TRANSIT GUIDELINES IN PROJECT DEVELOPMENT

Missoula Urban Transportation District

Mountain Line


Board Approved July 11, 2011

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ACKNOWLEDGEMENTS

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1.1 Purpose of the Design Guidelines

The Missoula Urban Transportation District (MUTD) operates the popular Mountain Line public transportation system in the greater Missoula area. Mountain Line includes a fleet of regular route buses and smaller buses to serve as an important mode of transportation for residents. The agency mission statement reads:

> *"The mission of Missoula Urban Transportation District is to contribute to a safe, seamless, convenient and accessible transportation system for the greater Missoula area which reduces vehicle miles traveled, carbon emissions, air pollution and traffic congestion."*

Public Transportation enjoys widespread community support in Missoula. During the Envision Missoula process, fully two-thirds of participants in the workshops favored a vision for the future of the community in which public transportation plays a key role. The dominant vision to emerge through Envision Missoula is known as the Focus Inward scenario.

The Focus Inward scenario seeks to manage travel demand by bringing together activities into one highly concentrated downtown area, encouraging the majority of the Missoula's transportation investments be made in a densely developed In-town Mobility District. Focus Inward also supports the concept of a Multi-Modal Corridor from Lolo to downtown Missoula. MUTD fully supports the findings of Envision Missoula and the Focus Inward concept, and recognizes the importance of multi-modal development in providing effective transit service and reducing congestion on area roadways.

The ability of MUTD to provide an effective and efficient transportation service in the greater Missoula area is determined by a large extent on the development decisions made in the community. Planning decisions are often thought of in terms of residential density, street configuration and geometry, and zoning regulations. However, there are a number of design decision made by developers and jurisdictional officials, such as bus stop layouts, which also facilitate better transit service.

MUTD has developed the publication *Transit Guidelines in Project Development* to encourage the coordination of local development and transit services. This manual is intended to provide guidance for the development of physical facilities in the region to assure that they are supportive of transit service.

Through distribution of this manual to jurisdictions and developers in the region, MUTD hopes to promote a better understanding of the role of physical development on transit service. We encourage developers to design for transit and pedestrian access concurrent with their overall design process. When facilities such as street intersections, commercial, retail, and residential developments are being planned, the cost of making the investment suitable for transit use is typically not very large. On the other hand, retrofitting a site after construction is usually quite costly. Developers and local officials are strongly encouraged to seek the guidance of MUTD staff in making design decisions on development and local infrastructure.

This manual is organized into several sections corresponding with facility decisions. Sections 2 & 3 (Transit Friendly Urban Design and Transit Priority Measures) describe the general relationship between transit service and the built environment, in addition to several concepts and technologies widely used today to improve bus service and reduce travel time.

Section 4 (MUTD Fleet Characteristics) discusses the physical attributes of MUTD equipment including dimensions, turning radii, and curb weight. The purpose of this is to guide local officials, facility developers and owners on the size of MUTD equipment to assure that the vehicles can access developments.

Section 5 provides guidance on the design of streets and intersections (Streets and Intersections) to facilitate transit utilization and operations. This section contains guidance on curb radii for intersections where transit service operates and other elements of street geometry.

Section 6 (Transit Facilities Design) discusses specific designs for transit amenities including bus stops, bus shelters, and bus turnouts.

In general, if local jurisdictions or developers are planning a development which may be in MUTD's service area, they are requested to consult with MUTD staff at 406-543-8386. The following are examples of the types of facilities about which MUTD should be contacted early in the planning and design process:

- New housing developments/subdivisions
- Commercial developments
- Road construction, reconstruction and intersection reconfiguration projects
- Street improvements, including driveway entrances on major streets

1.2 Coordination of Land Use and Transportation Planning Policies

Currently, MUTD participates in the development review process of all jurisdictions in the area by offering suggestions and recommendations that may improve and enhance transit services provided in MUTD's service area. The process of siting and installing bus stops and bus shelters may appear to be a simple task; however, this task requires the consideration of many factors, including where and how bus stops are located, if transit service is provided along specific corridors, and proximity to bus stops on the opposite side of the road.

To expedite the development review process, all jurisdictions are encouraged to notify MUTD of its planning review calendar, including dates, times and places of meetings for Pre-submittal Conferences, Development Review Teams, Consolidated Planning Board and City Council meetings, in addition to special community outreach and planning activities that may have impact on transit services. The best way is to include MUTD on Planning and Public Works Departments mailing lists for new development projects. The mailing address for MUTD is 1221 Shakespeare, Missoula, MT 59802, or info@mountainline.com.

1.3 Joint Development Opportunities

To promote the coordination of transit facilities with private and/or public sector development, MUTD will pursue joint development opportunities with local jurisdictions when appropriate and resources are available. Joint projects can support economic growth and transit use while providing investment opportunities to the development community. MUTD encourages joint use for high density residential, office, commercial or industrial development to reduce trip making and alleviate congestion.

1.4 Coordination with Construction

Private development construction and local jurisdiction public works activities, such as street improvements, including repaving, street grading or water line installation often impact bus operations and bus stops. Construction impacts to transit service and bus stops can be minimized through conditions placed on private development construction to ensure contractors work with MUTD staff. The following are examples of conditions that are effective:

- MUTD staff should be contacted at least 15 business days prior to the beginning of construction that will necessitate street closure, rerouting of traffic, or construction in the vicinity of transit service operation and bus stops;
- Representative from MUTD should be invited to the project's pre-construction conference meeting.
- Contractor is required to work with MUTD to ensure temporary bus stops are established before bus stops are closed during construction;
- Contractor shall make every effort to schedule their work to minimize impacts and the duration of impacts to transit operations and the general public.
- Contractor should work closely with MUTD when contemplating the removal of any bus stop signs or the closer or cone off of any bus stops;
- All work must conform to the Americans with Disabilities Act Accessibility Guidelines (ADAAG) requirements, including provisions for temporary access to and from bus stops;
- Contractor will be responsible for costs incurred for loss or damage to bus stop signs, hardware and transit furniture;
- Contractor shall provide MUTD with the name and telephone number of the construction manager on site prior to the beginning of construction;
- A minimum four (4) foot wide walkway should be provided to maintain passenger access to and from bus stop during construction, if it is determined that the bus stop will remain open during construction.

MUTD will coordinate with local agencies for providing and posting the appropriate temporary bus stop signage if needed.

1.5 Development of Bus Turnouts, Passenger Waiting Areas and Shelters in New Facilities

The design of bus stop waiting areas and provision of amenities that enhance security and comfort plays a significant role in a person's decision to use transit. Passenger amenities are installed at bus stops to improve passenger comfort and the relative attractiveness of transit as a transportation option.

MUTD encourages local jurisdictions to condition development projects for the installation of bus shelters, waiting areas, and street improvements. Local jurisdictions are encouraged to coordinate with MUTD in determining what passenger amenities and other improvements are appropriate and where they should be installed.

2.1 Transit-Oriented Design

The story of Missoula's urban form is the story of its transportation choices. There is little doubt that its railroads, highways, and public transit (street cars) have shaped the region's settlement patterns. They have also promoted or impacted its livability and guided its sustainability.

Envision Missoula provided a public process for residents to express their desires for how Missoula would be shaped into the future. Missoulians overwhelmingly favored a sustainable and unique community that would manage travel demand by bringing activities together into a highly concentrated urban core area. This "Focus Inward" strategy results in a much higher density of mixed-use development through redevelopment and designates an In-town Mobility District that focuses on multi-modal transportation options and balance, such as pedestrian, bicycle, and public transportation travel, to minimize roadway congestion. Conversely, the Focus Inward strategy limits roadway expansion projects and the costly geographic scope of development offered by current trends.

Envision Missoula and the subsequent Downtown Master Plan embrace what is referred to as Transit-Oriented Development. The MUTD Board fully supports Transit-Oriented Development ("TOD"). Typically, TOD follows these principles:

- *Mixed Uses.* Land uses are mixed and may include a combination of residential, commercial, retail and entertainment activities.
- *Compact Development.* Residential development occurs at medium to high densities. Parking is often limited.
- *Location within walking distance of transit.* Boundaries of the TOD area extend approximately ¼-mile from transit service, a distance that can be covered in about five minutes on foot.
- *Neighborhood Focal Points.* Open spaces or plazas near transit stations function as community gathering spots.
- *Pedestrian Orientation.* Streets and open spaces are friendly to pedestrians.

TOD projects can be designed with layouts and site features that enhance transit accessibility and convenience, resulting in diminished reliance on private automobiles for routine trips. For example, developers should endeavor to place commercial, office, institutional, apartment, and other high-intensity uses along existing and proposed transit corridors/centers, or within ¼ mile of them. This strategy will increase density patterns and evolve into a positive planning policy that many local governments and transit advocates support. For the elderly and mobility-impaired, distance is particularly important when selecting their mode of transportation, and where they live.

Transit-friendly streets "balance" street uses with respect to having any single mode of transportation dominate. In many cases, this means altering a street to make transit use more efficient and convenient. When these alterations are properly executed, a kind of equilibrium is achieved among transit, cars, bicycles, and pedestrians. Transit-friendly streets accomplish the following four goals:

- Establish a clear priority for transit vehicle operations with convenient, accessible transit stops;
- Reduce conflicts between cars and other vehicles, including reduction of vehicle speeds;
- Create a strong pedestrian orientation where practical, including adequate circulation space, ease in crossing streets, and appropriate amenities, all of which contribute to comfort and convenience;

Finally, the greatest appeal of Envision Missoula's Focus Inward strategy is clearly its financial feasibility. By concentrating development in the urban core, the scenario enables Missoula to forego the costly expansion program of the current development trends, reaping economies of scale, taking advantage of increased density on a smaller footprint to lower infrastructure costs and decreasing congestion.

2.2 Fundamental Site Planning Principles

MUTD has an extensive network of bus routes and public transportation services. The map on the following page shows the current route network. The area where bus service operates is characterized by either relatively high residential or employment density. The flexibility of bus service is such that routes and services can be extended. However, it is the policy of MUTD to focus resources where they are most effective.

In the areas where MUTD operates, some fundamental site planning principles are recommended:

- Walking distances for the transit user in urban areas should not exceed one-quarter mile to a transit stop. Transit is very ineffective in areas where passengers must walk a long distance to and from a bus stop.
- Direct walkways or sidewalks that link residences to transit stops should be provided within residential developments.
- Roadways should be designed to permit transit service to appropriate locations within the development. At least one through street should be incorporated into a development's site design to provide access to transit stops.

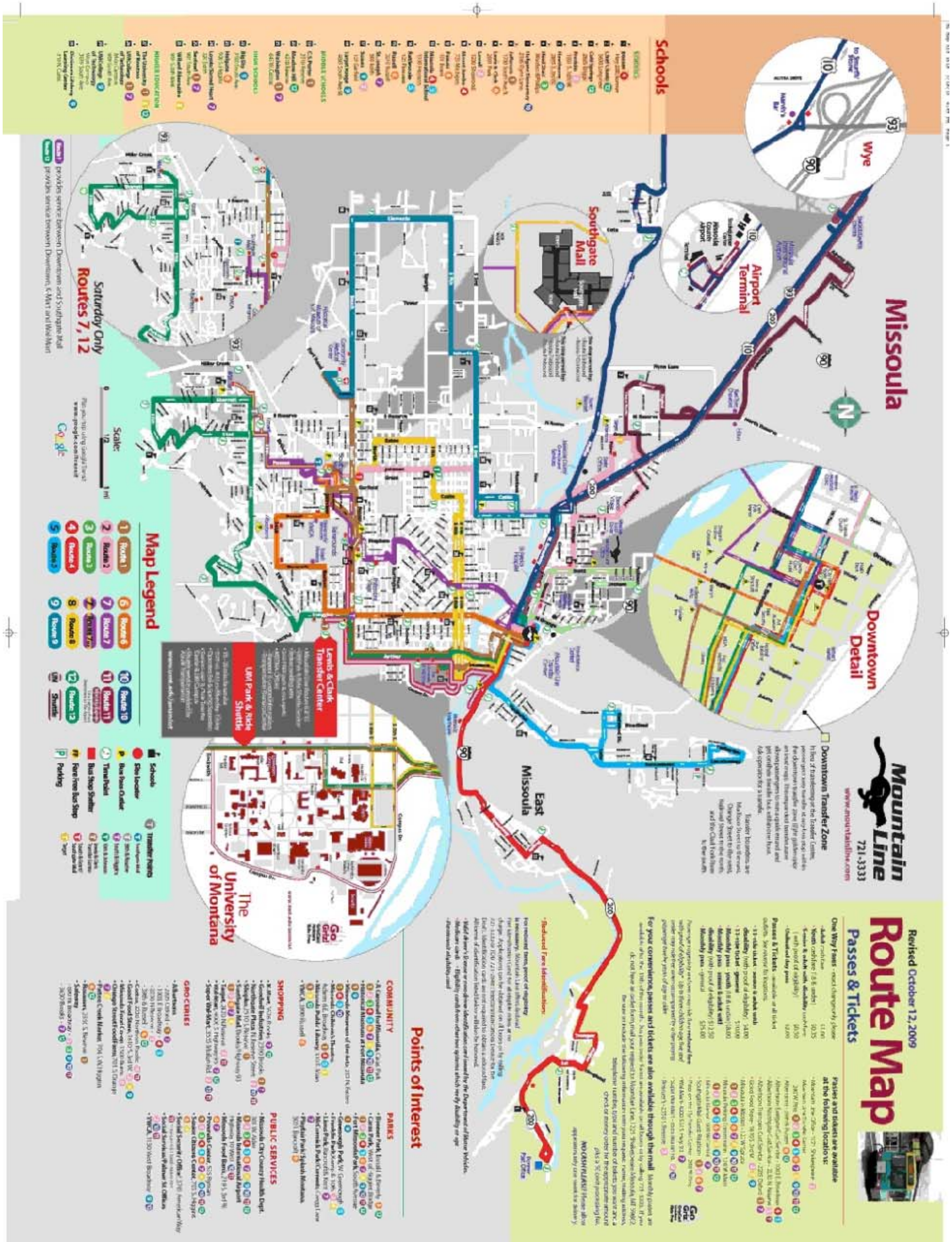


Figure 2.1 Mountain Line System

- Park and Ride facilities should be provided at appropriate transit points to concentrate transit users from low density residential areas. These facilities should be provided in conjunction with off-street open space parking.
- Retail establishments should be clustered to reduce the number of curb cuts and bus stops and to decrease shopper walking distances.
- Buildings should have a setback no greater than 150 feet from the curb to provide employees with more effective and convenient access to public transit.
- Pedestrian walkways (sidewalks) should be constructed along the perimeter of all developments. Where there are commercial buildings, the walkways should connect to the lobby, located at the front of the building, to the bus stop area.
- Parking spaces should be assigned for vanpool and carpool vehicles. These parking spaces should be given priority designation and located adjacent to the primary building entrance from the parking lot.
- Mixed use developments, where residences are not far from neighborhood commercial activity, reduce the demand for travel of all forms in a region. In addition to the more obvious energy and environmental benefits of such an arrangement of land, recent studies have shown that it is a healthier environment because residents frequently substitute walking for motorized trips of all types.

Other more specific guidance on transit facilities and amenities is provided in later sections of this document.

2.3 Street Networks

Transit-friendly designs recognize that a transit customer is a pedestrian first. The segment between the bus stop and the point of origin or ultimate destination is an integral part of the transit journey. Cul-de-sacs and other dead-end streets are common in subdivisions built in America the last half of the 20th Century. Unlike the grid pattern of traditional urban streets, cul-de-sacs limit the ways in and out of neighborhoods and require taking long and circuitous routes to reach close destinations. Figure 2.2 compares two areas of equal size, the first with a typical cul-de-sac layout and the second with streets arranged in a grid pattern.

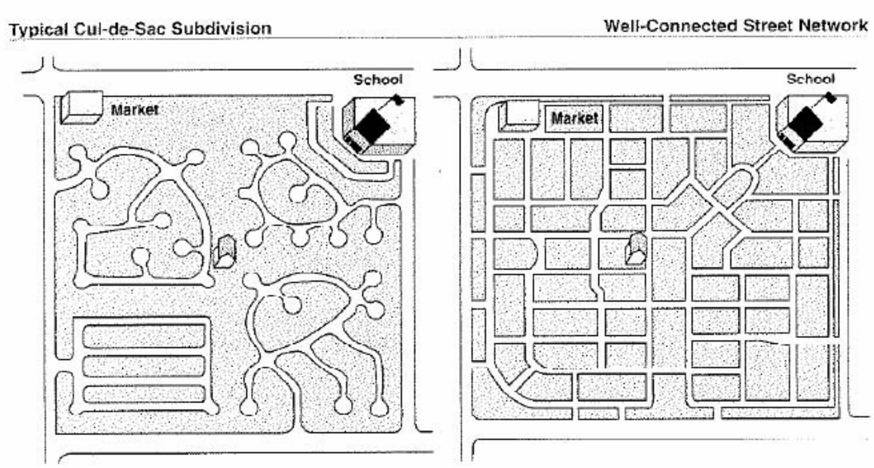
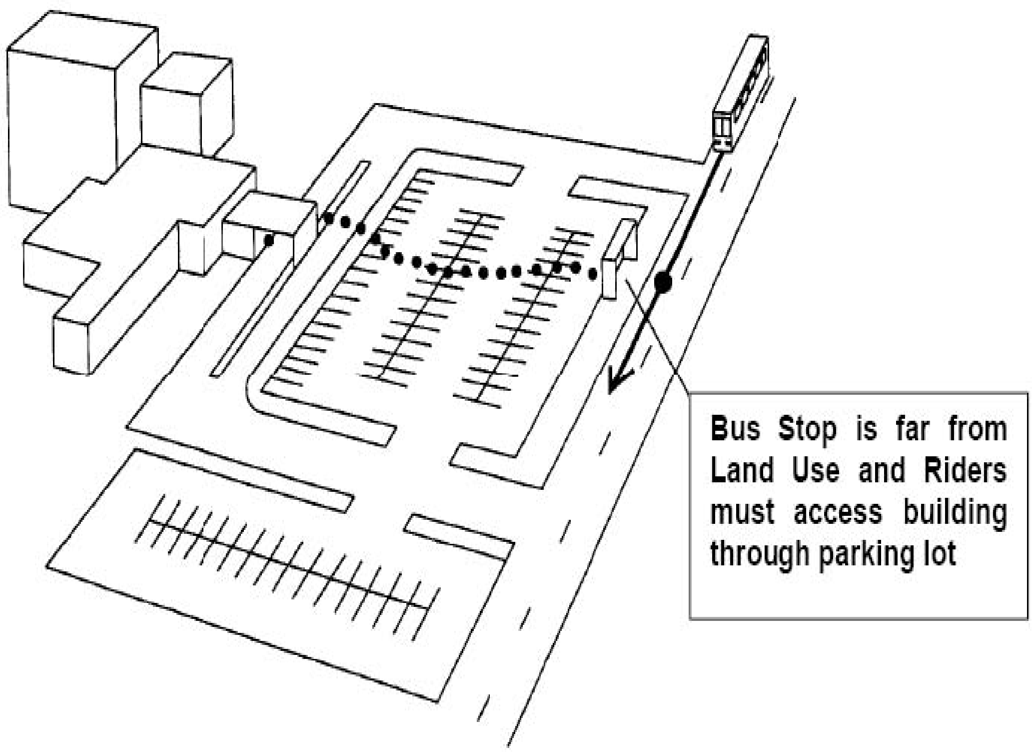


Figure 2.2 Comparison of Street Networks

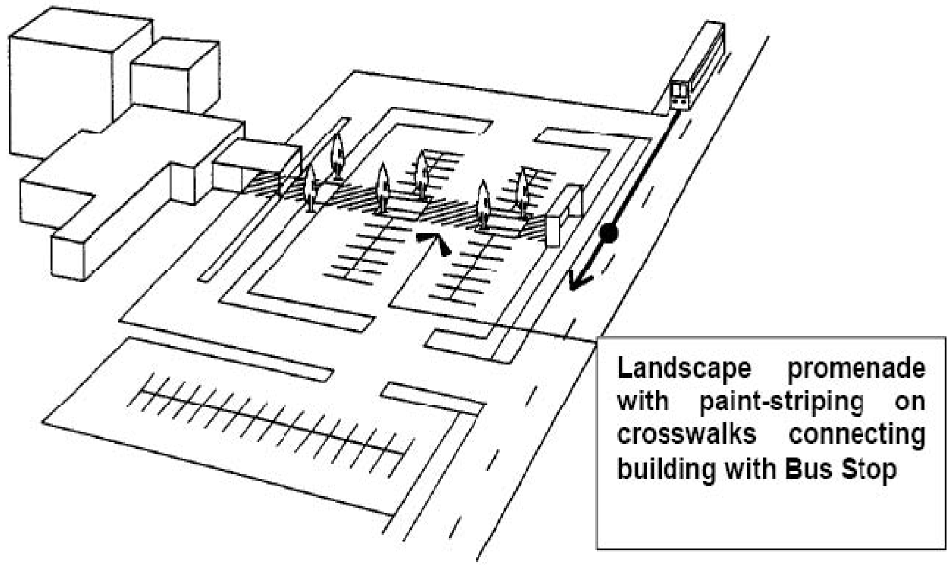
2.4 Facility Site Plans

The same general principles in building transit-friendly subdivisions apply to major commercial and institutional facilities. The link between the building entrance and bus stop is a critical part of the transit journey. While it is possible for MUTD to deviate routes into major facilities, MUTD refrains from doing so because it lengthens the trip of passengers who are not bound to the facility and also due to safety concerns with vehicular conflicts within these facilities. Further, meandering in and out of parking lots of major facilities dramatically reduces travel speed and makes the transit service a less attractive product relative to driving. The figures below also illustrate examples of good and poor practice in facility layout. The site layout in Figure 2.3 requires transit passengers to travel through a parking lot without a clearly identified pedestrian path. Figure 2.4 illustrates an improved example with a clearly defined path from the bus stop to the building. An even better example appears in Figure 2.5 in which the building is not deeply set back from the street.



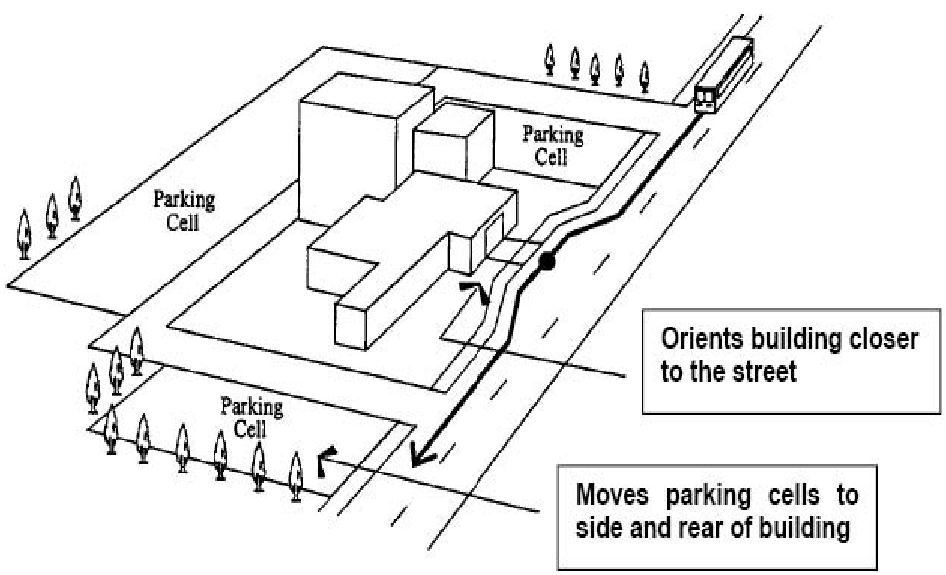
Source: Transit Cooperative Research Program, Report 19

Figure 2.3 Poor Example of Facility Site Plan



Source: Transit Cooperative Research Program, Report 19

Figure 2.4 Improved Example of Facility Site Plan



Source: Transit Cooperative Research Program, Report 19

Figure 2.5 Ideal Example of Facility Site Plan

2.5 Bus Stop Spacing

The actual design of specific bus stops is treated in Section 6. However, this section focuses on spacing between bus stops, which is an important aspect of transit planning. As a general rule, transit passengers will not walk more than one-quarter mile to a bus stop. This guideline must be balanced against the fact that frequent bus stops and starts makes for a slow, uncomfortable journey for a transit passenger.

Actual distance between stops is a function of the adjacent land use and density. The table below is illustrative of industry practice in bus stop spacing. It is generally the practice that bus stops are placed at intersections. However, where there are major mid-block generators or long blocks without intersecting streets, mid-block stops may be required.

Table 2.1 Design Criteria for Bus Stop Spacing

Density Characteristics	***Spacing Dimensions***
MAJOR ACTIVITY CENTERS – Activity centers such as hospitals and universities	Major facilities should be served.
HIGH – 4,000 + persons per square mile. Apartments, seniors' housing, offices, and commercial.	Approximately every 1/4 mile
MEDIUM – 2,000-4,000 persons per square mile.	Every 1/4 - 1/2 mile
LOW or RURAL – Less than 2,000 person per square mile.	Every 1/2 - 3/4 mile or on flag stop

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3.1 Types of Transit Priority Measures

There are several concepts and technologies widely used today to improve bus service and reduce travel time. Collectively these measures are part of what makes a Bus Rapid Transit (BRT) system. Transit priority measures seek to improve bus service by reducing travel time. The components of travel time include getting to and from bus stops, time waiting for the bus to arrive, and the time spent traveling on the bus. Additional time is required if a transfer is necessary. Transit priority measures primarily seek to reduce in-vehicle travel time by giving buses priority over other types of vehicles on streets, excluding emergency medical and law enforcement vehicles. These measures can include reserved bus lanes and priority treatment for buses at traffic signals. The planning and implementation of bus priority measures works best in urban areas with a high concentration of bus services, high levels of traffic congestion, and good community support for transit service. To be successful, transit priority measures must be coordinated with the local jurisdictions responsible for traffic control and roadway planning and operations.

Transit priority measures should effectively:

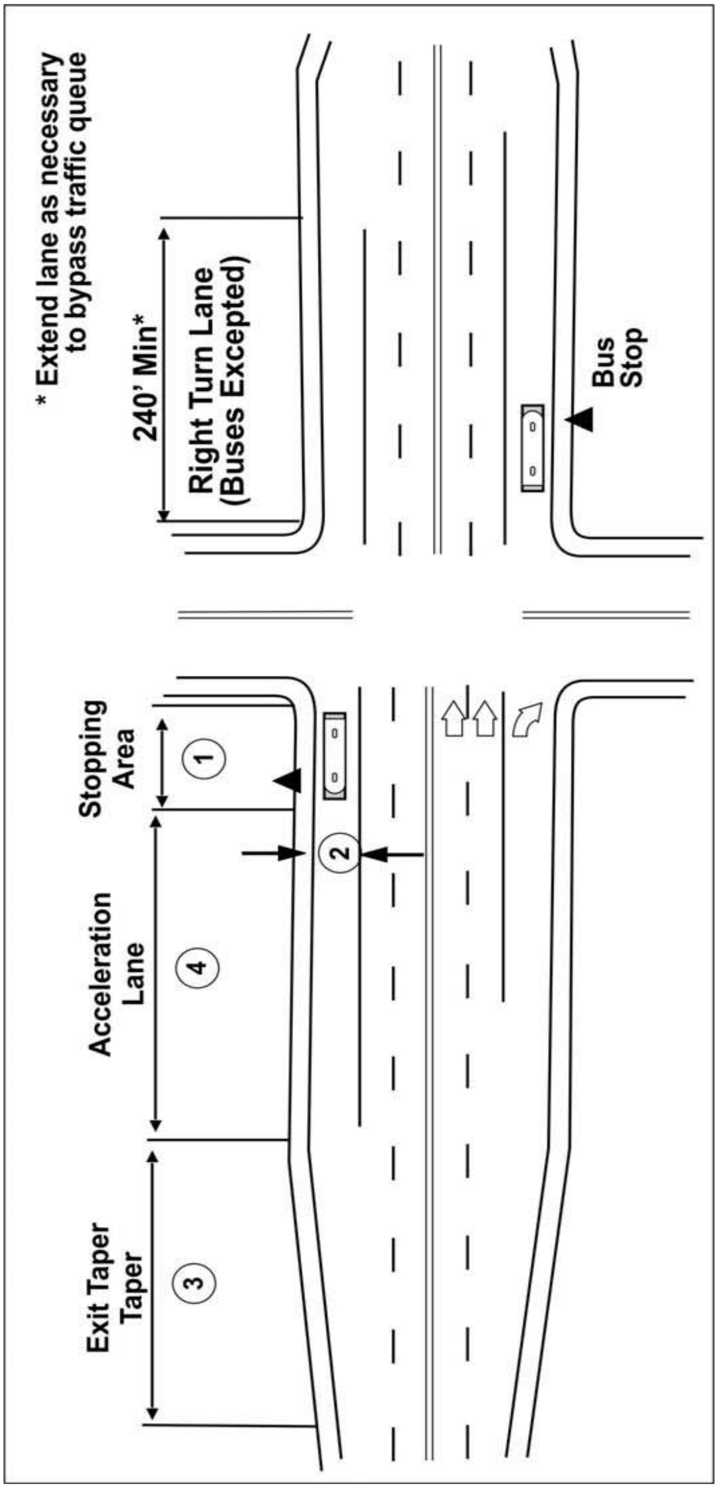
- Alleviate existing bus service deficiencies,
- Achieve attractive and reliable bus service,
- Serve demonstrated existing demands for transit,
- Provide reserve capacity for future growth in bus trips, and
- Attract auto drivers to transit.

The following sections generally describe some of the transit priority measures that local jurisdictions should be planning for and implementing in the future.

3.2 Queue Jumpers

Queue jumpers provide a priority treatment for buses along arterial streets by allowing buses to bypass traffic queued at congested intersections. Queue jumpers evolved from the need to solve problems not answered by bus turnouts. In the past, traffic engineers constructed bus turnouts to move buses out of the traffic stream while they are stopped for passengers. Unfortunately, bus turnouts introduce significant travel time penalties to bus patrons because buses are delayed while attempting to reenter the traffic stream. Queue jumpers are able to provide the double benefit of removing stopped buses from the traffic stream to benefit the general traffic and getting buses through congested intersections so as to benefit bus operations.

Queue jumpers consist of a nearside right turn lane and farside bus stop and/or acceleration lane. Buses are allowed to use the right turn lane to bypass traffic congestion and proceed through the intersection (See Figure 3.1). Additional enhancements to queue jumpers could include an exclusive bus only lane upstream from the traffic signal, an extension of the right turn lane to bypass traffic queued at the intersection, or an advanced green indication allowing the bus to pass through the intersection before general traffic does.



Source: Transit Cooperative Research Program, Report 19

Figure 3.1 Queue Jump Design—Right Turn Only Lane

3.3 Traffic Signal Priority

Traffic signal priority measures are designed to eliminate delays in bus service due to excessive waits at intersections signals. There are two general types of systems. In the first, depending on the program algorithm, a bus approaching a downstream traffic signal extends the green light or advances the cycle to green, either through transponders or other electronic communications means, to proceed through the intersection. The bus operator determines when signal priority is needed to maintain the bus schedule. In the second, a bus system equipped with an automatic vehicle location system and advanced radio communications gives signal priority control to the operations center, where typically a computerized system determines bus adherence to schedule and automatically triggers traffic signals when needed. MUTD encourages local and state agencies to invest in community intelligent transportation systems.

3.4 Bus Rapid Transit

Conventional urban bus operations often are characterized by sluggish vehicles inching their way through congested streets, delayed not only by other vehicles and traffic signals, but also by frequent and time-consuming stops to pickup and discharge passengers. Buses travel on average at only around 60 percent of the speeds of automobiles using the same streets due to the cumulative effects of traffic congestion, traffic signals, and passenger boarding.

Low cost investments in infrastructure, equipment, operational improvements and technology can provide the foundation for Bus Rapid Transit systems that substantially upgrade bus system performance. Conceived as an integrated, well-defined system, Bus Rapid Transit would provide for significantly faster operating speeds, greater service reliability, and increased convenience, matching the quality of rail transit when implemented in appropriate settings. Improved bus service would give priority treatment to buses on urban roadways and would be expected to include some or all of the following features:

- Bus lanes: a lane on an urban arterial or city street is reserved for the exclusive or near-exclusive use of buses.
- Bus streets and busways: A bus street or transit mall can be created in an urban center by dedicating all lanes of a city street to the exclusive use of transit buses.
- Bus signal preference and preemption: Preferential treatment of buses at intersections can involve the extension of green time or actuation of the green light at signalized intersections upon detection of an approaching bus. Intersection priority can be particularly helpful when implemented in conjunction with bus lanes or streets, because general-purpose traffic does not intervene between buses and traffic signals.
- Traffic management improvements: Low-cost infrastructure elements that can increase the speed reliability of bus service include bus boarding islands, and curb realignments.
- Faster boarding: Conventional on board collection of fares slows the boarding process, particularly when a variety of fares are collected for different destinations and/or classes of passengers. An alternative would be the collection of fares upon entering an enclosed bus station or shelter area prior to bus arrivals. This system would allow passengers to board through all doors of a stopped bus. A self-service or "proof-of-payment" system also would allow for boarding through all doors, but poses significant enforcement challenges. Prepaid "smart" cards providing for automated fare collection

would speed fare transactions, but requires that boarding remain restricted to the front of the bus.

3.5 Automated Vehicle Locating Systems

One of the advanced technologies used in Bus Rapid Transit and in conventional bus operations is Automatic Vehicle Location systems (AVL). These systems track transit vehicles against their designated route schedules. AVL is often integrated with other systems including:

- Automatic vehicle monitoring and control.
- Emergency vehicle locating.
- Fleet management including performance monitoring.
- Data collection.
- Fare collection, and
- Transit signal priority.

AVL can be integrated with a local jurisdiction's central traffic control center and used to dynamically adjust signal timing to maintain route schedules.

3.6 Traveler/Customer Information

Upon arrival to a bus stop or transit center, passenger orientation and wayfinding is a critical element of the convenience of using the transit system. Minimum information that should be displayed on bus stop signs includes route number, route name, transit agency symbol, and variable information such as operating times. Sign visibility and proper lighting of signs at night is also very important. In addition to basic signs, schedules and maps provide valuable information, particularly to new users. Specific guidance information to provide at bus stops includes:

- Hours of services and routes.
- Schedules/headways and waiting times.
- Locations of terminals, transfer points, and stops with routes served.
- Maps showing transit system and local area.
- Fare schedule.

In addition to basic signs, route maps and schedules, another technology that MUTD will implement in the future is real time bus arrival information. This information utilizes AVL systems to notify passengers when the next bus will arrive. Real time displays are typically only installed at transit centers or bus stops with shelters that have a high number of boards with a high rate of transfers.

4.1 MUTD Types of Bus Service

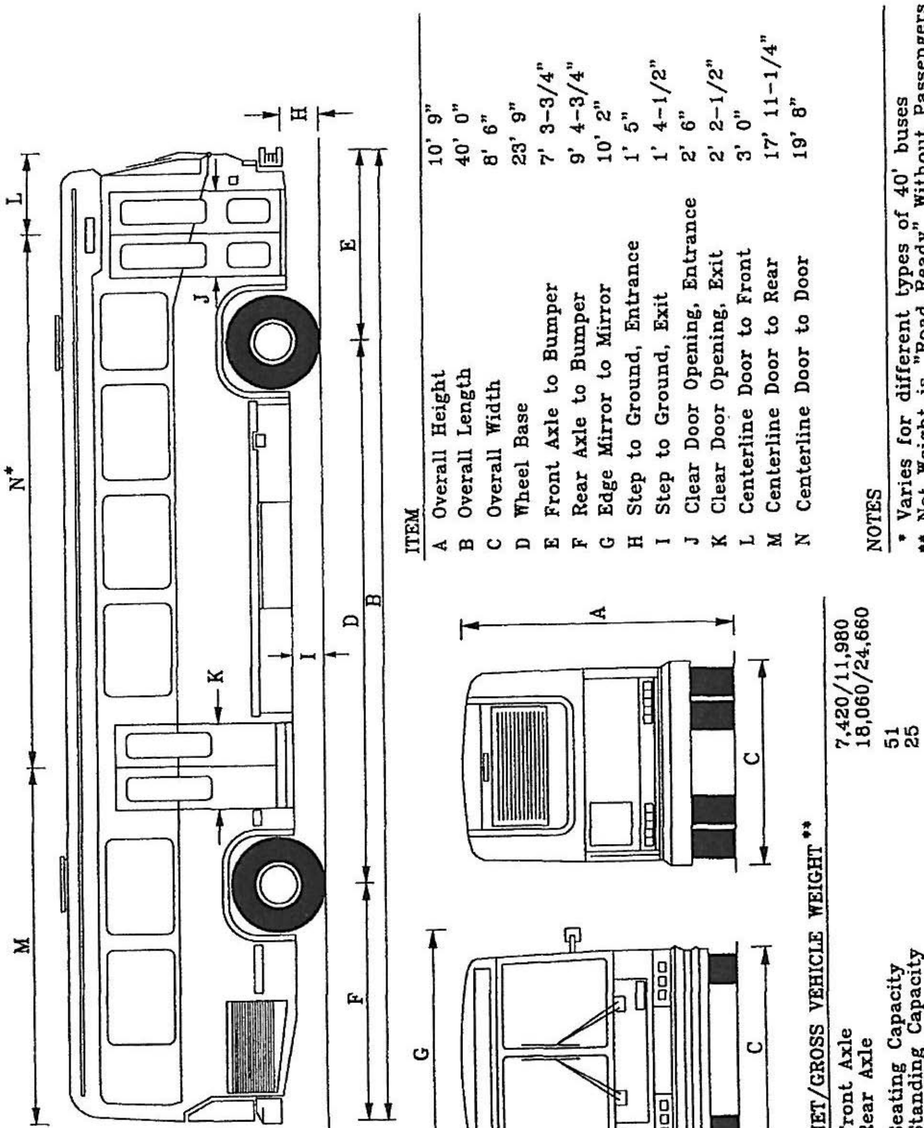
In General MUTD operates two types of service; fixed route service and demand response, or curb-to-curb service. The fixed route services consist of regularly scheduled routes using large buses that operate throughout the greater Missoula area. The demand response buses are generally smaller and provide curb-to-curb service for the region's senior and disabled population. Facilities should be sensitive to accessibility issues.

Figure 4.1 illustrates the physical dimensions of 40 foot buses, which are the largest bus that will be operated by MUTD in the foreseeable future. Figure 4.2 illustrates the physical dimensions of a demand response bus, which is typical of the vehicles used in curb-to-curb service for seniors and disabled residents.

The weight of a loaded bus is summarized in the Table 4.1 below along with axle weightings with diagrams of both fixed route and paratransit buses shown on the next two pages.

Table 4.1 Loaded Bus Weight

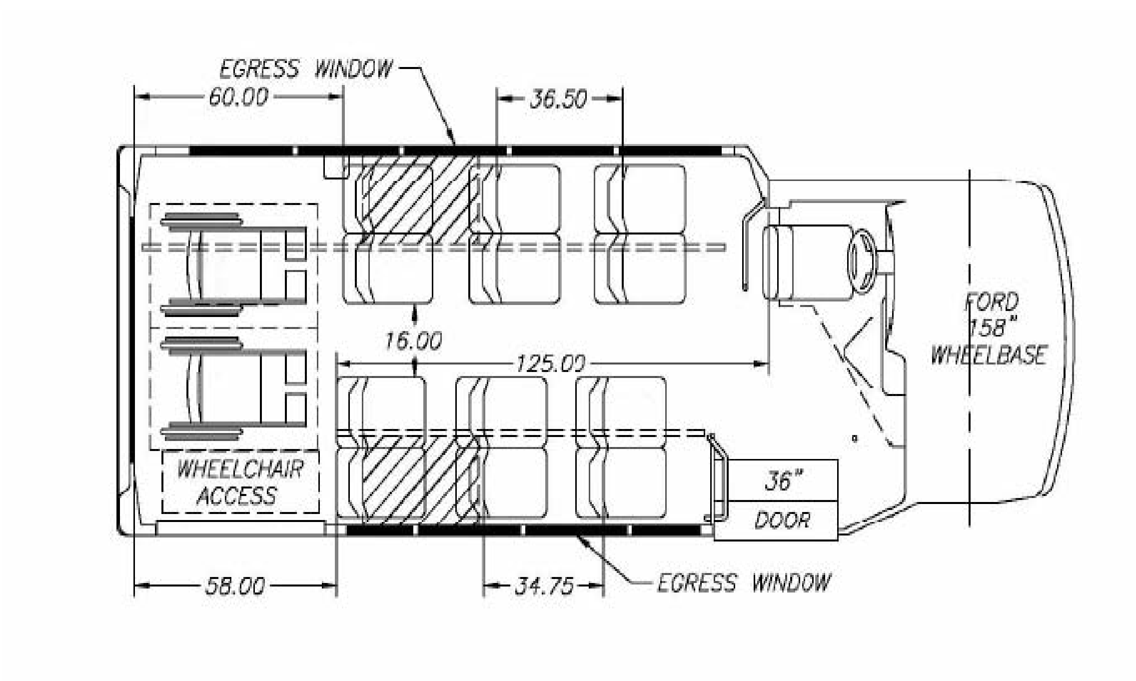
Total weight	40,500 pounds
Front axle	14,500 pounds
Rear axle	26,000 pounds



Source: Transit Cooperative Research Program, Report 19

Figure 4.1 40-Foot Transit Bus Physical Characteristics

Vehicle Feature	"Paratransit" Maximum Dimensions
Overall Height,	9 Feet, 0 Inches
Overall Length, w/bumpers	23 Ft, 0 In
Overall Vehicle Width	8 Ft, 0 In
Front Axle to Front Bumper	7 Ft, 5 In
Rear Axle to Rear Bumper	10 Ft, 0 In
Edge of Outside Mirror-to-Mirror	10 Ft, 0 In
Step to Ground, Front Entrance	0 Ft, 10 In
Step to Ground, Rear Entrance	Not applicable



Source: Vehicle Manufacturer

Figure 4.2 Demand Response Bus

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5.1 Design of Streets and Intersections

The design of streets and intersections greatly affects the provision of transit services. Generally, bus stops are located at intersections for safety reasons, and proper design is necessary to assure safety of transit passengers, pedestrians, and motorists and to operate the intersection efficiently.

5.2 Intersection Radii

Figure 5.1 shows bus turning radii requirements for a 40 foot coach. The minimum interior radius is 28 feet and the minimum outer radius is 50 feet. These templates may be used in the design of facilities to identify required pavement width and possible vehicle encroachment. Additional allowance should be made under special circumstances such as:

- bus speeds greater than 10 miles per hour
- reverse turns
- sight distance limitations
- bike racks on front of bus (which add four feet to the length of the bus)
- changes in pavement grade
- restrictions to bus overhang

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

- less bus/auto conflict at heavily used intersections
- higher bus operating speeds and reduced travel time
- improved bus rider comfort

The design of intersection radii should consider the following elements:

- bus turning radius
- on street parking
- right of way/building restrictions
- allowable bus encroachment into other traffic lanes traveling in the same direction
- placement of power poles or other utilities

MUTD’s larger buses for fixed route services have bike racks mounted on the front of each bus, and have the capacity to carry two or three bicycles. Because of the bicycle rack, the turning radius of MUTD’s larger buses increases an additional four feet.

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

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

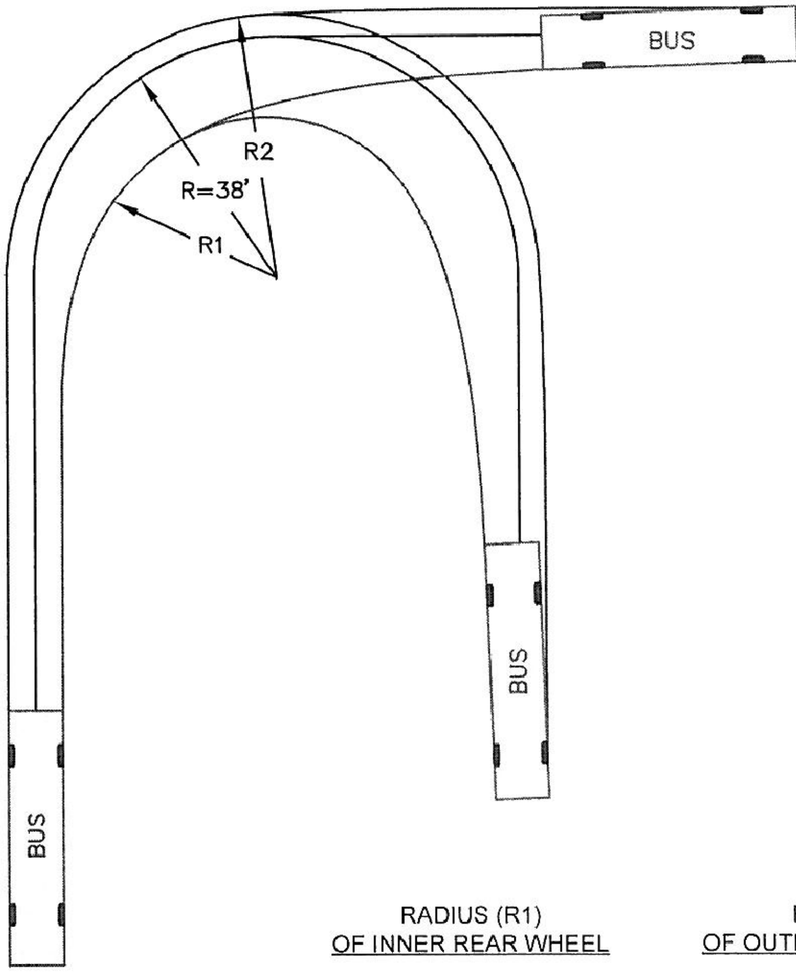
The final element of corner radii design is the amount of lane encroachment which can be tolerated. This tends to be a subjective decision made by the designer based on an evaluation of the speed and volume of the vehicles involved and the functional classification of the roadways. In general, there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

One additional item should also be evaluated. At intersections, as the size of the corner radius increases, the walking distance across the intersection increases. Designers should be aware of this pedestrian factor and be prepared to accommodate the pedestrians if the length of one particular crossing increases to the point where it may create operational problems.

When designing a new facility, the designer should select the design vehicle, the roadway widths, and determine the amount of encroachment which can be tolerated. Figure 5.2 shows appropriate corner radii for transit vehicles and various combinations of lane widths and turning maneuvers. Figure 5.2 does not present all situations, so it should be used as a starting point and turn radii must be checked with an appropriate turning radius template before being incorporated in a final design.

If an existing intersection or driveway is to be evaluated for transit operations, a layout showing existing lane widths and corner radii should be prepared. The layout should then be checked with the appropriate turning radius template and the resulting encroachment, if any, determined. This can then be compared to the amount of encroachment that can be tolerated and potential remedial efforts such as increases in lane width or corner radii evaluated.

The simple curve is the most simple corner radius which will be encountered in typical urban designs. A simple curve uses a uniform radius connecting the points of tangency of the intersecting streets. However, in some special situations such as a skewed intersection or when it is desirable to allow turns at speeds greater than 10 miles per hour, the designer should consider using a compound curve. Compound curves are a combination of simple curves with different radii joined together. Compound curves have an advantage over simple curves because they more closely fit the natural turning paths of design vehicles. Design procedures using compound curves and the channelization which frequently accompanies them can be found in local agency street design standards or the Association of American State Highway Transportation Officials (AASHTO) “Green Book”.



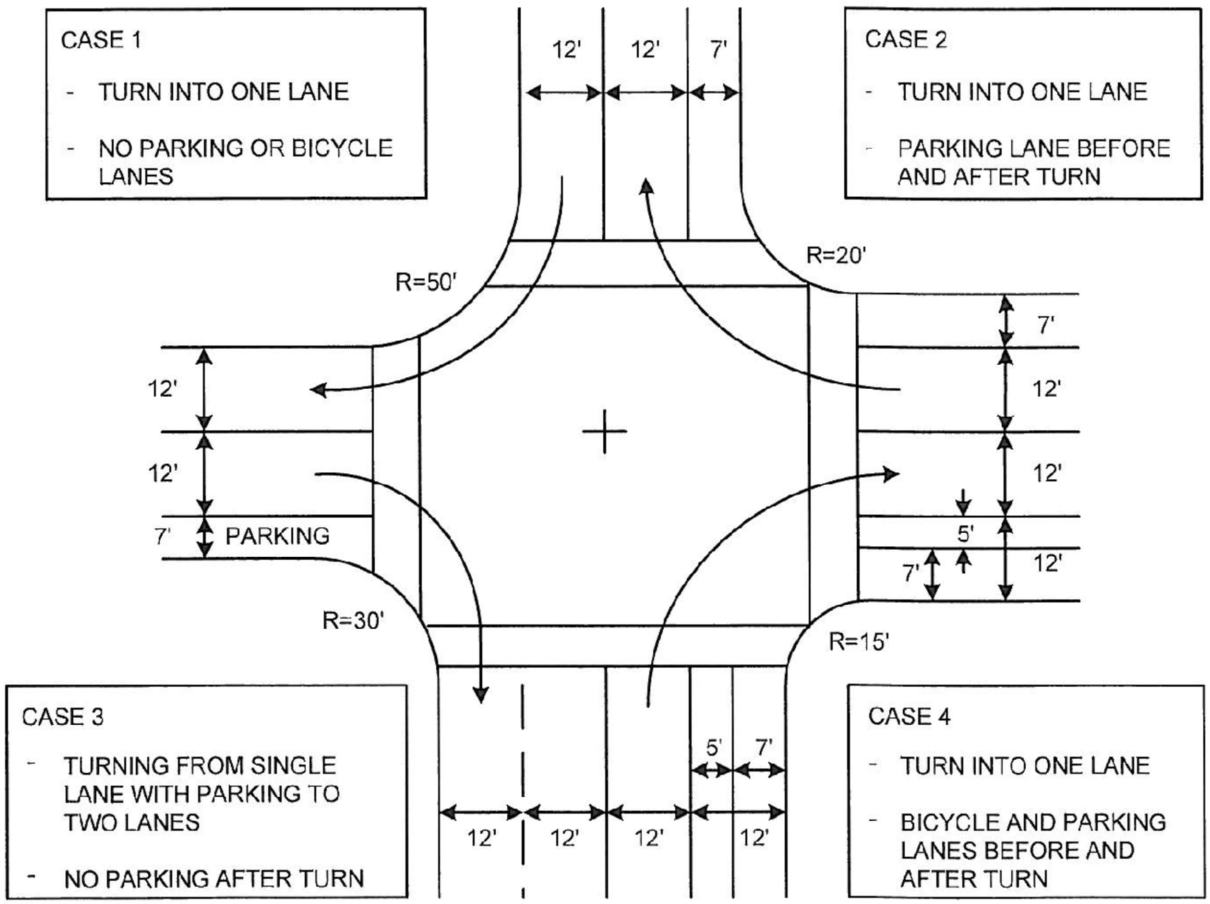
	RADIUS (R1) OF INNER REAR WHEEL	RADIUS (R2) OF OUTER FRONT CORNER
MINIMUM	28'	50'
DESIRABLE	30'	55'

MINIMUM CENTERLINE RADIUS = 38 FEET

Source: Orange County Transportation Authority

Figure 5.1 Bus Turning Radii for Large Buses

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



Source: Orange County Transit Authority

Figure 5.2 Intersection Design for Transit Turns

5.3 Parking and Loading Zones

In built-up commercial areas, there should be sufficient space for on-street truck loading and unloading. If there is no provision for deliveries, truck drivers will inevitably park at bus stops or double park, neither of which is beneficial for transit service or efficient traffic flow.

5.4 Crest and Sag

The distance between the front and rear axle of a bus poses limitations on bus operations. A sharp rise and fall on a hill may result in a bus "bottoming out" at the crest of a hill—a bus' front and rear overhang beyond the respective axles. A similar conditions known as sag occurs where a road surface depression is so severe that it can leave a bus suspended or "hung up."

The American Association of State Highway and Transportation Officials (AASHTO) minimum acceptable vertical curve length is calculated by determining the "K-Value." This is the length of vertical curve divided by the algebraic difference in the grade. The following are the minimum vertical curve K-Values for crest and sag at various speeds:

Table 5.1 Minimum Vertical Curve K-Values

Speed (mph)	Crest (ft)	Sag (ft)
60	160	105
50	85	75
40	55	55
30	28	35

5.5 Roadway Surfaces

Roadway pavements need to have sufficient strength to accommodate repetitive bus axle loads of up to 25,000 pounds. Concrete is preferred where buses start, stop, or turn to avoid failure problems that are experienced with asphalt. Concrete aids in the retention of roadway surface shape, drainage capabilities, and skid resistance. Rarely will MUTD buses use unpaved roads or parking surfaces.

5.6 Clearance Requirements

Buses usually travel in the curbside traffic lane and make frequent stops to pick up and drop off passengers. Therefore, it is important to consider bus clearance requirements:

- Overhead obstructions should be a minimum of 12 feet above the street surface.
- For future street improvements, obstructions should not be located within a minimum of two (2) feet of the edge of the street to avoid being struck by a bus mirror (this lateral clearance is not only important at ground level, but it is necessary at the top of the bus).
- A traffic lane used by buses should be wide enough to permit adequate maneuvering space and to avoid sideswipe accidents. Since the maximum bus width including mirrors is 10'-4", the minimum curb lane width (including gutter) should be 11 feet.

- When buses pull out of the bus zone to reenter traffic, on occasion the rear of the bus will pivot and extend over the curb line. If above grade obstacles are located too close to the street, buses could sideswipe these fixtures damaging both the fixed object and/or bus. The rear overhang swing should be checked, possibly requiring a lateral clearance greater than (2) feet.

6.1 Bus Stops

Bus stops are the interface between the transit vehicle network and the sidewalk network. Accordingly, they must be designed from both the on-street perspective and the pedestrian perspective. Section 2 (*Transit Friendly Design*) discussed network issues of bus stop spacing. Design issues are addressed in this section.

6.1.1 Bus Stop Placement Policies

The proper location of bus stops is critical to the safety of passengers and motorists, and to the proper operation of the transit system. Bus stop locations are recommended by MUTD and approved by the local jurisdictions. Local jurisdictions can suggest bus stop locations at their discretion. Generally speaking far side stops are preferred. However, because of the numbers of factors involved, each new or relocated bus stop must be examined on a case-by-case basis. It is important to consider these unique circumstances at each possible site when selecting bus stop locations including the following:

- Spacing along the route
- Proximity to expected trip generators
- Adequate right-of-way to ensure the bus stop meets the Americans with Disabilities Act (ADA) accessibility standards
- Presence of sidewalks and curb ramps leading to trip generators and surrounding pedestrian circulation system
- Width, placement and conditions of sidewalk
- Protect crossings at signalized or stop controlled intersections, or at crosswalks
- Conflict between buses, other vehicles and pedestrians
- Pedestrian activity through the intersection
- Open and visible spaces for personal security and passenger visibility
- Street illumination
- Ability to control parking
- Adequate curb space for the number of buses expected to be at the bus stop, and return to the traffic flow
- Volume and turning movements of other vehicles including bicycles
- Proximity and traffic volumes of nearby driveways, and traffic safety
- Street and sidewalk grades
- Convenient passenger transfers to intersecting bus routes
- Ease for bus re-entering the traffic stream
- Bus route turns
- Unusual intersection angles or predominant turning movements
- Proximity to rail crossings
- Sight distance at adjacent intersections and driveways

6.1.2 Bus Stop Location

The proper location of bus stops is critical to the safety of passengers and motorists, and to the proper operation of the transit system. Bus stops are generally located at intersections where they maximize pedestrian accessibility from both sides of the street and provide connection to intersecting bus routes. The first design determination in bus stop placement is whether stops should be near side (before the intersection), far side (after the intersection), or mid-block. Very frequently, bus turning movement and the location of major generators dictate the placement of stops at or near an intersection. While there are compelling reasons to have the stop at either side of an intersection, two factors - right turn on red and the introduction of automatic traffic signal priority - increase the desirability of far side stops.

While in service, buses generally stay in the right lane, except to turn left from a multilane roadway, or to pass a stalled vehicle or very slow moving traffic. Operators must make sure before moving into the left lane that riders waiting for their bus are not missed.

Bus stop types can be categorized by their relationship or location to the travel intersection:

- Near side—immediately prior to passing through an intersection
- Far side—immediately after passing through an intersection
- Mid-Block—between two intersections

Right-turning lane treatments at intersections traditionally negate near side stops. Further, if the traffic control at an intersection is a stop sign on either the route or intersecting street or both, near side stops can impede sight distance and should be avoided.

Near Side

Advantages	Disadvantages
Minimizes interference when traffic is heavy on the far side of the intersection	Increases conflicts with right-turning vehicles
Allows riders to access buses close to the crosswalk	May obscure motorists' view of traffic control devices and crossing pedestrians
Allows operators to use the width of the intersection as an acceleration lane	May obscure line of sight distance for the motorists crossing the intersection
Eliminates potential double stopping through intersection	May obscure line of sight for crossing pedestrians
Allows riders to board and alight at traffic signal	May block travel lane with queuing buses
Allows operators the opportunity to observe oncoming traffic and make transfer connections	May require more than one traffic signal cycle to cross an intersection

Far Side

Advantages	Disadvantages
Minimizes conflicts with right-turning vehicles	May block intersection during peak period traffic
Allows additional right-turning capacity before intersection	May obscure line of sight for crossing vehicles
Minimizes sight distance concerns when approaching an intersection	May obscure line of sight distance for crossing pedestrians
Allows operators to use the width of the intersection as a deceleration lane	May require double stopping (before and after intersection) to serve the bus stop
Allows operators to use gaps in traffic created by the traffic signal	May restrict or choke travel lanes on far side of intersection

Mid-Block

Advantages	Disadvantages
Minimizes motorist and pedestrian line of sight concerns	Requires additional no-parking restrictions at the bus stop
Minimizes cross street pedestrian congestion	Encourages rider street crossing (or jaywalking)
	Increase walking distance from intersections

The Far Side May Be Better Where:

- Buses regularly execute many left turns at intersections. The far side stop provides a more convenient service point after such turns;
- Dedicated, high volume right run lanes are present;
- Easier bus re-entry into traffic compensates for gaps created by traffic signals;
- Complex intersections occur with multi-phased signals, dual turn lanes, etc. Far side stops remove buses from complicated maneuvers and circulation activities in and around intersections.

The Near Side May Be Better Where:

- Transit users can board or alight from buses closer to crosswalks and intersections, thereby often minimizing walking distance to connecting transit service;
- There may not be sufficient room for an accumulation of multiple buses at the far side. Then, to avoid buses spilling over into the intersection area, the near side becomes preferable.

Mid-Block May Be Better Where:

- It is simply the safest location to stop;
- A less congested location away from the intersection is preferred;
- The bus makes a relatively sharp right turn and can't maneuver into a far-side stop;
- Long stretches of road offer no suitable intersecting streets or traffic stops.

Special Circumstance May Override These General Rules Where:

- Transfer activity between two routes exhibits a strong directional pairing (i.e. heavy volumes from eastbound to northbound). Then, placing one bus stop nearside and one far side can minimize pedestrian activity through the intersection;
- If a single trip generator/attractor (school, office, shopping center, etc.) weighs heavily on an intersection, and then the bus stop should be located closest to that generator, whether near or far side.

MUTD staff makes many of these locational recommendations during the normal development review process. However, all interested parties are advised to consult MUTD staff whenever special circumstances arise regarding bus stop placement.

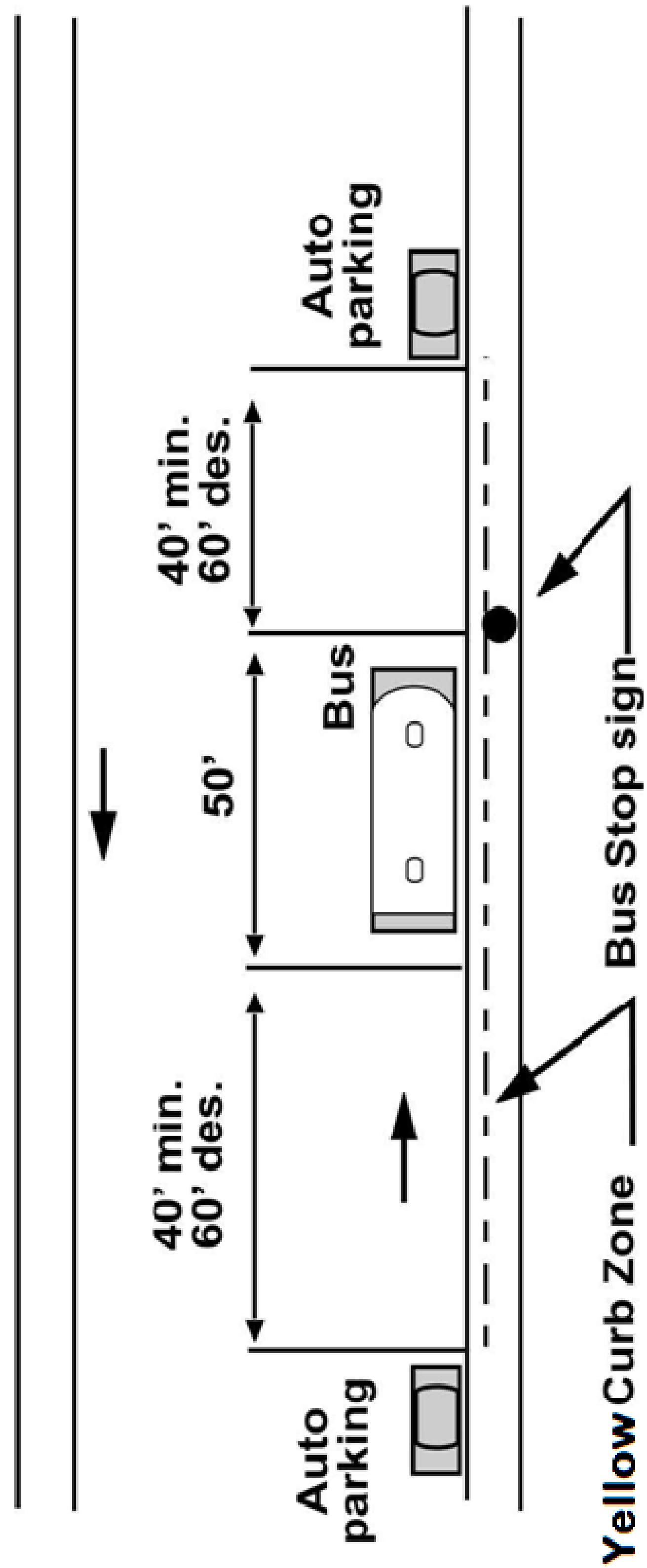
6.1.3 *Stops and Intersection Geometry*

Information on the previous pages summarize the advantages and disadvantages related to locating bus stops on the far side, nearside, and mid-block, as well as conditions under which each location may be recommended. The placement of bus stops at intersections varies from site to site. General conditions that should be considered when placing bus stops at intersections include:

- When the route alignment requires the bus to make a left turn, the preferred location for the bus is the far side of the intersection after the bus completes the left turn.
- When the route alignment requires the bus to make a left turn and it is not feasible or desirable to locate the bus stop on the far side of the intersection after the bus turns, a mid-block stop may be warranted. The mid-block bus stop should be located about 500 feet from the intersection so that the bus can easily maneuver into the proper lane to turn left. If a mid-block is necessary, Mountain Line will work with the jurisdiction and developer to incorporate design elements to discourage bus patrons from jay-walking.
- If there is a high volume of vehicles turning right at an intersection, the preferred location for a bus stop is on the far side of the intersection after the turn.
- If the route alignment turns right at the intersection, the preferred location for the bus stop should be on the far side of the intersection after the bus turns.
- In situations where two or more buses stop at a far side bus stop, which spills over into the intersection and additional length is not available, the bus stop should be placed on the nearside of the intersection. This reduces the potential for queuing buses to overflow into or block the intersection.

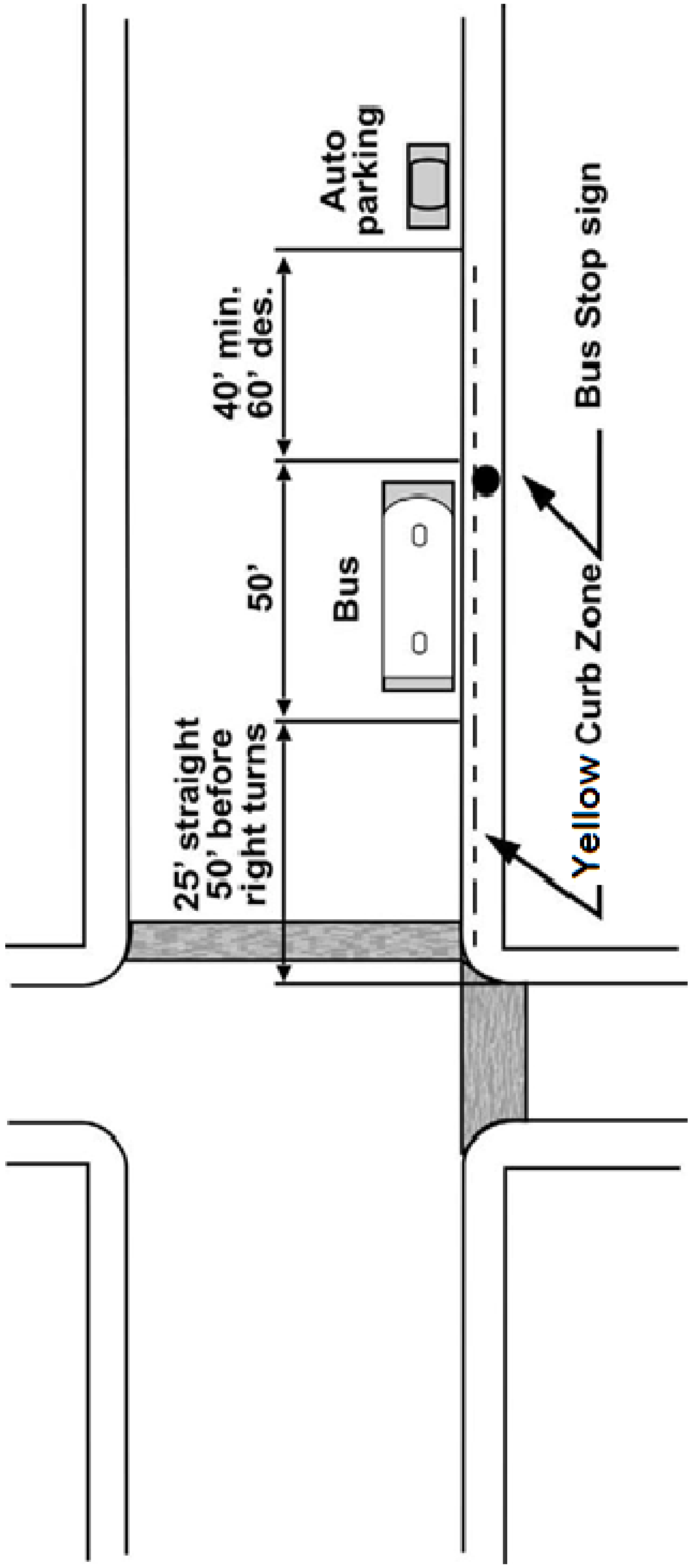
- At intersections with complex, multi-phased traffic signals or dual right or left turn lanes, far side bus stops are preferred because they eliminate buses from an area of complicated traffic movement at that intersection.
- When passenger transfers between two bus routes show a strong directional pairing, e.g. heavy passenger volumes from eastbound to southbound, placing one bus stop on the nearside and the other on the far side can curtail pedestrian activity at the intersection.

The street geometric design of bus stops is illustrated in the figures on the next three pages. These enable buses to pull into the curb and not block through traffic. In the case of far side and mid-block bus stops, they also enable buses to return to the traffic stream without a hard left turn. The design shown should not be confused or construed for designing bus turnouts. Design criteria for bus turnouts appear later in this chapter.



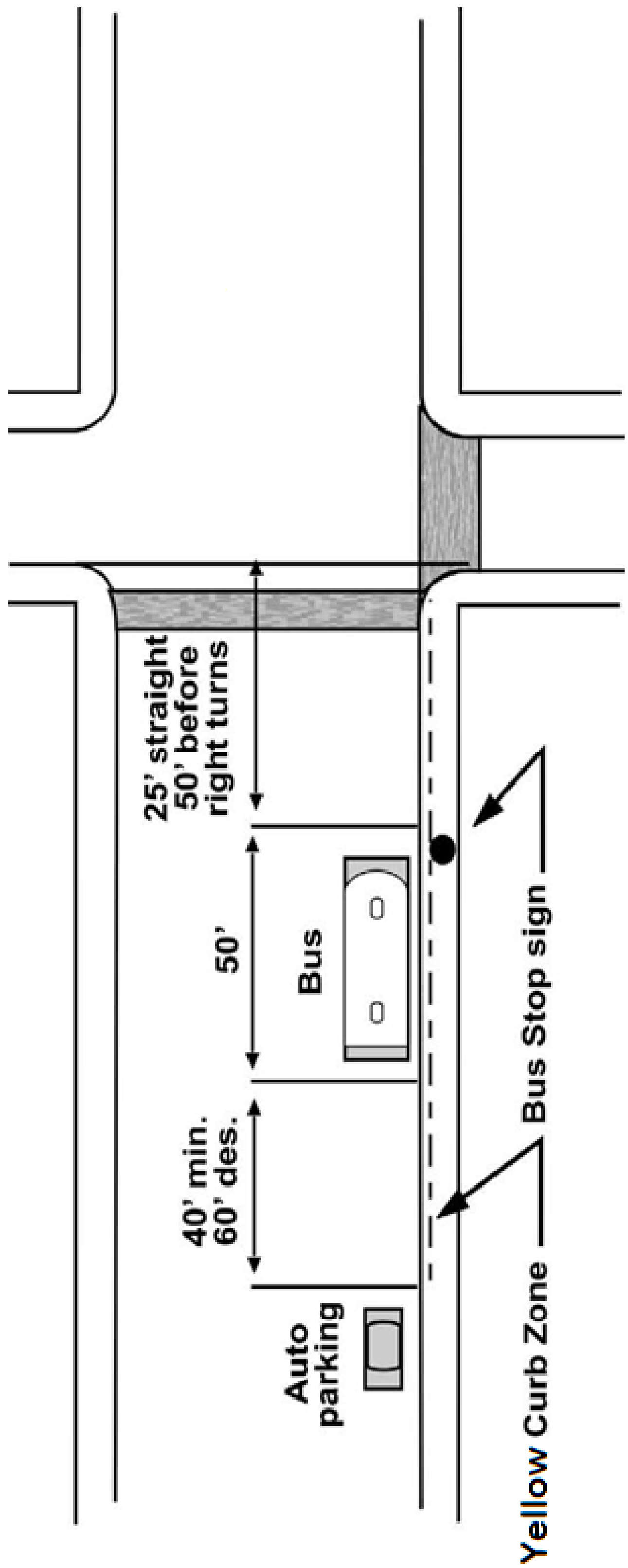
Source: SunLine Transit Agency

Figure 6.1 Mid-Block Bus Stop Geometry



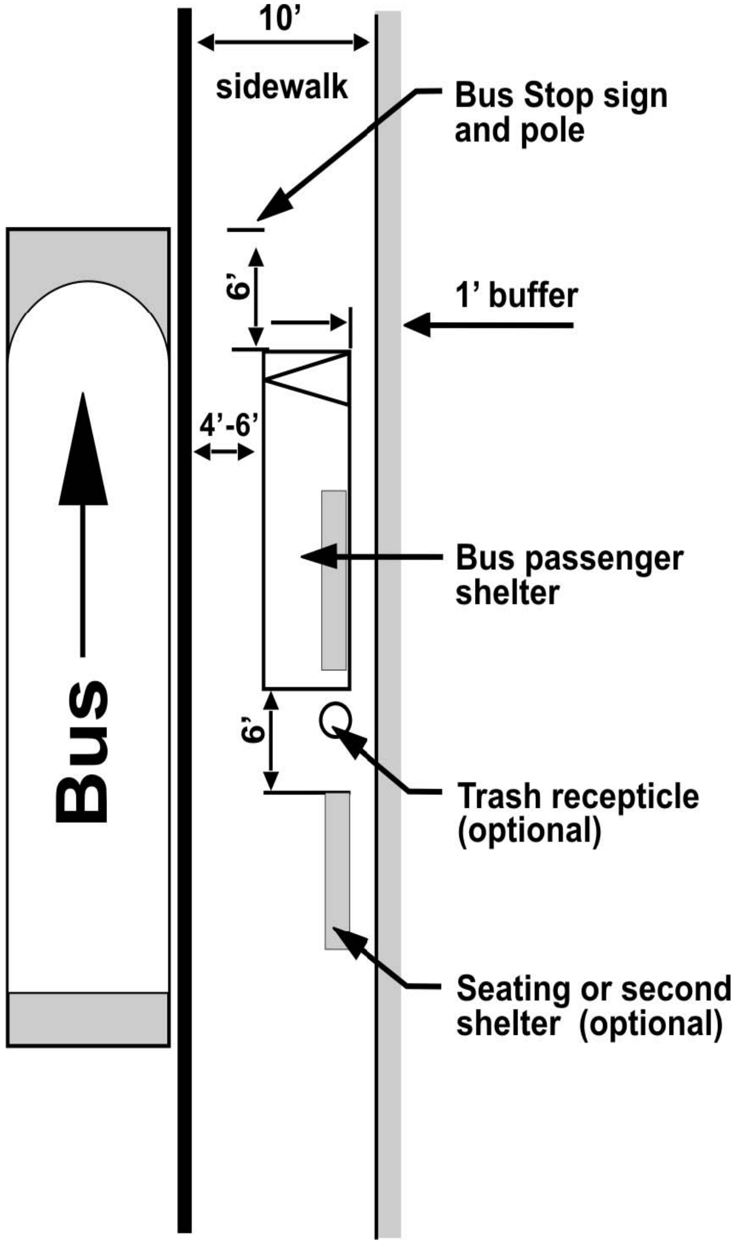
Source: SunLine Transit Agency

Figure 6.2 Far Side Bus Stop Geometry



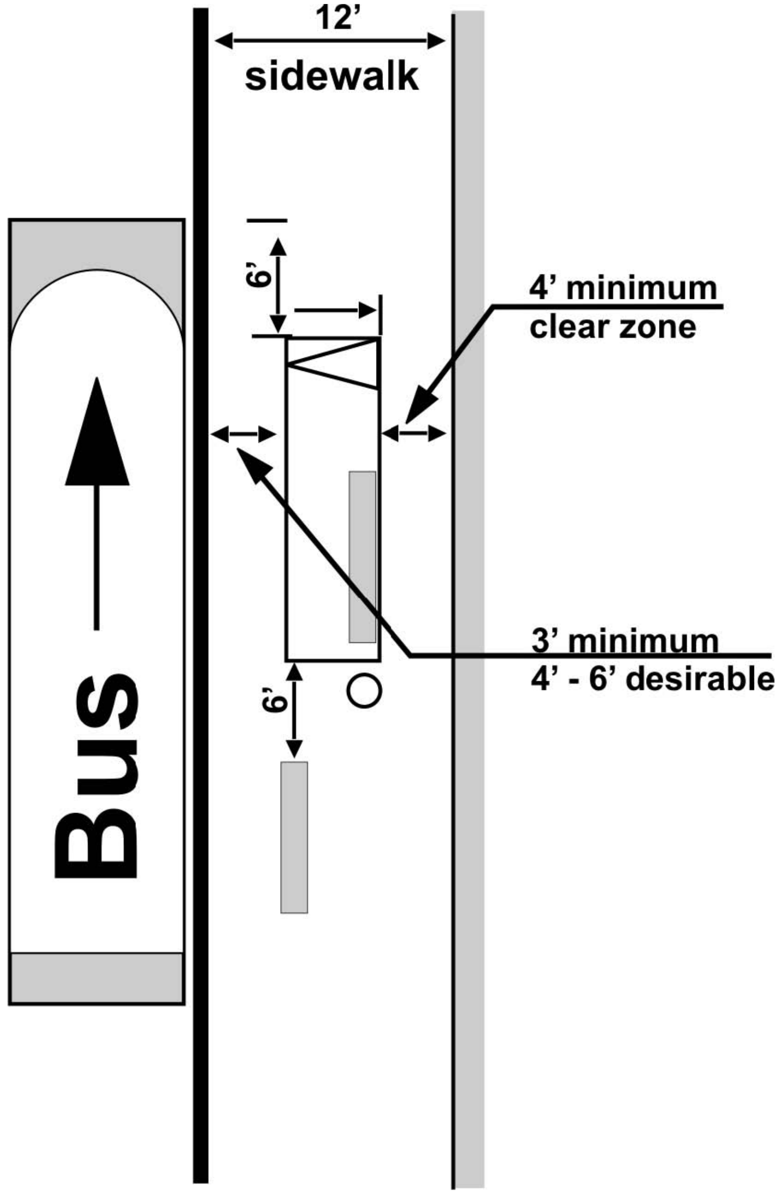
Source: Riverside Transit Agency

Figure 6.3 Near Side Bus Stop Geometry



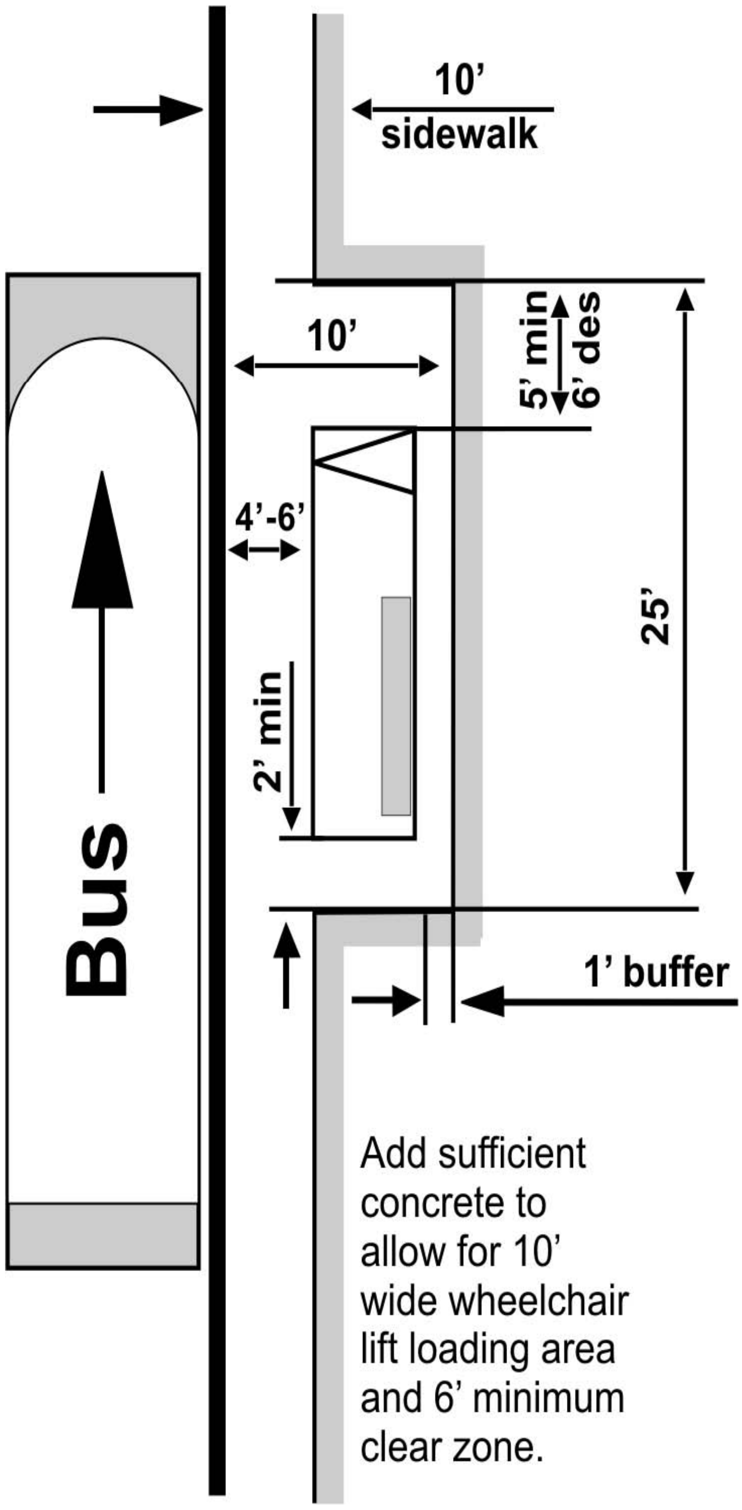
Source: SunLine Transit Agency

Figure 6.4 Design for Standard Bus Stop



Source: SunLine Transit Agency

Figure 6.5 Design for Bus Stops on Sidewalks More than 12' Wide

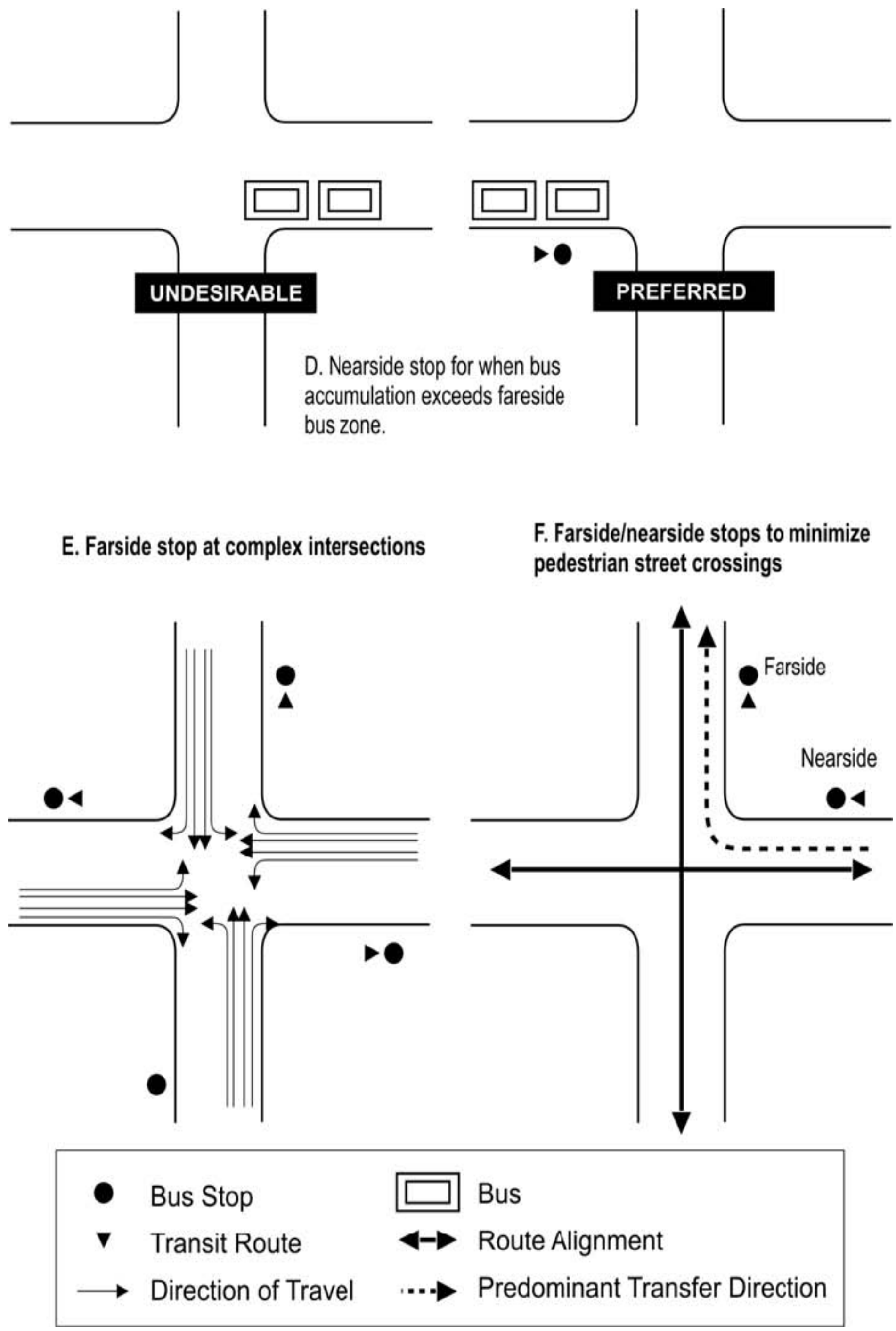


Source: San Diego Metropolitan Transit Development Board

Figure 6.6 Design for Bus Stops on Narrow Sidewalks or Severely Constrained Locations

6.1.4 *Complex Intersections*

The previous discussion in Section 6.1.3 is appropriate for most simple intersections. Intersections with complex turning movements warrant special consideration. A couple of examples follow.



Source: Riverside Transit Agency

Figure 6.7 Examples of Bus Stop Designs

6.1.5 *Crosswalks*

All bus stops should be designed with the eventual path of the passenger in mind. Crosswalks are essential to enable safe crossing of arterial streets. At mid-block stops, an ideal treatment is a clearly lit crosswalk behind the bus with a pedestrian activated traffic control device. Particular attention should be paid to road side distance both for crossing pedestrians and buses re-entering the traffic stream.

6.1.6 *Parking Restrictions at Bus Stops*

Parking restrictions should be placed at bus stops when parking is expected to impact bus service. This can be achieved by painting the curb "yellow" or installing a "No Parking" sign at the bus stop. The lack of parking restrictions can impact bus service, sight distances and passenger access. Potential issues that may arise include:

- Buses may have to double park when they stop to pick or drop off passengers, which interferes with traffic movement.
- Passengers may have to maneuver between parked vehicles when they board or deboard the buses, which may contribute to hazardous environments that endangers them.
- The restrictions prevent the buses from accessing the curb and sidewalk area to pick or drop off passengers.

6.1.7 *Driveways*

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

- Attempt to keep at least one exit and entrance open to vehicles accessing the property while a bus is loading or unloading passengers.
- Locate bus stops to allow good visibility for vehicles leaving the property and to minimize vehicle/bus conflicts. This is best accomplished by placing bus stops where driveways are behind the stopped bus.
- Never place a bus stop that forces passengers to wait for a bus in the middle of a driveway.
- It is preferable to fully rather than partially block a driveway to prevents vehicles from attempting to squeeze by the bus in a situation with reduced sight distance.

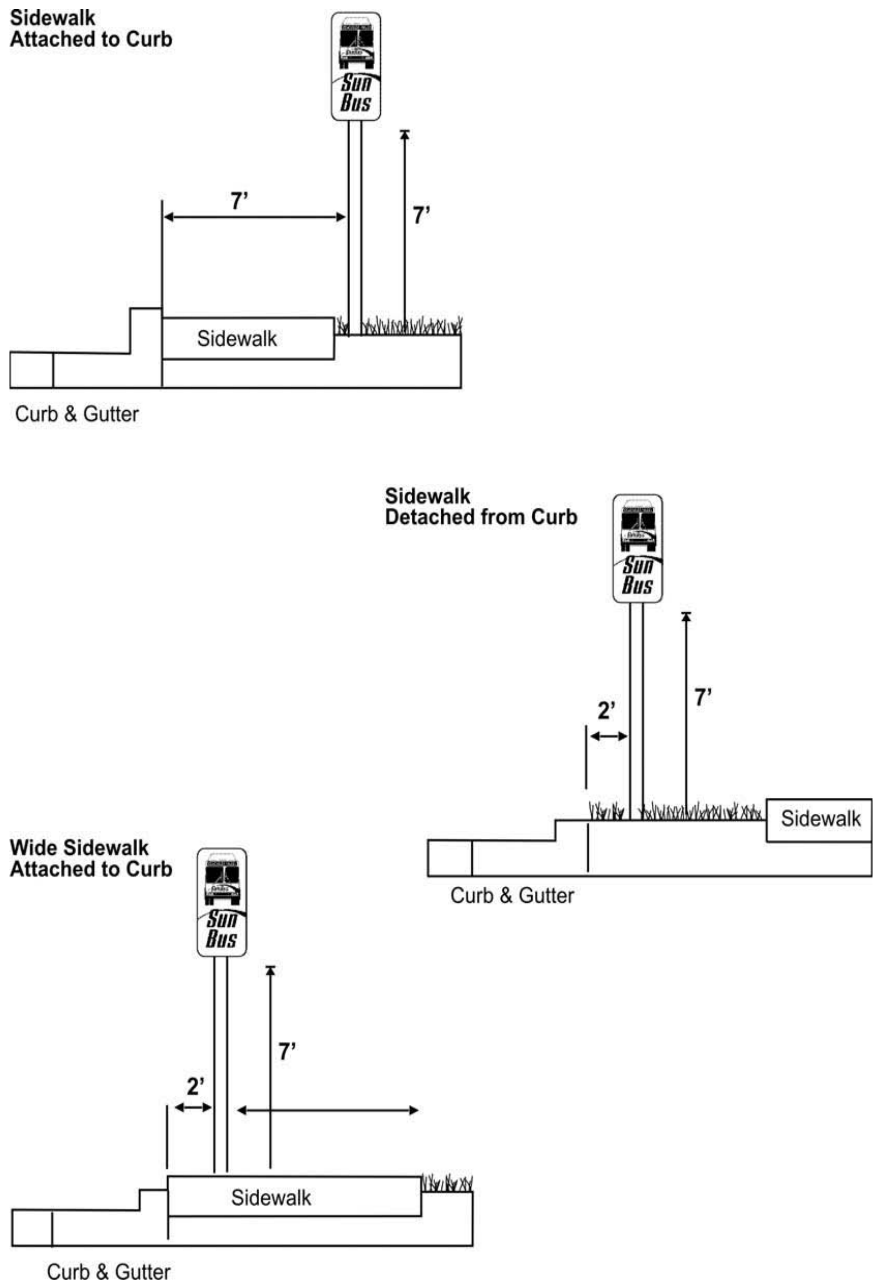
6.1.8 *Areas Without Curb, Gutter, and/or Sidewalk*

Pedestrian pathways should be paved to ensure that they are accessible to everyone. In underdeveloped areas with no curb, gutter, and/or sidewalk:

- A flat, level area should be located to place the stop.
- Adequate drainage should be provided to avoid muddy conditions at the bus stops.
- A concrete waiting area should be provided to which a shelter and other bus stop amenities can be anchored. The paved area should be 35 feet long by 8 feet wide. In these cases, curb ramps and a compacted and stabilized decomposed granite, asphalt, or concrete pathway to the nearest intersection or development should also be considered. On roads without curbs, the local jurisdiction should consider placing a

tactile warning device (such as grooved concrete or truncated domes) between the road's shoulder and the passenger waiting area.

6.1.9 Bus Stop Sign Placement Under Varying Sidewalk Conditions



Source: SunLine Transit Agency

Figure 6.8 Location for Bus Stop Signs Under Varying Sidewalk Width

6.1.10 Passenger Transit Amenities at Stops

A sheltered, paved waiting area outside the flow of pedestrian traffic and secure from automobile traffic is important to the transit patron. The goal is to provide this protection at all bus stops to encourage transit ridership.

However, since many bus stops do not have a shelter and agency resources are limited, a system to set priorities for bus stop improvements at current bus stop locations without a shelter is needed. Table 6.1 is the MUTD priority for placement of bus amenities. It recognizes that the limiting of criteria and ordering of priorities are artificial boundaries, however it is an attempt to bring order to the selection process:

Table 6.1 Bus Stop Amenities Warrants

Bus stops that accumulate 10 points or more may be considered for shelter placement; 6 points or more may warrant a bench and trash receptacle.	
• 7 points	High Boarding Count—Number of patrons getting on the bus at this stop exceeds 25 people per day.
• 4 points	Special Needs—Includes small facilities or people with special requirements for shelter that might not qualify for attention based on boarding counts (senior citizen center, medical offices, libraries, persons with certain disabilities, etc.).
• 4 points	Activity Location—Locations with high density of people and thus high potential for ridership (apartments, high rise office building, shopping center, schools, hospitals, etc.)
• 4 points	Board Count—Number of patrons getting on the bus at this stop exceeds 10 people per day, but not more than 25.
• 3 points	Exposure to Elements—Locations with no landscape or buildings to offer shade/rain/snow protection, no seat walls, no area to stand outside of sidewalk, and 2-3 lanes of traffic of 40 mph or more giving patron no feeling of security at stop.
• 1 point	Request for Improvement—Citizen requests improvements at stop.
Note: The warrants serve to direct an agency's limited resources when not every location can be improved. Ideally, every bus stop should have a shelter, which includes a bench, trash receptacle, and a bus schedule.	

6.2 Bus Shelters and Developer Responsibilities

Bus shelters are covered, semi-enclosed waiting areas with seating. Shelters offer protection from inclement weather conditions, provide for passenger comfort, and establish a transit presence within an area. Bus benches are a convenience amenity provided for passenger comfort.

Ideally, a shelter should be provided at every bus stop location. When a development is constructed near an existing or proposed bus stop location, the developer should be responsible for providing bus stop amenities and accompanying infrastructure to meet Americans with Disability Act (ADA) standards. ADA regulations can be viewed at www.access-board.gov. The shelter should meet MUTD criteria as well, with Figure 6.9 illustrating a shelter that meets MUTD criteria.

Source: Brasco International

Figure 6.9 MUTD Bus Shelter

Developers are encouraged to place shelters that conform to MUTD criteria for passenger recognition and ease of maintenance. Shelters should be sized based on the appropriate number of passengers that will use the amenity (to be determined through discussions with MUTD), and provide for bus schedule information enclosed in a map case.

Upon successful purchase and installation by the developer of shelter that meets MUTD criteria, MUTD will take ownership and ongoing maintenance of the shelter. However, developers may design a custom style shelter to fit into the landscape and complement the architectural style of their project or streetscape.

Custom style shelters must be engineered appropriately for strength and durability, provide for shelter and seating of an appropriate number of passengers from the elements (to be determined through discussions with MUTD), and provide for bus schedule information enclosed in a map case. Additionally, the custom bus shelter will remain the ownership and maintenance responsibility of the developer. Graffiti is to be removed within 24 hours. Importantly, custom shelters and their installation must meet all applicable Americans with Disability Act (ADA) requirements.

Developers are strongly encouraged to consult with MUTD if a custom shelter is to be constructed and installed. Developers should be aware that the installation of a customized bus shelter does not constitute an implied promise to serve or continue to provide transit service to that stop.

6.3 Bus Turnouts

An important but controversial transit facility is the bus turnout. Bus turnouts are bus stop areas recessed from the thoroughfare that provides a route bus with an off-street service point which does not interfere with traffic movement, and enables traffic to move around a bus when passengers are boarding and alighting. They must be sited thoughtfully since there are times when bus drivers have difficulty re-entering the traffic stream upon leaving the bus stop, resulting in increasing bus delay and increasing average travel time. They should be designed so that bus operators have clear rear vision necessary for safe re-entry into traffic.

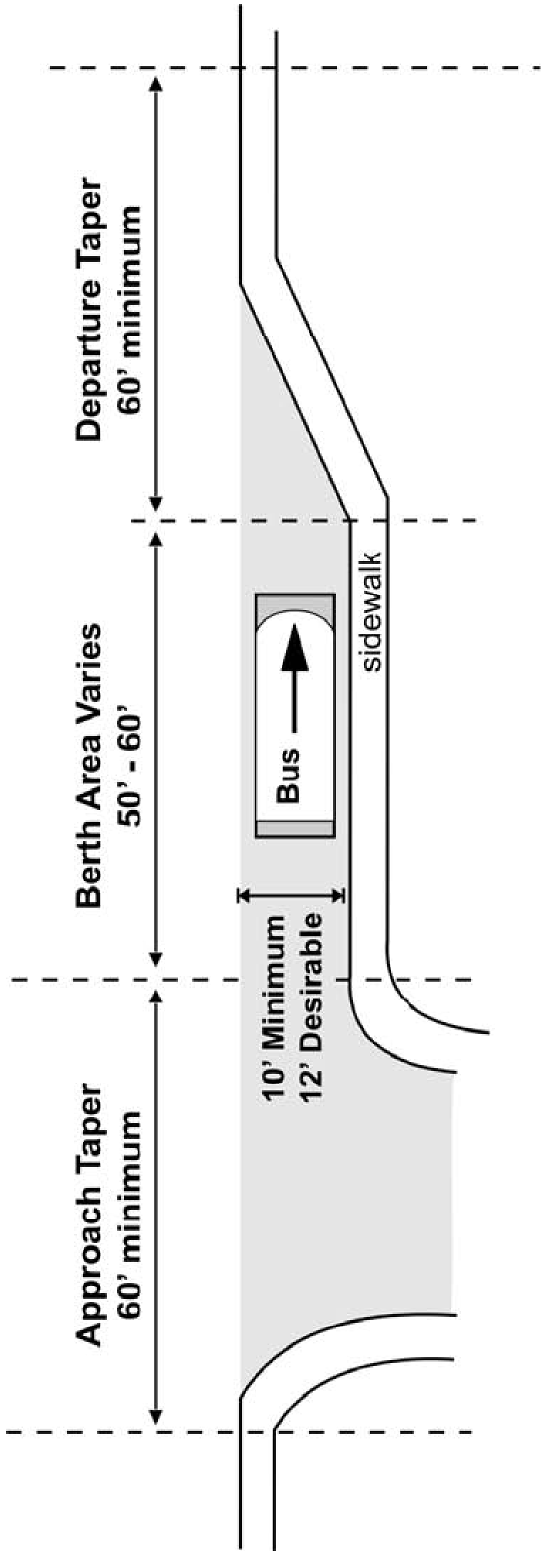
Bus turnouts should be considered at selected locations where passenger volumes and the flow of traffic could be significantly impeded by stopped transit buses. Bus turnouts may also be needed at locations where traffic speed exceeds 40 miles per hour. However, this should be discussed with MUTD to determine ridership at a given bus stop before further improvements are made. Because transit is fluid and may necessitate realigning existing routes, it is important to coordinate construction of bus turnouts with MUTD to ensure that investments made along a bus route are cost effective. Other areas where speeds are less than 40 miles per hour where bus turnouts may be warranted include:

- Average peak-period dwell time exceeds 30 seconds per bus (dwell time is the scheduled time a bus is allowed to discharge and take on passengers at a stop);
- Frequent service—4 buses per hour or more;
- Buses are expected to layover at the end of a trip;
- Potential for auto/bus conflicts warrant separation of transit and passenger vehicles;
- History of repeated traffic and/or pedestrian accidents at stop location;
- Right-of-way width is adequate to construct the bay without adversely affecting sidewalk pedestrian movement;
- Sight distances (i.e. hills, curves, etc.) prevent traffic from stopping safely behind a stopped bus;
- A right-turn lane is used by busses as a queue jumper lane;
- Appropriate bus signal priority treatment exists at an intersection;
- Bus parking in the curb lane is prohibited;
- Improvements, such as widening, are planned for a major roadway (this provides the opportunity to include the bus turnout as part of the reconstruction, resulting in a better designed and less costly bus turnout).

Consideration should be given to the concerns of bus drivers re-entering the traffic stream in the design of turnouts. Using acceleration and deceleration lanes, recommended taper, signal priority, or far side (versus near side or mid-block) placements are potential solutions. Acceleration and deceleration lanes should be considered and provided to accommodate speed changes necessary for the buses to enter and exit traffic. The lanes vary in length depending on the traffic speeds and volumes and include tapers that guide the buses moving back into and away from the roadway.

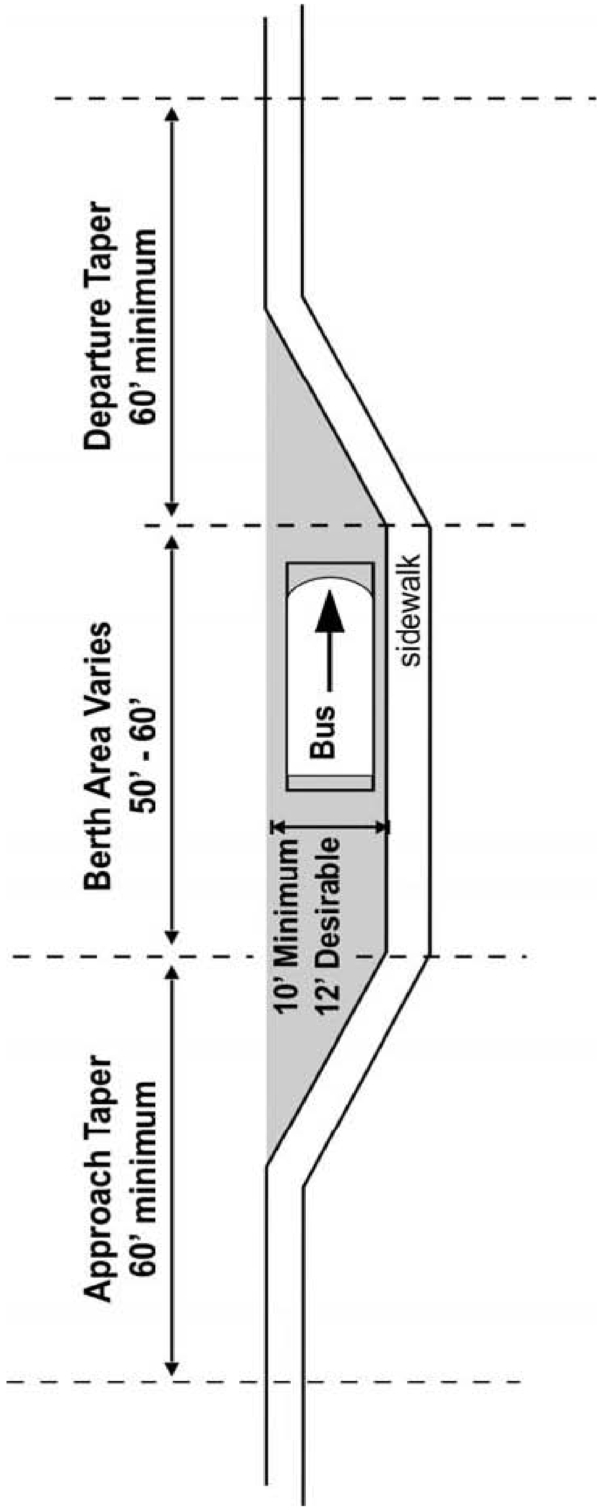
The recommended width for bus turnouts is 12 feet for arterials, which may vary depending on the available right-of-way; and 20 feet for highways. These dimensions provide sufficient space to enable bus operators to properly maneuver and stop the buses. Construction of bus turnouts on highways requires additional buffering from traffic because of increased speeds on the roadways. MUTD recommends using the American Association of State Highway and Transportation Officials (AASHTO) specifications for the construction of bus turnouts along highways. A minimum 8 foot buffer by 10 foot shoulder must be provided to separate continuous traffic flow from transit buses that are accelerating and decelerating. If passenger waiting areas are recommended and provided, they must be consistent with MUTD bus shelters standards.

The diagrams on the next three pages show the ideal dimensions of mid-block, farside and nearside bus turnouts (developers should consult with the Engineering Division of their local jurisdiction to obtain approved drawings for final design and construction purposes). These designs enable buses to decelerate in the turnout. Developers must ensure that the bus turnout is not the entrance to an adjacent commercial use. All figures shown are for a 40 foot bus. As in the case of bus shelters, jurisdictions should consult MUTD on whether there is a need for bus turnouts, particularly in areas not currently served by MUTD.



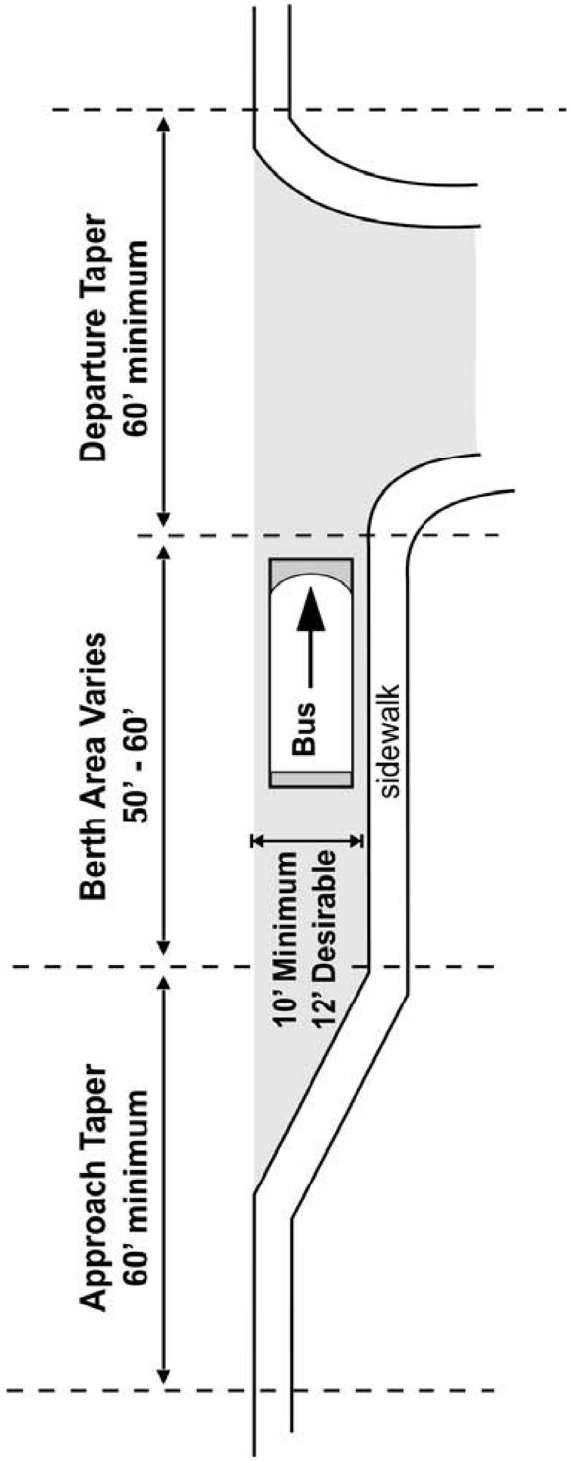
Source: SunLine Transit Agency

Figure 6.10 Far Side Bus Turnout Design



Source: SunLine Transit Agency

Figure 6.11 Mid-Block Bus Turnout Design



Source: SunLine Transit Agency

Figure 6.12 Near Side Bus Turnout Design

Contact for Information on Transit Design Guidelines in Project Development

For additional information, including the request for copies of the Missoula Urban Transportation District (MUTD) Transit Design Guidelines in Project Development, all interested parties may contact MUTD at 406-543-8386. The document may also be downloaded from MUTD's website at www.mountainline.com.

Accessibility - The extent to which facilities are barrier free and useable by persons with disabilities, including wheelchair users.

Activity center - A small geographic area with a high concentration of employment and retail activity. High demand of services, including transportation, is characteristic of activity centers. Orange County is a multi-nucleated county, with activity centers scattered throughout.

Association of American State Highway Transportation Officials (AASHTO) – A national organization that develops and publishes planning and engineering design guidelines for streets and highways.

Alighting – Exiting a bus.

Americans with Disabilities Act (ADA) – An act passed by the United States Senate in 1990 to provide a clear and comprehensive national mandate for the elimination of discrimination against individuals with disabilities. Provides consistent, enforceable standards addressing discrimination against individuals with disabilities.

Attached sidewalk – A sidewalk which is directly attached to the back of curb.

Boarding – Entering a bus.

Bus bench – A bench that can accommodate three or more persons and is placed at a bus stop for use by waiting passengers.

Bus pad – Concrete pad constructed in the street, adjacent to a bus zone, that can accommodate the weight of a bus.

Bus shelter – A covered passenger waiting area, often semi-enclosed with benches, that provide protection from the elements.

Bus stop – A linear curbside area that is specially designated for bus passenger boarding and alighting. It is identified by a bus stop sign and is accompanied by a red curb zone and/or “No Parking” sign. Bus stops can be located nearside, farside or between intersections (mid-block).

Bus turnout – A bus stop located in a recessed curb area, separated from moving lanes of traffic.

Bus zone – A length of curb designated as a bus stop where parking is prohibited.

Curb lane – A travel, parking, or bike lane adjacent to the curb.

Curb ramps – A ramp constructed to allow persons with disabilities and wheelchairs to travel from a sidewalk to the street level.

Curb return radius – The radius of the curve of an intersection from the BCR to ECR.

Far side bus stop – A bus stop located at the farside of an intersection. At a farside bus stop, buses cross the intersection before stopping to serve passengers.

Fixed route – Transit service provided on a repetitive, fixed-schedule basis along a specific route with vehicles stopping to pick up and deliver passengers to specific locations; each fixed route trip serves the same origins and destinations, unlike demand responsive service.

Horizontal or Vertical Clearance – The distance between the grade level and any obstacle such as a sign, tree branch, overcossing, etc.

Large bus – a standard 40-foot long coach.

Layover – Time built into a schedule between arrivals and departures, used for the recovery of delays and preparation for the return trip.

Mid-block bus stop – A bus stop located between two adjacent intersections.

Mixed-use development – A development which has a variety of land uses placed together in one project area (commercial, residential, industrial). Mixed-use developments are different from activity centers because mixed-use developments are concentrated in relatively compact areas whereas activity centers have separate but complementary uses.

Nearside bus stop – A bus stop located at the approach side of an intersection. At a nearside bus stop, buses stop to serve passengers before crossing the intersection.

Park and Ride Lot - Designated parking areas for automobile drivers who then board transit vehicles from these locations.

Parking lane – A curb lane that is used for on-street parking.

Parkway – A strip of landscaped area located between the back of curb and the sidewalk.

Passenger boarding area – see Boarding area.

Protected crossings – a pedestrian crosswalk controlled with a traffic signal.

Queue jump lane – A short section of preferential lane that allows transit vehicles to bypass an automobile queue or a congested section of roadway. Usually located at approaches to intersections.

Sight distance – The distance between a driver's eye and some object allowing the driver to react to a hazard or decision.

Transfer – A passenger's change from one transit vehicle to another transit vehicle.

Transfer Center - A fixed location where passengers interchange from one route or vehicle to another.

Transit center – A bus facility which acts as a hub for transit routes with a region.

Transit amenities – May consist of a transit shelter, bench, trash receptacle or other components provided at a bus stop for the comfort and convenience of waiting passengers.

Travel lane – A lane devoted exclusively to vehicular travel.

Wheelchair boarding area – A paved area, or sidewalk, adjacent to the front and rear loading areas of a bus that allow the extension of a wheelchair lift and safe boarding or alighting of a person in a wheelchair.

Wheelchair lift – A device used to raise and lower a platform to transport a person in a wheelchair from the sidewalk area or paved landing area to the interior of the bus or vice versa.