Appendix E: What TOD Manuals Tell Us

Planning agencies and transit operators have come to realize that transit ridership depends as much on the urban environment in which transit operates as on the level of transit service provided. With this in mind, transit-oriented development (TOD) guidelines have been prepared by many planning agencies and transit operators throughout North America. All told, more than 50 TOD manuals are currently available.

This review covers the following topics from these manuals: land use; roadway design; site planning; pedestrian and bicycle facilities; pedestrian amenities; and transit stops.

TOD Manuals Reviewed

TOD manuals are more numerous than we imagined at the beginning of our review. Some can be characterized as land planning/urban design manuals with a transit orientation; others as transit facility design manuals that pay secondary attention to land planning and urban design. The former emphasize the needs of transit users accessing the system, the latter the needs of the transit operator running the system. A few of the manuals are essentially informative brochures while others are more comprehensive.

As a group, the manuals are largely duplicative of one another, even to the point of reproducing each other's graphics. Thus, we can review a subset of TOD manuals with some confidence that we will not miss too much. Our sample consists of the following manuals, listed in chronological order:

Land Planning/Urban Design Manuals

Alameda-Contra Costa (CA) Transit District, *Guide for Including Public Transit in Land Use Planning*, 1983a. (Oakland)

Municipality of Metropolitan Seattle, *Encouraging Public Transportation through Effective Land Use Actions*, 1987. (Seattle)

Orange County (CA) Transit District, *Consideration of Transit in Project Development*, 1987. (Orange County)

Calthorpe Associates, *Transit-Oriented Development Design Guidelines*, prepared for Sacramento County, 1990. (Sacramento)

Beimborn and Rabinowitz, *Guidelines for Transit-Sensitive Suburban Land Use Design*, Urban Mass Transportation Administration, 1991. (National)

Delcan Corporation, *Guide to Transit Considerations in the Subdivision Design and Approval Process*, prepared for the Transportation Association of Canada (TAC) Ottawa, 1991. (TAC Canada)

City of Winnipeg, *Planning and Building Transit Friendly Residential Subdivisions*, 1991. (Winnipeg)

Ontario Ministry of Transportation, *Transit-Supportive Land Use Planning Guidelines*, 1992. (Ontario)

Regional Transportation Commission of Washoe County (RTC), Nevada, *Planning for Transit - A Guide for Community & Site Planning*, 1992. (Reno)

Calthorpe Associates, *Transit-Oriented Development Design Guidelines*, prepared for the City of San Diego, CA, 1992. (San Diego)

Metropolitan Transit Development Board (MTDB), *Designing for Transit*, San Diego, 1993. (San Diego Metro)

Snohomish County (WA) Transportation Authority, *A Guide to Land Use and Public Transportation for Snohomish County*, 1989; Update, 1993. (Snohomish County)

Tri-County Metropolitan Transportation District of Oregon, *Planning and Design for Transit*, Portland, 1993. (Portland)

BC Transit, *Transit Friendly Subdivision & Development Guidelines*, prepared for the Victoria (British Columbia) Regional Transit System. (Victoria)

Glatting Jackson Kercher Anglin Lopez Rinehart, Inc., *Central Florida Mobility Design Manual*, LYNX, The Central Florida Regional Transit Authority, 1994. (Orlando)

Skidmore, Owings & Merrill, *Planning for Transit-Friendly Land Use: A Handbook for New Jersey Communities*, New Jersey Transit, 1994. (New Jersey)

Regional Transportation District (RTD), *Creating Livable Communities: A Transit Friendly Approach*, Denver, CO., 1995. (Denver)

Lohan Associates, *Guidelines for Transit-Supportive Development*, Chicago Transit Authority, 1996. (Chicago)

Monterey-Salinas Transit, *Designing for Transit: A Manual for Integrating Public Transportation and Land Use in Monterey County*, Monterey, CA, 1996. (Monterey)

Triangle Transit Authority, *Station Area Development Guidelines for the Regional Transit Stations*, Research Triangle Park, NC, 1997. (Raleigh-Durham)

Transit Services of Frederick County, *Transit-Oriented Design Guidelines*, Frederick County, MD, 2001. (Frederick County)

Mid-America Regional Council, *Smart Choices: Transit-Supportive Development Guidebook*, Kansas City, 2001. (Kansas City)

Calthorpe Associates, *Wasatch Front Transit Oriented Development Guidelines*, Envision Utah, Salt Lake City, 2002. (Salt Lake City)

San Francisco Bay Area Rapid Transit District, *BART Transit-Oriented Development Guidelines*, San Francisco, 2003. (San Francisco)

City of Calgary, *Transit Oriented Development: Best Practices Handbook*, 2004. (Calgary)

Neighborhood Planning and Zoning Department, *Transit-Oriented Development (TOD) Guidebook*, City of Austin, TX, 2006. (Austin, 2006)

City of Ottawa, *Transit-Oriented Development Guidelines*, Ottawa, 2007. (Ottawa)

Department of Planning, Building & Code Enforcement, *Transit-Oriented Development, San Jose*, CA, undated. (San Jose, undated)

Transit Facility Design Manuals

Southeastern Michigan Transportation Authority (SEMTA), *Designing for Transit: A Transit Design Criteria and Standards Manual*, 1982. (SE Michigan)

Alameda-Contra Costa (CA) Transit District, *Transit Facilities Standards Manual*, 1983b. (AC Transit Facilities)

D.R. Jessup, G. Van Wormer, and H. Preston, *Guidelines for the Design of Transit Related Roadway Improvements*, Metropolitan Transit Commission, St. Paul, Minnesota, 1983. (Minneapolis-St. Paul)

Center for Transportation Research, The University of Texas at Austin, *Transit Facility Design Guide, Prepared for the Capital Metropolitan Transportation Authority*, Austin, 1988. (Austin, 1988)

Maryland Department of Transportation, *Access by Design: Transit's Role in Land Development*, 1988. (Maryland)

Pace Suburban Bus Service, *Pace Development Guidelines*, Illinois, 1989. (Suburban Chicago)

Texas Transportation Institute (Fitzpatrick et al.), *Guidelines for Planning, Designing and Operating Bus Related Street Improvements*, 1990. (Texas)

Municipality of Metropolitan Seattle, Metro Transportation Facility Design Guidelines, 1991. (Seattle Facilities)

Orange County (CA) Transportation Authority, *Design Guidelines for Bus Facilities*, 1992. (Orange County Facilities)

Canadian Urban Transit Association (CUTA), *Canadian Transit Handbook*, Toronto, 1993. (CUTA Canada)

Herbert-Halback, Inc., *Customer Amenities Manual*, LYNX Members, The Central Florida Regional Transportation Authority, Orlando, FL, 1994. (Orlando Amenities)

Hillsborough Area Regional Transit Authority, *Transit-Friendly Development*, Tampa, FL, 1994.

Niagara Frontier Transportation Authority, *Building for Tomorrow: A Guide to Transit Friendly Designs for New Residential, Commercial and Light Industrial Developments in the Niagara Frontier*, Buffalo, NY, 1997. (Buffalo)

City of Brunswick, *Transit-Oriented Design Guidelines*, Brunswick, MD, 2006. (Brunswick)

Land Uses

"Transit-oriented development (TOD) is the functional integration of land use and transit via the creation of compact, walkable, mixed-use communities within walking distance of a transit stop or station" (Austin 2006, p. 5). The distance that a person is willing to walk to take transit defines the primary area within which TOD should occur Calgary 2004).

The industry standard is 1/4 mile (see Table E-1). However, walking distances are known to depend on user characteristics, the pedestrian environment, climate and topography, and transit quality of service. High-quality rail service is believed to extend walking distances to ½ mile or more. The propensity to use transit drops off long before the "maximum walking distance" is reached and extends beyond "maximum walking distance" for those with no other means of transportation.

Table E-1. Maximum Walking Distances

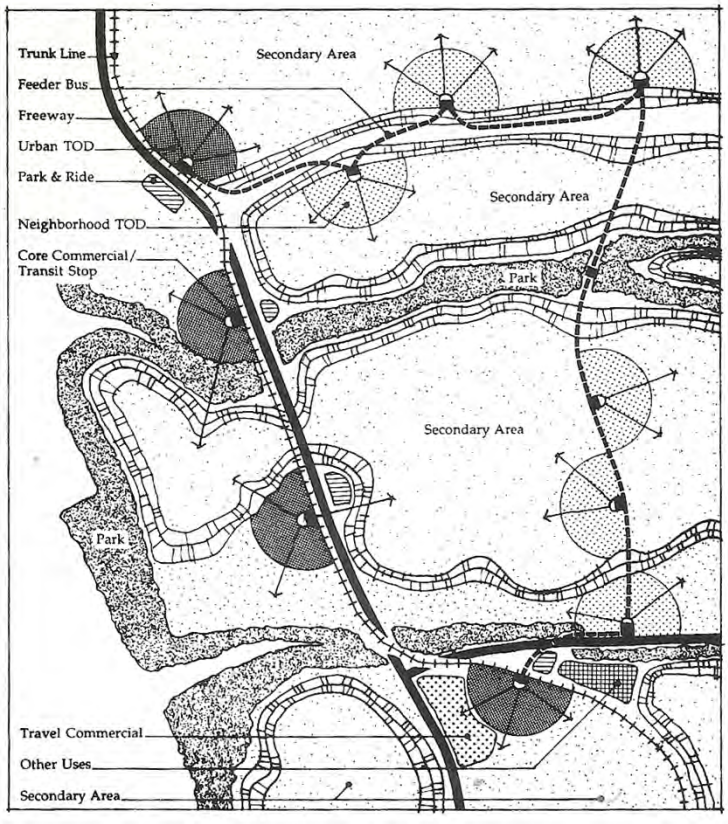
660 ft (1/8 mi)	for seniors, SE Michigan, 1982
750 ft	for seniors, Seattle, 1987; for mobility impaired, Snohomish County, 1989
1,000 ft	Seattle, 1987; Snohomish County, 1989
1,320 ft (1/4 mile)	SE Michigan, 1982; Suburban Chicago, 1989; Texas, 1990; National, 1991; Rabinowitz et al., 1991; Ontario, 1992; TAC Canada, 1991; Winnipeg, 1991; Buffalo, 1997
1,500 ft	Maryland, 1988; CUTA Canada, 1993;
2,000 ft	San Diego, 1992; Austin, 2006; Ottawa, 2007
2,640 ft (1/2 mile)	for rail, Raleigh-Durham, 1997

TOD manuals prescribe compact development within walking distance of transit stops (Seattle 1987; Snohomish County 1989; Sacramento 1990; TAC Canada 1991; San Diego 1992; Oakland 1992; Ontario 1992; CUTA Canada 1993; San Diego Metro 1993; New Jersey 1994; Kansas City 2001; Salt Lake City 2002). Compact development may take the form of high activity nodes (Sacramento 1990; San Diego 1992; Portland 1993),

high activity corridors (National 1991; Oakland 1992; Reno 1992; CUTA Canada 1993; San Diego Metro 1993), or both nodes and corridors (Ontario 1992).

Peter Calthorpe's node-based TODs consist of mixed-use neighborhoods built around commercial cores and transit stops, with average maximum walking distances to the stop of 1/4 mile prescribed for Sacramento and 2,000 feet or less for San Diego (Sacramento 1990; San Diego 1992). Each nodal development is designated an "Urban TOD" or "Neighborhood TOD" and is intended to create a pedestrian-oriented settlement that emphasizes transit while not eliminating or ignoring the role of the automobile (this is a common theme among TOD manuals). Depending on "location, purpose, and market demand" (San Diego 1992, p. 3), exact uses in the commercial core will vary. Surrounding the TOD is a "secondary" area extending up to a mile in distance (within bicycling range), containing medium-density housing, schools, parks, some retail uses, and park and ride lots.

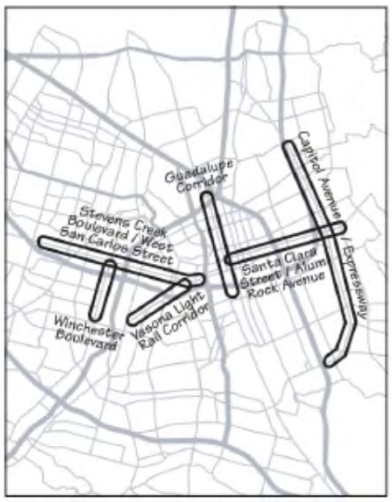
Figure E-1. San Diego TODs.



Source: San Diego (1992 p. 9)

Beimborn and Rabinowitz's transit corridor districts (TCDs) consist of linear developments 1/2 mile wide featuring transit-oriented land uses (National 1991). In TCDs, densities decline with distance from the transit line, and housing, office, retail, and light industrial uses are mixed. Auto-oriented uses are relegated to parallel corridors separated from the transit line by at least 1/4 mile.

Figure E-2. San Jose's Transit-Oriented Development Corridors



Source: San Jose (undated, p. 134)

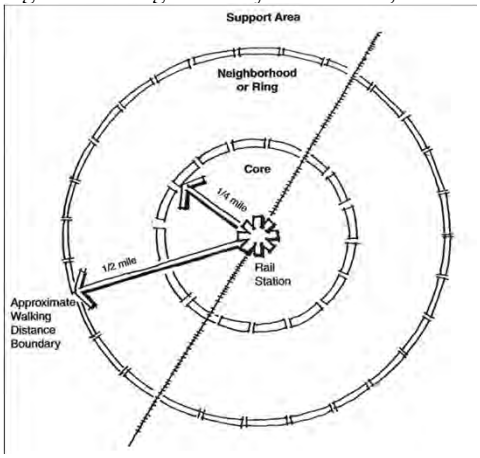
Whether located in nodes or corridors, some land uses are more transit-supportive than others. The National manual (1991) rates land uses for their compatibility with public transit. Uses receiving the highest score (5) include commercial airports, colleges and universities, and shopping centers. Scoring next highest (4) are apartments, schools, hospitals, and office buildings. Snohomish County (1989), Portland (1993), New Jersey (1994), Denver (1995), and Raleigh-Durham (1997) also rate land uses for compatibility with transit, while the Reno manual (1992) offers a compatibility worksheet to be used on a case-by-case basis. Calgary (2004), Austin (2006), and Ottawa (2007) classify some land uses as transit supportive, and others as non-transit supportive.

Figure E-3. Transit Supportive and Non-Transit Supportive Land Uses

Source: Calgary (2004, p. 8)

TOD manuals agree that, at a minimum, medium residential densities are required to support basic bus service. Lower densities may suffice at lower levels of service, and higher densities may be required for higher levels of service (see Table E-2). TOD manuals sometimes prescribe density gradients moving out from stops or stations. New Jersey (1994), Denver (1995), and Raleigh-Durham (1997) call for high densities within a quarter mile of stops and medium densities from a quarter to a half mile.

Figure E-4. High Density in the Core, Medium Density in the Secondary Area



Source: Raleigh-Durham (1997, unnumbered)

Table E-2. Minimum Residential Densities for Transit Service (dwellings/acre)

2	Oakland (45-minute service)*
3	Suburban Chicago*
	Texas
4	Ontario (60-minute service)
	County (60-minute service)
5	Oakland (30-minute service)*
	San Diego Metro (suburban areas)
6	Maryland
7	National (30-minute service)
	Ontario (30-minute service)
	Reno
	Seattle
	San Diego (suburban areas)
	Raleigh-Durham (rail station area in neighborhood)
	Denver
	New Jersey (local bus service)
8	Oakland (20-minute service)*
	Portland (suburban neighborhoods)
	Snohomish County (30-minute service)
	Salt Lake City (suburban areas)
12	Sacramento (Neighborhood TOD)
	San Diego (urban areas)
15	National (10-minute service)
	Portland (mixed-use centers/urban neighborhoods/urban corridors)

	Sacramento (Urban TOD)
	Raleigh-Durham (rail station area in core)
	Denver (net in community centers)
	New Jersey (rail service)
	Austin (Neighborhood Center TODs)
20	San Jose (Transit Corridor Residential)
30	San Diego (urban centers)
	Salt Lake City (urban areas)
20/40	San Francisco (gross density/net density)
40	Denver (net density in urban centers)

*Density standards were converted from persons per square mile to dwelling units per acre, assuming approximately 2 persons per household.

It turns out that once the transit capture rate and cost recovery ratio are established, the density required to support transit service is a simple function of level of service (National 1991). The higher the level of service, the higher the density required to support it. This relationship is captured in Pushkarev and Zupan's density standards, which have been incorporated into several TOD manuals (Seattle, Sacramento, San Diego, Ontario, National) (see Table E-3).

Table E-3. Minimum Residential Densities for Different Service Frequencies

Service Frequency	Residential Density
1 hour service	4 units/acre
1/2 hour service	7 units/acre
10 minute service	15 units/acre

Many TOD manuals also establish commercial intensity standards for transit service (see Table E-4 and Figure E-5).

Table E-4. Minimum Commercial Intensities for Transit Service

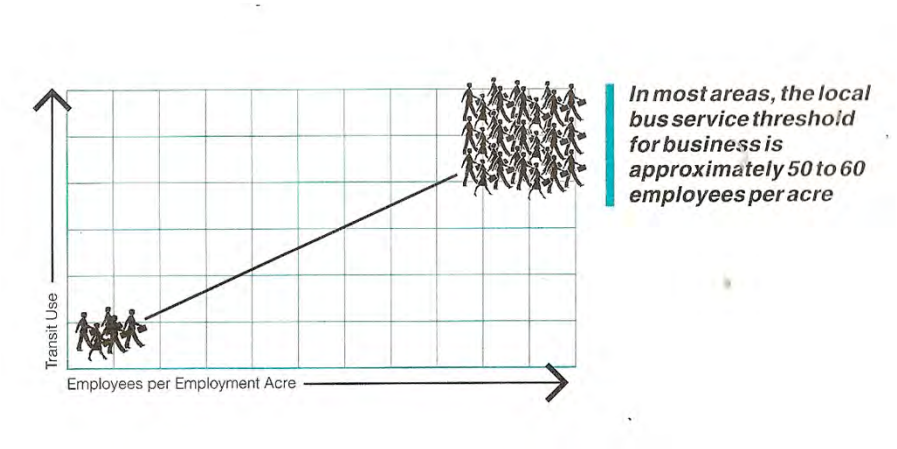
FARs	
.25	Suburban employment centers (Portland, 1993)
.35	Office uses with surface parking (San Diego, 1992); suburban neighborhoods (Portland, 1993); office uses in urban and suburban areas within 1/4 mile of bus stops (San Diego Metro, 1993)
.50	Office uses with structured parking (San Diego, 1992); urban corridors without structured parking, urban neighborhoods, and mixed use centers (Portland, 1993); office uses in urban centers within 1/4 mile of bus stops (San Diego Metro, 1993); rail stations in core areas (Raleigh-Durham, 1997); commercial centers with surface parking (Denver, 1995)
1.0	Near transit stops (National); office uses in urban and suburban areas, and in urban

centers within 1/2 mile of transit (San Diego Metro, 1993); commercial centers with structured parking (Denver, 1995)
1.5 Activity nodes in small municipalities (Ontario)
2.0 Activity nodes in large municipalities (Ontario); urban corridors with structured parking (Portland, 1993)

Employees/Acre

10 San Francisco – per gross acre (2003)
20 Portland (1993)
30 Portland (for light rail) (1993)
40 New Jersey (local bus service) (1994)
50 Seattle (1987); Snohomish County (1989); Denver (1995)
60 Ontario (1992)
150 New Jersey (for rail) (1994)

Figure E-5. Ridership vs. Employment Density



Source: Denver (1993, p. 12)

Most TOD manuals call for a mix of land uses in transit corridors or around transit stops (Seattle 1987; Snohomish County 1989; Suburban Chicago 1989; Sacramento 1990; National 1991; TAC Canada 1991; Orange County 1992; San Diego 1992; Ontario 1992; Reno 1992; Portland 1993; San Diego Metro 1993; CUTA Canada 1993; New Jersey 1994; Denver 1995; Raleigh-Durham 1997; Frederick County 2001; Kansas City 2001; Salt Lake City 2002; Calgary 2004; Austin 2006; Ottawa 2007; San Jose, undated). This is done to encourage pedestrian activity, allow errands on the way to or from transit

stops, establish the security of a 24/7 environment, and provide interesting points of interest on the walk to transit stops.

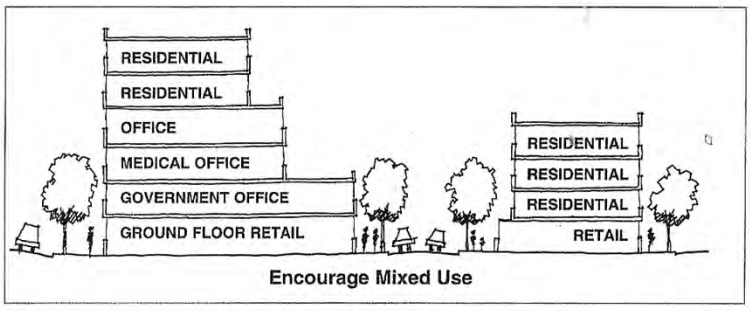
Only Sacramento (1990), San Diego (1992) and Portland (1993) offer detailed guidance regarding the appropriate mix of land uses in TODs. Minimum percentages of site area from the San Diego and Portland manuals are shown in Table E-5.

Table E-5. Minimums Percentages of Different Uses

Centers	Neighborhood TOD	Urban TOD	
Public	10%	10%	30%
Core Commercial	10%	30%	30%
Housing	40%	20%	40%

Snohomish County (1989), Sacramento (1990), San Diego (1992), Ontario (1992), Portland (1993), New Jersey (1994), Salt Lake City (2002), and Ottawa (2007) all encourage vertical mixing of uses—that is, the mixing of uses from floor to floor within individual buildings—as well as horizontal mixing from building to building. The mix may include residential, office and retail use in a single building or, in the case of parking structures, parking above and retail below. Retail uses are generally preferred at ground level, because they generate more pedestrian traffic (San Jose, undated). "Long expanses of street-level office space without multiple entries or visual interaction with the street create 'dead zones' along pedestrian paths and should be discouraged. Encourage, instead, pedestrian-oriented uses that activate the street with customer traffic, especially those uses that are open beyond normal 9 am to 5 pm business hours" (New Jersey 1994, p. 25).

Figure E-6. Vertical Mixing of Uses



Source: New Jersey (1994, p. 22)

Some TOD manuals go so far as to prescribe the percentage of the population living and/or working in transit-served areas. Ontario (1992) requires that at least 65 percent of

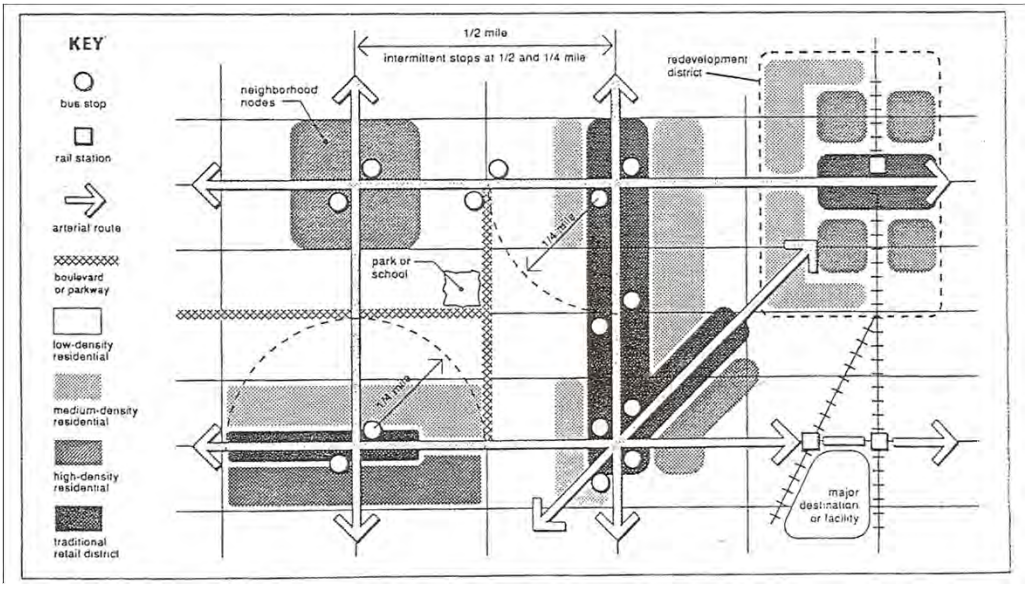
households and jobs be within 1/8 mile of stops, and 90 percent within 1/4 mile. Oakland (1983a) and Texas (1990) have coverage standards that vary with population densities in areas served. At densities of more than 4,000 persons per square mile, Austin (1988) recommends that 90 percent of households have service within 1/4 mile; at densities of 2,000 to 4,000 persons per square mile, the standard drops to 50 percent of households within 1/2 mile of transit lines.

Roadway Design

TOD manuals agree that, for transit operation, interconnected, grid-like road networks are superior to the discontinuous, curvilinear networks found in many suburbs (Seattle 1987; Suburban Chicago 1989; Orange County 1992; Ontario 1992; San Diego 1992; Reno 1992; Portland 1993; Denver 1995; Buffalo 1997; Raleigh-Durham 1997; Frederick County 2001; Kansas City 2001; Salt Lake City 2002; Austin 2006; Ottawa 2007). "Typical suburban streets often follow a curvilinear pattern with little opportunity for through routing. In addition, adjoining subdivisions may well have non-aligned streets or complete boundary separations. In this situation transit vehicles are required to make frequent turns and may need to 'backtrack' in order to provide service within a reasonable distance of homes or places of work" (National 1991, p. 14).

Many manuals contend that grid-like networks are better not only for buses but for transit users accessing the system. Traveling at pedestrian speeds, users need direct routes to transit stops. The suburban road hierarchy, with its curves and cul-de-sacs, makes for very circuitous trips to transit stops.

Figure E-7. Grid Supportive of Compact Development and Transit

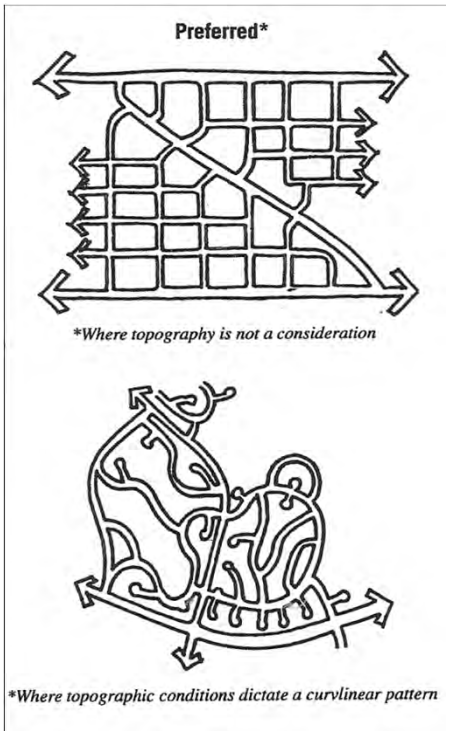


Source: Chicago (1995, p. 6)

The road network need not be a gridiron of parallel streets meeting at right angles. Reno (1992) offers the following on the subject of grid street patterns:

They have been criticized as being monotonous, ignoring topography, and increasing through traffic on residential streets. These shortcomings are not inherent to grid patterns, and they can be overcome through modifications in design. Through traffic can be directed to collectors. Monotony can be averted and topography incorporated by enhancing the grid with curves, landscaping and building patterns. The site need not be limited to geometrically straight lines, and all blocks do not need to be of equal size and shape (Reno 1992, p. 22).

Figure E-8. Street Networks Dependent on Topography



Source: Denver (1995, p. 4-10)

Kansas City (2001), Salt Lake City (2002), and Austin (2006) prescribe short blocks of 300 to 600 feet to keep walking distances short and provide alternative route options. Several TOD manuals emphasize the importance of collectors and arterials spaced no more than ½ mile apart (Oakland 1983a; Seattle 1987; Snohomish County 1989; TAC Canada 1991; Ontario 1992). Collectors that are widely spaced may fail to penetrate

residential areas and activity centers. Portland's solution to this dilemma involves the use of "connectors" to carry moderate levels of local traffic, maintain bicycling and pedestrian safety, and provide alternative paths within neighborhoods (Portland 1993, p. 75).

TOD manuals usually prescribe travel lanes wide enough to accommodate standard buses. Recognizing a standard bus width of 10 feet, including mirrors, 12-foot lanes are generally recommended (see Table E-6).

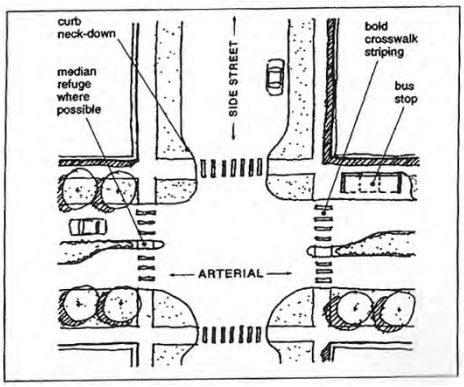
Table E-6. Minimum Lane Widths

9.5’	Salt Lake City
10'	Maryland; Minneapolis-St. Paul
11'	SE Michigan; Reno (when restricted by available width); Oakland, 1983b, Orlando; San Diego Metro
11.5'	Ontario; CUTA Canada
12'	Suburban Chicago; Orlando (for curb lanes); San Diego Metro (for curb lanes)

Oakland (1983a) requires transit to operate on collectors or arterials, which tend to be wider, higher speed roads. Winnipeg (1991) calls for transit to follow streets built to collector standards with respect to construction materials, width, depth, and roadway geometrics. Two TOD manuals specify minimum street widths, 9 meters, or just under 30 feet (Ontario 1992; TAC Canada 1991).

On the other hand, Portland, Raleigh-Durham, Sacramento, San Diego, and San Jose recommend minimizing road widths within TODs to reduce street crossing distances and create safer pedestrian environments. With the advent of traffic calming in the U.S., some of the newer TOD manuals call for measures such as traffic circles and intersection neckdowns to ensure that traffic speeds are not excessive (New Jersey 1994; Orlando 1994; Chicago 1996; Raleigh-Durham 1997; Salt Lake City 2002; San Francisco 2003; San Jose, undated). Traffic calming may be limited to local access routes to transit stops, or may extend up the street hierarchy to the arterials and collectors that serve as bus routes.

Figure E-9. Neckdowns on a Multimodal Street



Source: Raleigh-Durham (1997, unnumbered)

Site Planning

Guidelines for subdivision design and site planning emphasize transit and pedestrian accessibility within subdivisions, and connections to arterial roads and neighboring subdivisions. Barriers to transit, such as insufficient access roads into subdivisions, dead-end streets, and circuitous routes should be avoided (San Diego 1992), as should barriers to pedestrian access, including perimeter walls, berms, landscaping, and slopes between residences and bus stops (Snohomish County 1989).

The orientation of buildings is discussed in some detail by most manuals reviewed. The following is a summary of major recommendations and requirements:

- Commercial strip development with large parking lots that front on arterial roads should be avoided (CUTA Canada 1993; Buffalo 1997).

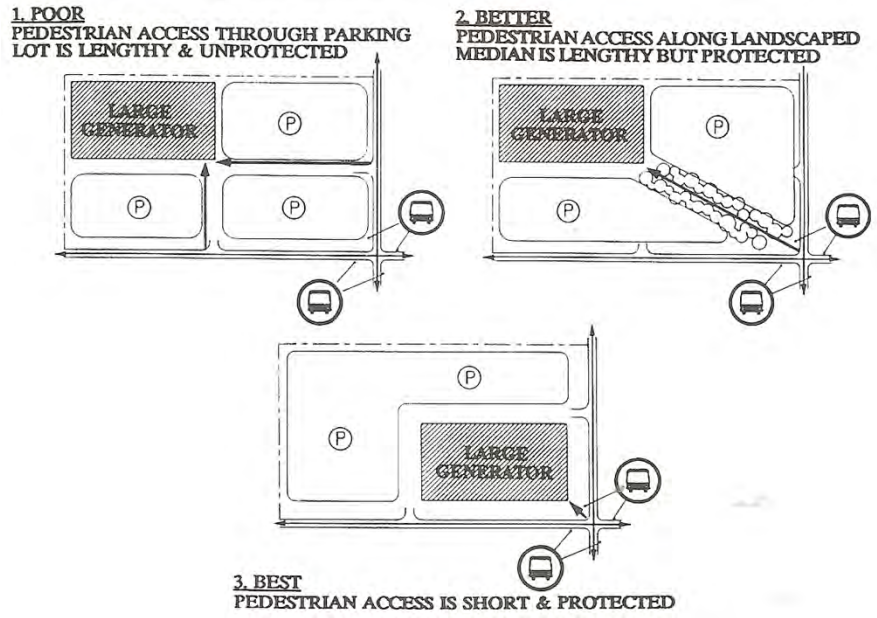
- Buildings should be oriented toward streets with transit facilities (Oakland 1983a; Ontario 1992; Snohomish County 1989; National 1991; Chicago 1996; Raleigh-Durham 1997; Frederick County 2001; Calgary 2004; Austin 2006; Ottawa 2007).

- To minimize walking distances, parking lots should be placed at the rear or side of buildings (see Figure E-10) (Seattle 1987; Snohomish County 1989; Sacramento 1990; TAC Canada 1991; San Diego 1992; Portland 1993; New Jersey 1994; Chicago 1996; Frederick County, 2001; Salt Lake City, 2002; Calgary, 2004; Austin, 2006; Ottawa 2007; San Jose, undated). If parking must be located between the building and the street, a walkway connecting the entrance of the building to the sidewalk should be provided.

- Building setbacks should be reduced or eliminated altogether (Snohomish County 1989; Suburban Chicago 1989; Ontario 1992; San Diego Metro 1993; Orlando 1994; Salt Lake City 2002; San Francisco 2003; Austin 2006; San Jose, undated). A number of manuals specify setback requirements (see Table E-7).

- Parking garages should be recessed behind the main facades of homes to reduce their visual prominence, and when parking garages front on commercial streets, they should be lined with retail uses (Salt Lake City 2002).

Figure E-10. More and Less Preferred Site Designs

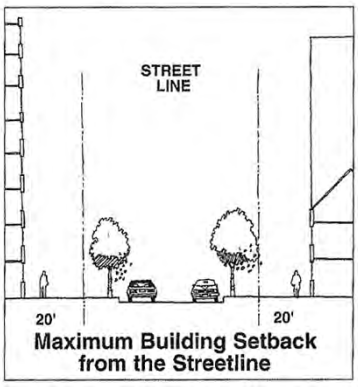


Source: Canada (1991, p. A-6)

Table E-7. Building Setbacks

Residential
10-15 ft San Diego, 1992; Portland, 1993
Commercial
0-10 ft Raleigh-Durham, 1997
0-20 ft Sacramento, 1990, San Diego, 1992; Portland, 1993; New Jersey, 1994
0-25 ft San Jose, undated
Large Buildings
10-20 ft Ottawa, 2007

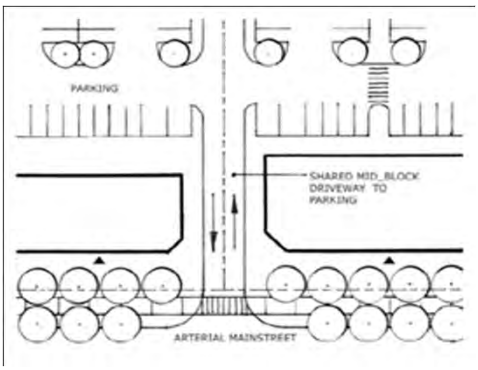
Figure E-11. Maximum Building Setback of 20 Feet



Source: New Jersey (1994, p. 29)

Suburban Chicago (1989), Ontario (1992), Calgary (2004), and Ottawa (2007) recommend that commercial curb cuts be kept to a minimum in order to facilitate pedestrian movement and access to transit, and to ease the flow of traffic on abutting roads. San Diego Metro (1993) likewise discourages "frequent driveways" to reduce the number of conflict points with pedestrians.

Figure E-12. Fewer Curb Cuts for Less Interruption to the Public Sidewalk



Source: Ottawa (2007, p. 15)

Many manuals call for off-street parking requirements in areas fully served by transit to be reduced, either unconditionally or tied to the provision of transit-related features (Seattle 1987; Snohomish County 1989; Sacramento 1991; National 1991; Suburban Chicago 1991; San Diego 1992; Ontario 1992; Portland 1993; New Jersey 1994; Salt Lake City 2002). San Diego (1992) suggests that parking lots occupy no more than 1/3 or 75 feet of the frontage of pedestrian-oriented streets. Raleigh-Durham (1997) recommends limiting surface lots to three acres, unless future development plans call for

transition of lots to buildings or parking garages. New Jersey (1994) recommends that parking structures be limited to 1/3 of street frontage. Salt Lake City (2002) sets a limit of 35-45% on the proportion of building facades occupied by garages so that streetscapes do not become garagescapes.

Strategies commonly recommended for reducing parking footprints include:

- low minimum and maximum parking requirements (New Jersey 1994; Frederick County 2001; Salt Lake City 2002; Calgary 2004; Austin 2006; San Jose, undated);
- shared parking (National 1991; Ontario 1992; San Diego 1992; Portland 1993; Denver 1995; Frederick County 2001; Kansas City 2001; Salt Lake City 2002; Ottawa 2007; San Jose, undated);
- institution of paid parking (Seattle 1987; Snohomish County 1989); San Diego Metro 1993; Salt Lake City 2002);
- preferential parking and reduced parking fees for HOVs (high occupancy vehicles) (Ottawa 2007);
- allowance for on-street parking (San Diego, 1992; Portland, 1993; Orlando, 1994; Raleigh-Durham, 1997; Frederick County, 2001; Kansas City, 2001; Salt Lake City, 2002; San Jose, undated); and
- structured parking (San Diego 1992; New Jersey 1994; Denver 1995; Kansas City 2001; Salt Lake City 2002).

Pedestrian and Bicycle Facilities

Pedestrian paths should radiate out from transit stops, and be as direct and visually unobstructed as possible (Orange County 1991; New Jersey 1994; Buffalo 1997; Salt Lake City 2002; San Francisco 2003; Calgary 2004; San Jose, undated). Wherever possible, street crossings should be at grade rather than depressed in tunnels or elevated in bridges (New Jersey 1994; Raleigh-Durham 1997; San Francisco 2003; Calgary 2004; Ottawa 2007).

All path surfaces should be paved, made of durable construction materials, maintained year-round, and well-lit for nighttime safety (Maryland 1988; TAC Canada 1991; Winnipeg 1991; Ontario 1992). Paths must also be wheelchair accessible, with curb cuts at all intersections and a detectable warning surface (raised truncated domes) along the curb edge (Balog et al. 1992). Use of different pavement textures or colors can show "priority of the pedestrian in critical locations" or provide "visual identification of pedestrian routes" (Denver 1995; Ottawa 2007). Pedestrian-scale lighting is recommended (New Jersey 1994; Salt Lake City 2002).

TOD guidelines and literature recommend that sidewalks be provided on at least one side of transit routes (Seattle 1987; National 1991; Rabinowitz et al. 1991), both sides of all urban streets (Orlando 1994, p. 2-6); or, when feasible, both sides of transit routes and at least one side of residential and industrial streets leading to transit (Suburban Chicago 1989; TAC Canada 1991; Winnipeg 1991; Ontario 1992). In addition to sidewalks that run parallel to transit routes, it is recommended that walkways radiate from each transit stop to serve nearby buildings (National 1991), and connect building entrances and stops as directly as possible to avoid shortcuts across lawns (Maryland 1988).

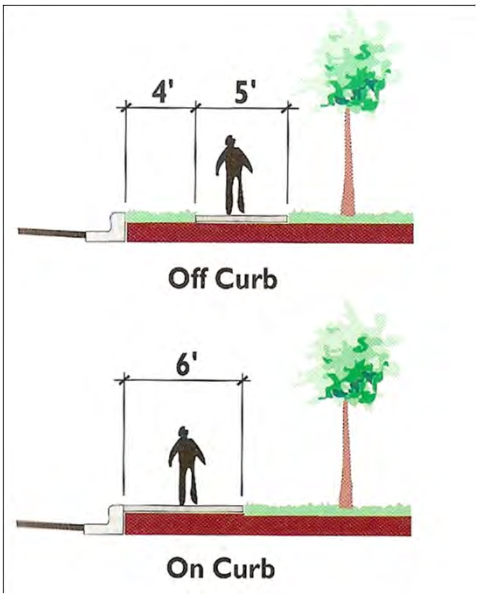
All sidewalks and walkways should be separated from roads by differences in grade, planting strips, amenity zones, or parking lanes (Snohomish County 1989; Raleigh-Durham 1997; Salt Lake City 2002). Several manuals call for delineated paths through parking lots to ensure pedestrian safety and ease transit access.

Some manuals recommend widths for sidewalks or walkways (see Table E-8 and Figure E-13). More specific recommendations, depending on density and land use, are provided by Bowman et al. (1989).

Table E-8. Minimum Widths for Sidewalks and Walkways

4 ft	at 4 units/acre or less (Bowman et al., 1989); in low-density residential areas (New Jersey, 1994)
5 ft	at more than 4 units/acre, arterial and collector streets, commercial/industrial areas (Bowman et al., 1989); in Urban and Neighborhood TODs (San Diego, 1992); in residential areas (Raleigh-Durham, 1997); in medium-density residential areas (Denver, 1995); at higher densities (New Jersey, 1994); in less traveled areas (Kansas City, 2001)
6 ft	on commercial streets (Chicago, 1996)
8 ft	on accessways to bus stops (Snohomish County, 1989; Orange County, 1992)
10-15 ft	in high activity areas (Denver, 1995); in heavily traveled areas (Kansas City, 2001)
15 ft	on access routes, including the planting strip or amenity zone (San Jose, undated)

Figure E-13. Minimum Sidewalk Width With and Without a Planting Strip



Source: Orlando (1994, p. 2-6)

Some TOD manuals specifically call for bicycle networks to be linked to transit stops (Suburban Chicago 1989; National 1991; Orlando 1994; Denver 1995; Raleigh-Durham 1997; Salt Lake City 2002). The Orlando guidelines designate four categories of bicycle facilities—bike lane, bike path, bike route, and bikeway—with corresponding design standards (Orlando 1994, p. 3-2). Additional consideration is given to bicycle storage facilities, bicycle parking standards, and signage clearly indicating bicycle facilities (Orlando 1994, pp. 3-3 - 3-4). Manuals call for bicycle paths to be from 5 to 6 feet wide for one-way systems and 8 feet wide for two-way systems (Suburban Chicago 1989; Buffalo 1997).

Pedestrian Amenities

"Amenities are necessary to make places 'pedestrian-friendly' and encourage us to get out of our cars" (Portland 1993, p. 21). A hierarchy of public spaces (e.g., parks, plazas, courtyards, and paseos) should be provided along access routes to transit stops (San Jose, undated). These stopping and resting places can incorporate landscaping, benches, increased lighting, special paving materials, water fountains, and other landmark features (New Jersey 1994; Salt Lake City 2002; Calgary 2004).

Ottawa (2007) recommends that seating be provided along walkways and sidewalks greater than 50 meters (165 feet) in length and at scenic locations. It also recommends that shade trees and shrubs be planted along access routes to help reduce urban heat and to create a more comfortable microclimate.

Buildings themselves can be amenitized by incorporating the urban design qualities of complexity, transparency, and human scale (New Jersey 1994; Ottawa 2007). In commercial areas, shops, restaurants, and service establishments should open directly on the street because their window displays, signs, and frequent entrances add visual points of interest and give pedestrians a sense of security (Ontario 1992; San Francisco 2003). "The visual variety created by building elements such as storefront entrances, canopies, and signage, helps to shorten the sense of walking distances and reduce the monotony of pedestrian trips…. A minimum of 50% of the ground floor level of buildings along major pedestrian streets should be composed of clear transparent glass. Building entries should occur at least once for each 50 feet or less of frontage" (New Jersey 1994, pp. 26-27).

Similarly, "architectural variety on the lower three to four stories can define an interesting public realm. Articulated building facades incorporate attractive windows and varied architectural elements, and are built to the sidewalk. Upper floors of tall buildings can be set back to allow sunlight to reach the street and help reduce the sense of scale of the building" (Calgary 2004, p. 11). "Pedestrian-scale street and building variation heightens the interest of walking environments and can decrease the perception of the length of walking trips. A walking trip past uninteresting buildings with large footprints, vast parking lots, or monotonous home fronts can seem longer than it actually is." (Salt Lake City 2002, p. 90).

San Jose (undated) recommends that building elevations and facades change approximately every 30 feet, and that floors above a height of 50 feet step back to maximize solar access (San Jose, undated). Examples of façade variations include porches, balconies, bay windows, and changes in materials (Salt Lake City 2002). Austin (2006) and Ottawa (2007) suggest that buildings at transit stops have awnings, overhangs, and colonnades for interest and weather protection (Austin 2006; Ottawa 2007). Long blank walls should be avoided (Raleigh-Durham 1997; San Francisco 2003; Austin 2006).

Transit Stops

Most TOD manuals offer guidelines for bus stops and shelters, and, to a lesser extent, transit centers and park and rides. The Orlando manuals designate three bus stop types: local transit stops, primary local transit stops and super stops, with corresponding design guidelines (Orlando 1994; Orlando Amenities 1994).

Guidelines for bus stop spacing relate to the 1/4 mile (1,320 feet) comfortable walking distance. Stops placed about 1/2 mile apart will result in maximum walking distances of about 1/4 mile for areas closest to the transit route. In denser areas, or in areas with a higher proportion of elderly residents or riders, more frequent spacing may be used, usually about every 1/8 mile (660 feet or one to two blocks). Selected spacing guidelines are presented in Table E-9.

Table E-9. Bus Stop Spacing

450 ft	in high-density areas (Frederick County, 2001); downtown core (Brunswick,

2006)	
600 ft	for local service (Denver, 1995)
750 ft	in urban areas (Brunswick, 2006)
1,000 ft	in suburban areas (Frederick County, 2001; Brunswick, 2006)
1 mile	for limited service (Denver, 1995)

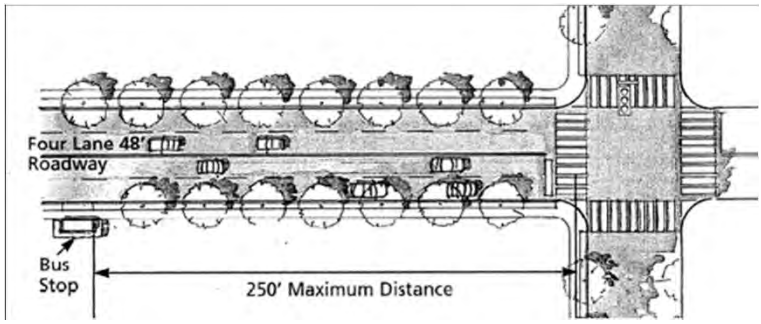
As the "primary interface between the patron and the transit system," transit stops and shelters should be located in areas that are inviting to waiting users (Bodmer and Reiner 1977, p. 48). A bus stop placed in front of a sidewalk cafe is more enticing than one placed in front of a parking lot (Woodhull 1991). Other placement guidelines include:

Unless dictated by the existence of a travel generator, stops should be placed at intersections, preferably signalized intersections, to increase access to service and reduce pedestrians crossing a street at mid-block.

At major transfer points, stops should be located so that transferring passengers do not need to cross a street to transfer. When there are multiple transfer movements at an intersection, the stop location should reflect the volume movements.

On roadways greater than 48 feet wide with a posted vehicle speed limit of 35 mph or higher and traffic volumes greater than 400 vehicles per lane in peak hours or 5,000 vehicles per lane per day, bus stops should be located as close to the intersection as possible with a maximum of 250 feet to the signalized pedestrian crossing (Brunswick 2006, p. 18).

Figure E-14. On-Street Bus Stop Placement



Source: Brunswick (2006, p. 18)

To increase safety, natural surveillance should be provided at transit stops (Rabinowitz et al. 1991). Waiting riders should be visible from abutting properties and streets (Orlando

Amenities 1994). Lighting should be provided, and landscaping and walls should not create hiding places or obstruct the view of drivers (Minneapolis/St. Paul 1983; Oakland 1983b; Chicago 1996; Buffalo 1997; San Francisco 2003; Ottawa 2007).

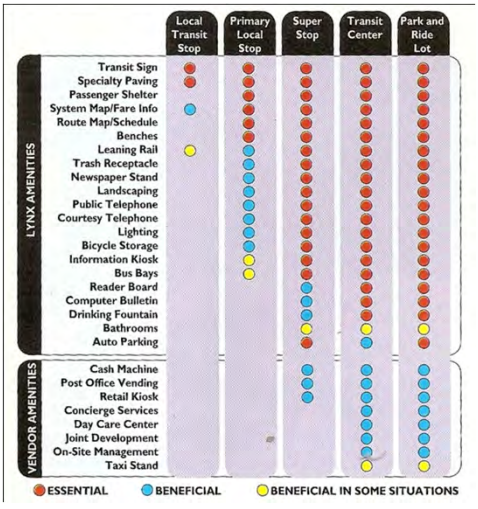
Benches and shelters may be warranted at transit stops, depending on passenger volumes. Benches should be safe, comfortable, placed so as to minimize obstruction of the public right-of-way, and have high resistance to vandalism and weathering (Orange County 1992). Shelters should be oriented so that pedestrian and vehicular sight distance is not impaired and so that passengers within the shelter are able to see and be seen by approaching buses (Frederick County 2001). Guidelines for bench and shelter setbacks are presented in Table E-10.

Table E-10. Minimum Distance from Benches/Shelters to Curb

2 ft	Oakland, 1983b
4 ft	Orange County, 1992; Reno, 1992 (30 mph zones)
5 ft	Suburban Chicago, 1989; Orlando, 1994 (residential areas); Frederick County, 2001
8-10 ft	Reno, 1992 (45 mph zones)

Beyond shelters and benches, common amenities called for at stops include trash receptacles, newspaper boxes, and bicycle parking. Less common but worth consideration at major stops are landscaping, artwork, and decorative paving (Chicago 1996). Orlando (1995) relates the number and type of amenities to the importance of transit stops (see Figure E-15).

Figure E-15. Essential and Beneficial Amenities for Transit Stops



Source: Orlando (1994, p. 6-4)