferred maximum design grade of about 8 percent. However, the length of grade and the horsepower of the transit vehicle are also critical in the design consideration. Electric buses will tend to have greater hill climbing ability; however, they are not typically used in park-and-ride services because of their need for overhead electrification and inability to reach highway speeds.
Except for very short distances, grades of 5 percent or greater should generally not be allowed on roadways serving the park-and-ride facility without taking into account the impact on schedule and operating costs. Stops on either the up-hill or down-hill direction should generally not be allowed on grades of 5 percent or greater due to the added effort required to start and stop under such conditions.

Evaluations of grades should be considered both within the lot and on the streets providing direct access to the lot. If the lot is to be located on an arterial or minor street at some distance from the primary travel corridor, the entire route between the proposed park-and-ride facility and the primary travel corridor should be examined for grade considerations.

### Table 5-2

**Recommended Design Criteria for Turn Radii by Speed**

<table>
<thead>
<tr>
<th>Minimum Speed</th>
<th>Movement Operation</th>
<th>Typical Location</th>
<th>Applicable Template</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 MPH</td>
<td>Turning after stop or turning to stop</td>
<td>At bus stop or bus bay</td>
<td>Exhibit 6.13</td>
</tr>
<tr>
<td>7 MPH</td>
<td>Turning after slowing down from 10 MPH</td>
<td>At bus loop at park-and-ride or transit center</td>
<td>Exhibit 6.14</td>
</tr>
<tr>
<td>10 MPH</td>
<td>Turning after slowing down from 15 MPH</td>
<td>At bus loop at park-and-ride and transit center</td>
<td>Exhibit 6.15</td>
</tr>
<tr>
<td>15 MPH</td>
<td>Turning after slowing down from 30 MPH</td>
<td>Entering or exiting HOV or freeway ramp</td>
<td>Exhibit 6.16</td>
</tr>
</tbody>
</table>

**Reference:** [2]

The design of the park-and-ride facility, and especially the entrances and exits to the lot, should not allow for unnecessary obstruction to clear lines of sight. Landscaping and natural vegetation should be kept pruned and other physical barriers minimized or removed.

For each driveway exit, the required clear sight zone will be determined by the critical vehicle using the driveway and local street and roadway standards. For driveways used primarily by transit, the transit vehicle should be held as the critical design vehicle because of its slower acceleration capabilities. Minimum safe sight distances of approximately 61m (200 feet) should be maintained, assuming a 48 kmh (30 mph) average travel speed on the intersection arterial. At 48 kmh (30 mph), a 61m (200-foot) clear sight standard allows for a minimum vehicle gap acceptance of approximately 4.5 seconds.

On-street parking should be restricted within 9m (30 feet) of all street or driveway intersections surrounding the park-and-ride facility. This restriction should apply to both the internal park-and-ride roadway network and to the arterials serving the park-and-ride facility and connecting it to the primary travel corridor.
Table 5-3

Compound Curve Radii Recommended for Turns at Intersections (meters)

<table>
<thead>
<tr>
<th>Angle of Turn (Degrees)</th>
<th>Compound Curve Radii (meters)</th>
<th>Offset (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
<td>36.6-13.7-36.6</td>
<td>1.2</td>
</tr>
<tr>
<td>90</td>
<td>36.6-12.2-36.6</td>
<td>1.2</td>
</tr>
<tr>
<td>105</td>
<td>30.5-10.7-30.5</td>
<td>1.2</td>
</tr>
<tr>
<td>120</td>
<td>30.5-9.1-30.5</td>
<td>1.5</td>
</tr>
<tr>
<td>135</td>
<td>30.5-9.1-30.5</td>
<td>1.5</td>
</tr>
<tr>
<td>150</td>
<td>30.5-9.1-30.5</td>
<td>1.5</td>
</tr>
<tr>
<td>180</td>
<td>39.6-7.6-39.6</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Reference: [2]

Table 5-4

Compound Curve Radii Recommended for Turns at Intersections (feet)

<table>
<thead>
<tr>
<th>Angle of Turn (Degrees)</th>
<th>Compound Curve Radii (feet)</th>
<th>Offset (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
<td>120-45-120</td>
<td>4.0</td>
</tr>
<tr>
<td>90</td>
<td>120-40-120</td>
<td>4.0</td>
</tr>
<tr>
<td>105</td>
<td>100-35-100</td>
<td>4.0</td>
</tr>
<tr>
<td>120</td>
<td>100-30-100</td>
<td>5.0</td>
</tr>
<tr>
<td>135</td>
<td>100-30-100</td>
<td>5.0</td>
</tr>
<tr>
<td>150</td>
<td>100-30-100</td>
<td>5.0</td>
</tr>
<tr>
<td>180</td>
<td>130-25-130</td>
<td>8.0</td>
</tr>
</tbody>
</table>

Reference: [2]

5.3.4. PRIVATE AUTOMOBILE PARKING

It has previously been suggested that pedestrian and transit movements within the park-and-ride facility should be emphasized to assure successful community integration and efficient facility operations. The intent, however, has not been to downplay the importance of the private automobile in the design of the park-and-ride facility. In fact, the private automobile, along with the transit element, is the primary mode for which the intermodal park-and-ride facility is being designed and often serves as a primary measure of effectiveness for the facility (i.e., the number of vehicles using the facility is often a primary measure of effectiveness for justification of the investment). Thus, in addition to providing a pleasing and safe environment for the pedestrian and efficient transit operations, the successful park-and-ride facility must provide adequate and secure parking facilities for the private auto.

In terms of the private automobile, long-term or all-day commuter parking must be considered as well as short-term or drop-and-ride activities. Primary design considerations for these operations include:
Parking Layout and Stall Alignment

Parking Layout

Parking facilities within a park-and-ride lot should be designed in an easy-to-understand configuration that minimizes the time required to locate a parking space. The majority of parking spaces should be clearly visible from the major access points so that drivers can quickly identify if the lot is full or if space is available. If the lot is too large to allow visual identification of available spaces, a messaging system should be considered as an aid to the driver. Visibility from adjacent streets afforded by the design should be high. The design should be efficient in the way it relates to the parcel, providing opportunities for joint development, if appropriate, and the facility should complement the long-range community plan for the surrounding neighborhood.

Figure 5-24

Preferred Parking Stall Layout

Reference: [2]
Figure 5-25
Angled Versus 90 Degree Parking

Reference: [4]
In designing parking facilities for park-and-rides the goal is to provide a single continuous path for the commuter from the street to a parking space and to the transit platform with a minimum of conflicting barriers. Maintaining this goal throughout the design process will provide a convenient and efficient parking facility.

**Parking Stall Alignment**

Two primary components of parking stall design must be considered when determining the preferred design for a park-and-ride facility: parking angle and bay alignment.

Aligning the parking bay perpendicular to the intermodal transit platform allows pedestrian movement up the aisles to the transit boarding area, minimizing the need to cut between parked automobiles and the likelihood of access impediments such as landscaping. The consideration of parking stall angles will be a primary consideration in choosing a facility circulation pattern.

A number of options are available to the designer in terms of choosing parking angles. The most efficient parking configuration is the right angle or 90-degree parking configuration. A 90-degree configuration allows for two-way traffic flow between aisles for ease of access, and provides the least complicated pattern for drivers to recognize. Typical parking dimensions for 45-degree and 90-degree parking configurations are provided in Figure 5-25.

Although a 90-degree layout is clearly advantageous over angled alternatives, there may be specific cases in which angled or even parallel parking should be considered. For instance, if a site is larger than the space required for the projected demand, angled parking can be used, thus requiring more space within the lot and creating an appearance of higher use. When demand increases, the park-and-ride lot can be re-striped, adding additional stalls at a relatively low cost. Another example where angled parking might be advantageous is at the periphery of the lot, where space may be better utilized by an angled configuration.

**Access**

Access for automobile traffic should be separate from the transit entrance to reduce conflicts between the two modes. If a common access point must be used, a transit-only boarding area for transit patrons should still be provided, with automobile traffic directed to the lot via a separate internal lot entrance.

Because inbound access to the park-and-ride lot is perceived by the user as more critical than outbound movement due to the tendency of patrons to arrive with few minutes to spare, inbound access efficiency should be maximized. However, it is typically in the evening peak that the facility demonstrates the greatest external impacts on the surrounding transportation network because of the large platoons of vehicles trying to leave the park-and-ride lot at the same time (e.g., shortly after a transit vehicle arrives at the lot).

Because of the desire to maximize the efficiency of inbound access movement, park-and-ride lots should be located on the right-hand side of two-way arterials for the directional movement towards the major destination. This allows most patrons accessing the facility to make a right turn into the facility.

Entrances and exits for park-and-ride facilities should be located to provide a minimum of 45 meters (150 feet) (preferably 105 meters (350 feet)) between successive entrances, and not be placed closer than 45 meters (150 feet) (preferably 105 meters (350 feet)) to any street intersection. A minimum of two combined
entrances and exits should be provided for lots in excess of 300 spaces. When selecting the number of entrances and exits the goal is to not exceed 300 vehicles per hour at any one entrance or exit. Lots in excess of 500 spaces should be evaluated for two-lane exits and the need for a dedicated traffic signal (2).

**Circulation**

Vehicle circulation within the park-and-ride facility should generally encourage the inbound access movement, bringing inbound vehicles on-site quickly and conveniently to prevent on-street backups at key entrances. This will facilitate easier access in the morning peak period and will reduce on-street congestion. Entrances should allow the accessing driver to drive past as much of the lot as possible before entering, thus allowing visual inspection of the facility for available spaces.

Two-way circulation is generally preferred to one-way circulation within the lot. This will reduce confusion on the part of patrons and reduce the potential for drivers to circulate in the wrong direction in a one-way aisle. Two-way circulation is typically associated with 90-degree parking stalls, which provide a more flexible circulation and parking configuration but can also lead to increased parking conflicts between backing vehicles.

**Disabled Parking and ADA Requirements**

In July 1991, the United States Department of Justice published standards and guidelines for the provision of handicap parking spaces in general public parking facilities as stipulated in the Americans with Disabilities Act of 1990 (ADA). These standards dictate the minimum number of parking spaces to be provided for handicap parking within any park-and-ride facility, based on the number of general purpose stalls provided (see Table 5-5).

**Table 5-5**

<table>
<thead>
<tr>
<th>Total Parking Spaces</th>
<th>Required Minimum Number of Accessible Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 25</td>
<td>1</td>
</tr>
<tr>
<td>26 to 50</td>
<td>2</td>
</tr>
<tr>
<td>51 to 75</td>
<td>3</td>
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<td>76 to 100</td>
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<td>101 to 150</td>
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<td>301 to 400</td>
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<td>401 to 500</td>
<td>9</td>
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<tr>
<td>501 to 1000</td>
<td>2% of total spaces</td>
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<tr>
<td>over 1000</td>
<td>20 plus 1 for each 100 over 1000</td>
</tr>
</tbody>
</table>

Reference: [2]

In addition to providing an adequate number of handicapped stalls in the park-and-ride lot, facility design should promote safe and convenient access by all patrons. Grade changes and barriers between the handicapped parking stalls and the transit loading area should be eliminated, and all facilities clearly signed for restricted use (see Figure 5-26).
Paving

Pavement designs need not be uniform throughout a park-and-ride facility, but should be designed for vehicular traffic and weight distributions expected for the site. Three critical factors impact the selection of the proper pavement design:

- Expected traffic volume
- Vehicle weight and subgrade support
- The properties of the paving materials chosen [2]

In general, pavement designs should meet local code requirements. Common pavement materials include concrete, soil cement with an asphalt topping, or asphaltic concrete. Lots may also be unpaved, providing only a gravel surface for patrons. However, local weather conditions should be considered when selecting the appropriate material to provide for maximum patron comfort.

Example pavement designs for general parking areas can be found in various design manuals. Local soil conditions may dictate differing designs, and local code requirements should be consulted for specific design requirements.

Access streets and loading areas for transit vehicles will require additional design consideration to provide for the higher traffic volumes and bearing weights typically expected in these locations.

Reference: [2]
5.4. Community Integration

5.4.1. Integrating Transit Facilities with Adjacent Land Uses

Designing a park-and-ride facility to be an integral part of the surrounding community can be difficult, especially within a heavily auto-oriented travel market. However, there may be significant opportunities within the community to establish park-and-ride facilities that encourage transit-friendly design in the surrounding neighborhood. When the surrounding community is oriented toward transit-friendly design, maximum use of park-and-ride facilities and intermodal transfer stations can be accomplished.

The primary objectives and advantages of a community-compatible or integrated park-and-ride facility include:

- Adjacent residential, service-oriented, and commercial activities can provide transit patronage, services, and security to the transit agency operating the park-and-ride facility
- Multi-story buildings located near the site can provide visual surveillance of the park-and-ride facility, thereby increasing its perceived safety
- Attractive designs providing high visibility can engender a sense of community ownership and stewardship
- Adequate attention to pedestrian and bicycle facilities, both on-site and in the surrounding developments, encourage a multimodal use of the lot [2]
- Public investment in an integrated transit facility can serve as a focal point for suburban community development
- Increased massing of transit facilities and surrounding land uses increase the visibility of public transit and create a potential for future markets
- Centralizing transportation services increases accessibility to surrounding land uses and the community.

Organization of Surrounding Land Use

Effective organization of land uses and land use mix in the vicinity of transit facilities can help reduce the number of total trips within the area and eliminate the need to make some auto trips. This helps reduce the need to provide parking and encourages additional pedestrian activities.

Mixing residential, commercial and retail services near the park-and-ride lot can encourage residents to link trips that might otherwise occur separately. When these mixing policies are coordinated with specific design techniques, a transit-supportive pedestrian-oriented environment can be developed. Park-and-ride facilities are similar to other intermodal facilities, and if designed with the community in mind can become an integral part of the urban fabric while remaining efficient change-of-mode facilities.
A key to land use organization is the process of providing a focal point around which to organize various urban and suburban uses. Extensive research on this topic by New Jersey Transit (NJ Transit) suggests that three important concepts must be embodied in the design of a transit facility if it is to be used as a focal point for the surrounding community:

- **Emphasize pedestrian and bicycle access modes within the surrounding community and within the park-and-ride facility.** Pedestrian and bicycle linkages between the lot and the surrounding neighborhood and internal to the park-and-ride lot give the intermodal facility its character. Any transit-related trip includes some portion on foot. The pedestrian environment and the pedestrian activity generated by the amenities provided within the intermodal facility are typically identified as the elements that give a place its sense of community. It can therefore be argued that a pedestrian and bicycle-oriented environment makes for a good transit-friendly one, both at the neighborhood level and at the park-and-ride facility.

- **Utilize traffic calming techniques to emphasize the pedestrian and reduce the impacts of traffic circulation in and around the park-and-ride facility.** By their nature, park-and-ride facilities require an interchange between the auto mode and transit. The auto’s importance within this intermodal transfer must be accommodated, but the use of traffic calming techniques such as speed control devices within the lot can reduce or eliminate conflicts between the auto mode and pedestrian. This increases the opportunity for pedestrian linkages with surrounding land uses and encourages a more multimodal environment.

- **Create a sense of place surrounding the park-and-ride facility and foster a sense of community stewardship.** Often, transit is planned only as an afterthought and is located at the periphery of a community or suburban development. A bolder approach is to bring the park-and-ride facility and related transit service into the heart of the development so that it becomes a focal point for the surrounding land uses.

Careful planning of areas surrounding the intended park-and-ride lot can produce a sense of ownership for the park-and-ride lot within the surrounding community and provide a visible icon for the neighborhood. Architecturally unique pedestrian facilities, landscaping, and/or public art programs can add distinction to the park-and-ride facility, making it a focal point within the community. The design should not compromise the transit accessibility of the facility, but assure that an acceptable level of efficiency is provided.

**Locate Supporting Land Uses in Proximity to the Park-and-Ride Facility**

An important element in obtaining a community integrated park-and-ride facility is understanding the general travel and time characteristics of traditional land use types, and then encouraging beneficial types to locate near the proposed park-and-ride facility(s).

In outlying suburban communities, park-and-ride facilities situated near larger suburban employers can provide a destination for “reverse” commuters, those traveling from the traditional CBD to the suburban employment center or between different suburban employment centers if transit service allows. Such a park-and-ride facility can also serve as a transit center or hub for a suburban distribution system or local shuttle service.
These activities will increase usage and pedestrian activity at the park-and-ride lot. A mix of complementary land uses in the surrounding neighborhood will create increased transit activity throughout the day. This increased transit and community activity can improve the safety characteristics of the park-and-ride facility and increase community acceptance of individual facilities.

Understanding the generic travel characteristics associated with various land use activities can also assist in the design of a community integrated park-and-ride facility. As the intensity and diversity of the surrounding land uses increase, so does the opportunity for increased off-peak travel. For example, low density residential and single-use oriented commercial office developments tend to primarily generate peak-period trips. Similarly, destination retail and entertainment uses would be expected to primarily generate off-peak travel demands. A combination of these land uses in conjunction with a park-and-ride development often results in a facility that demonstrates traditional commute demand during the peak periods, and non-commute demand during the off-peak periods. Other land use activities demonstrate both peak and off-peak demand generating capabilities such as high density residential, destination retail, and institutional-based activities (e.g., post office or other government office).

Encouraging land uses that generate healthy off-peak travel demands on the transit system can increase the efficiency of the park-and-ride facility and change its character from a parking lot to a transit center/community focal point.

Elements important to reaching an increased level of all-day activity at a park-and-ride facility include:

- Creating a pattern of surrounding development that is supportive of transit service (e.g., in density, pedestrian orientation, and land use mix)
- Encouraging a pattern of development with a dense network of streets and pedestrian rights-of-way that enables pedestrian activity
- Improving pedestrian and bicycle connections to and from the park-and-ride facility
- Creating a visual focal point at the park-and-ride facility (e.g., a clock tower or similar unique elevated element)
- Utilizing open space to accentuate the park-and-ride facility, upgrading streetscapes to make them more interesting to the pedestrian via improved landscaping, paving techniques, public sculpture and art
- Making the intermodal transit facility within the park-and-ride lot a focal point for activity (e.g., provide the park-and-ride lot with a dual purpose, serving as both a transit center and a park-and-ride lot)
- Encouraging a land use intensity gradient, with the park-and-ride facility located near the center of the highest land use activity.

**Identify Joint-Use Development Opportunities Related to Existing and Future Park-and-Ride Facilities**

In addition to encouraging transit supportive development in the surrounding community, a park-and-ride facility can be directly integrated into a larger development through the use of joint-use concepts. Such concepts suggest that a park-and-ride facility can be designed in conjunction with supporting land uses and activities directly attached to the transit-oriented facility.
Two types of joint-use park-and-ride facilities are the opportunistic joint-use lot and the planned joint-use lot. The opportunistic joint-use lot can be developed within existing public or private parking lots that demonstrate peak parking demands at times not typically associated with peak transit demand (e.g., movie theaters, churches, large shopping centers). By their name, these lots are opportunistic and difficult to plan on a consistent basis.

The planned lot involves a much more proactive approach that seeks out potential partners to develop prospective transit facilities. Such design processes demand a much higher level of planning and design attention. To maximize the opportunities for developing joint-use developments, the implementing agency should strive to:

- Identify opportunities to focus development at and around transit stations
- Review joint development options
- Consider redevelopment of existing facilities and privatization opportunities
- Utilize structured parking
- Encourage public communication

Land uses complementary to a park-and-ride facility can encourage pedestrian activity and be compatible with park-and-ride operations. Such land uses typically have minimal parking requirements, or their parking demand characteristics do not significantly conflict with the peaking characteristics of the park-and-ride operations. Once solicitation of individual land use types is begun, the implementing agency may well discover unique opportunities for additional integration. Particular design locations and various local conditions may also provide unique opportunities.

Examples of compatible land use activities include:

- Short-term day care or parent’s-day-out facilities
- All-day, regular child care
- Convenience stores
- Video rental stores
- Pharmacies
- Dry cleaners
- Variety stores
- Small hardware stores
- Banks
- Photocopying
- Bakeries, small neighborhood grocery stores
- Shoe repair
- Post office
- Gas stations
- Auto repair facilities
Restaurants, express food/delivery activities (e.g., take-out pizza kitchens)

Public service office (e.g., transit headquarters, utility offices, police and fire stations, community libraries, health and human resource offices, transit maintenance facilities)

In seeking joint development opportunities, the basic design requirements for park-and-ride operation cannot be compromised. Basic design needs of the park-and-ride facility must be maintained to provide efficient and effective transit access. Also, in selecting joint development candidates for inclusion in park-and-ride facilities, the planner should consider the primary market requirement for the candidate land use. Specifically, those businesses that rely primarily on convenience to generate market share (e.g., gas stations, shoe repair, and dry cleaning) will be more successful than those that rely primarily on other market factors (e.g., all day child care).

If allowed, market forces will determine the best joint use candidates for specific park-and-ride locations.

The planner can facilitate this natural market selection by simply allotting adequate space for joint development within the design of the proposed lot and by releasing requests for proposals for joint development to the general business community. In this way, the business community will propose and define the best uses for incorporation into the proposed facility through a competitive process.

5.4.2. AESTHETIC CONSIDERATIONS

In 1995, the Federal Transit Administration published FTA Circular 9400.1A, establishing policies affirming the appropriateness of spending federal moneys on art and architecture in the design and construction of major transportation facilities.

The importance of art and architecture must not be overlooked in the design of park-and-ride facilities. Such facilities represent major investments for the communities in which they are sited and often have long-term impacts on the host community. As indicated by the FTA policy, art and architecture—including landscape architecture—can be used to make the transit facility more appealing to the surrounding neighborhood as well as to potential users. Art and architecture can be used to soften the related and unavoidable impacts of transit facilities, and can be used to inspire community ownership of the facility.

Justification for the use of federal funding in the pursuit of artistic elements in the design of park-and-ride facilities is specifically documented in FTA Circular 9400.1A under the definition of major construction projects. Use of federal funding is allowed for both “new start” projects, as well as for “modernization” projects. It can be adapted to vehicle and related facility improvements, including simple bus shelters, and can be used for construction mitigation [2].

Rationale for Art

One argument for including art and architecture in the basic design of every public facility, including park-and-ride lots and other higher order transit facilities, is to strive to inspire current populations as well as future ones through their artistic and architectural elements.

A second reason to include artistic elements in transit and park-and-ride design, is that art can reduce vandalism, by encouraging a community to take ownership of the facility, increasing the public watchfulness over the investments placed at the park-and-ride lot. A 1992 before-and-after study conducted by King County Metro in
Seattle concluded that the introduction of a community-based art program reduced window breakage by 20 percent for those shelters included in the program [2]. Transit administrators involved with community arts programs indicate that an investment in art and architecture in the design of transit shelters and park-and-ride lots noticeably reduces maintenance costs due to removing graffiti and other vandalism. Additionally, increased community scrutiny brings a new level of awareness and appreciation for the transit system, often resulting in increased community support.

Thirdly, the attention paid to art and architecture during the design of a park-and-ride facility can provide a statement of permanence within the community once the facility is constructed. Bus-oriented transit systems are often seen as less than permanent because of their non-fixed routing. For this reason, private businesses and developers are less likely to invest in transit-friendly projects because the transit system is seen as transitory over the long term. However, the construction of transit stations, intermodal facilities, and park-and-ride facilities inclusive of artistic and aesthetic elements makes a statement of commitment to the community and to system patrons.

When to Incorporate Art and Architecture

Art and architecture can be added to the park-and-ride design process at almost any point. The most effective and most influential approach is incorporation of artistic elements at the earliest opportunity, ideally at the concept or preliminary design stage. The FTA indicates that artists should be incorporated during all aspects of the project, including the planning, design, and engineering phases. When developing a new park-and-ride facility, the design team should, at a minimum, consist of representatives from the engineering, planning, public involvement, architecture, landscape architecture, and art professions.

5.5. References
