

APPENDIX B.

CORRIDOR MATRIX ANNOTATION DOCUMENT

The following Appendix contains the Corridor Matrix Annotation Document. This is an accompanying document to the Corridor Matrix and explains the sources, justification, and additional considerations for each of the recommended standards in the Corridor Matrix.

CORRIDOR MATRIX ANNOTATION DOCUMENT

This Corridor Matrix Annotation Document is an accompanying document to the Corridor Matrix and gives additional information on the sources, rationale, and additional considerations for each of the recommended standards in the Corridor Matrix. This document starts with a narrative explaining the overall approach to Multimodal Corridor design that is recommended in these Guidelines. Although some of this repeats information in Chapter 5 of the Guidelines, it is included in this document for ease of reference.

Places are defined in large part by the character and scale of the streets that traverse them. The Multimodal Corridor types are organized according to a composite of features that include their scale, capacity, function and context zone, characteristics. All of these are detailed in the Corridor Matrix. These features are customized to the Virginia context and correlated with the VDOT functional classification hierarchy, Access Management Standards, and Road Design Manual.

The Multimodal Corridor types used in these Guidelines are based on *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach* published by the Institute of Transportation Engineers (ITE) and the Congress for the New Urbanism (CNU). This ITE/CNU Guidebook defines thoroughfare types that correspond to the Transect Zones from CNU's *SmartCode* and to traditional functional classifications for roadways. This Corridor Matrix Annotation Document references specific pages and tables within the ITE/CNU Guidebook; readers will need a copy of the ITE/CNU Guidebook to refer to as a reference.

This Corridor Matrix Annotation Document serves as the detailed reference for the Corridor Matrix, which provides standards for each Multimodal Corridor type within each Transect Zone.

Corridor Matrix References and Resources

Road Design Manual

Virginia Department of Transportation

The VDOT Road Design Manual is the informational and procedural guide for engineers, designers, and technicians involved in the development of plans for Virginia's highways. It provides the standards for road design, and is used in conjunction with publications from the American Association of State Highway and Transportation Officials (AASHTO).

All standards provided in the Corridor Matrix meet the minimum standards as specified in the VDOT Road Design Manual, ensuring that the multimodal recommendations from these Guidelines are consistent with the VDOT Road Design Manual for constructability.

This Annotation Document explains how each corridor standard meets or exceeds the specifications within the VDOT Road Design Manual.

Designing Walkable Urban Thoroughfares: A Context Sensitive Approach

Institute of Transportation Engineers and Congress for the New Urbanism

This ITE/CNU report provides guidance for the design of walkable urban thoroughfares in places that currently support the mode of walking or in places where the community desires to provide a more walkable thoroughfare in the future. It focuses primarily on arterials and collectors. This document is a key industry best practice for Context Sensitive Solutions (CSS) and walkable thoroughfare design. It includes many details related to corridor design and process. Application is generally limited to low speed urban arterials and collectors - streets that require tradeoffs between pedestrian and vehicle priority. Separate sections highlight various elements of the planning and design process.

The ITE/CNU Guidebook was used as a key resource in the development of the corridor standards in the Corridor Matrix. All of the recommended metrics in the ITE/CNU Guidebook meet VDOT standards; some exceed the VDOT Standards. Generally, where the ITE/CNU parameters exceed VDOT standards, the ITE/CNU parameters are used. For example, VDOT requires a minimum sidewalk width of five feet, whereas the ITE/CNU Guidebook recommends a minimum sidewalk width of six feet in commercial areas. The ITE/CNU parameters were incorporated as appropriate, as further explained in this Annotation Document.

General Corridor Types and Correlation

The Corridor Matrix specifies six different Multimodal Corridor types: Transit Boulevard, Boulevard, Major Avenue, Avenue, Local Street, and Multimodal Through Corridor. The six Multimodal Corridor types are further subdivided by Transect Zone. The 34 detailed Multimodal Corridor types are variations of the six basic Multimodal Corridor types described below. The first five basic Multimodal Corridor types are based primarily on the ITE/CNU typology, are located usually within Multimodal Centers, and are referred to as Placemaking Corridors. For this reason, the Multimodal Through Corridor is included as a sixth Multimodal Corridor type, and generally describes the corridors and segments of corridors outside Multimodal Centers.

This fundamental distinction – between Multimodal Through Corridors and Placemaking Corridors is a key concept in these Guidelines. All Multimodal Corridors within a Multimodal Center, and often many of the corridors in a Multimodal District are considered to be Placemaking Corridors; these corridors facilitate movement to destinations within a Multimodal Center or District. The higher speed Multimodal Corridors that travel between and connect Multimodal Centers within a Multimodal District, or connect between Districts, are considered to be Multimodal Through Corridors. Multimodal Through Corridors and Placemaking Corridors work together in a region by getting people quickly from one Multimodal District or Multimodal Center to another and ultimately to activities within a Multimodal District or Multimodal Center. Multimodal Through Corridors will typically transition to Placemaking Corridors as they enter a Multimodal Center. Ideally, though, they are located at the edge of Multimodal Centers, remaining as higher-speed facilities to which Placemaking Corridors provide access from the core of the Multimodal Center. This relationship is shown in **Figure B-1**.

MULTIMODAL CENTERS & CORRIDORS

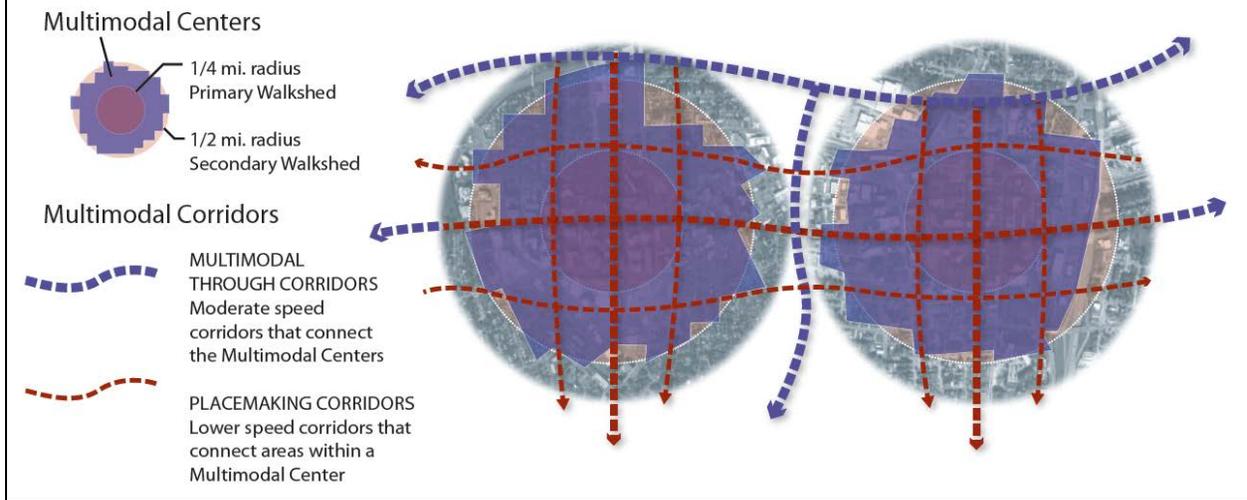


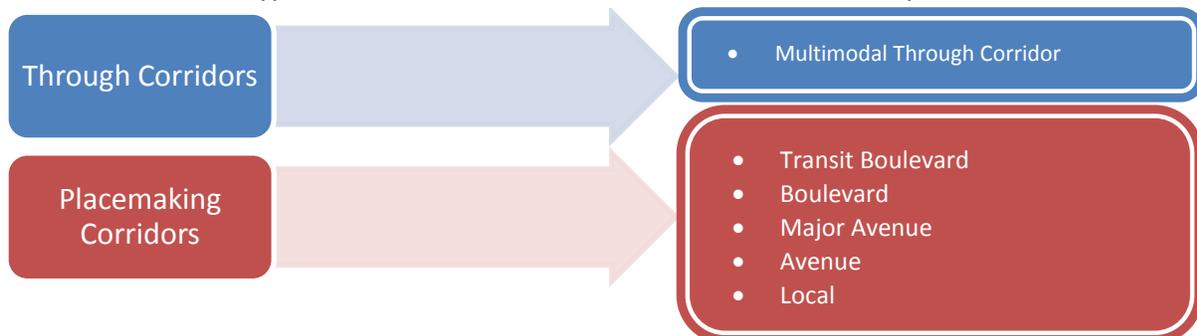
Figure B-1 – Multimodal Through and Placemaking Corridors. This diagram distinguishes Placemaking Corridors from Multimodal Through Corridors – the two general categories of multimodal corridors that together comprise a true multimodal transportation system in a region.

Placemaking Corridors are usually located within Multimodal Centers, but can extend outward beyond the Multimodal Center boundaries into a Multimodal District. Any street that communities desire to make into a lively, pedestrian-oriented street may be designated as a Placemaking Corridor, regardless of location. Because of the concentration and diversity of land uses within Multimodal Centers, the streets within Multimodal Centers should be designated as Placemaking Corridors.

Multimodal Through Corridors are located exclusively outside of Multimodal Centers, but may traverse Multimodal Districts. If possible, Multimodal Centers should be located such that Multimodal Through Corridors skirt the edges of a Multimodal Center. Alternatively, Multimodal Through Corridors must transition to Placemaking Corridors if they go through a Multimodal Center. Once they have passed through the Multimodal Center, they may transition back to Multimodal Through Corridors.

Multimodal Corridor Types

Each Multimodal Corridor type has a unique function relative to access, mobility, and multimodal features; this is similar, but more detailed than the VDOT roadway functional classes. The six Multimodal Corridor types used in these Guidelines are listed and individually described below.



Through Corridors

Multimodal Through Corridor

The Multimodal Through Corridor is a higher speed corridor that connects multiple activity centers. It is intended for longer distance, higher speed automobile, bus, or rail travel and ideally has limited at-grade intersections with other roadway types. Multimodal Through Corridors are good candidates for high speed commuter transit having few impediments to traffic flow. High speeds limit pedestrian and bicycle modes and hence the corridor design should provide separated facilities for these modes if they are needed. The design of the adjacent buildings should be oriented away from Multimodal Through Corridors and towards Placemaking Corridors on the other side of the buildings, providing more desirable pedestrian facilities and pedestrian-oriented land uses on the Placemaking Corridors, while still accommodating pedestrian travel along the Multimodal Through Corridors. Design speeds for Multimodal Through Corridors range from 35 to 55 mph.

Placemaking Corridors

Transit Boulevard

The Transit Boulevard is the highest capacity and most transit supportive Multimodal Corridor in the typology. It would typically only be found in dense urban centers that have sufficient density and market for premium transit. A Transit Boulevard is a multi-lane and multimodal boulevard with a dedicated lane or right-of-way for transit. Transit technologies could be bus service with a bus only lane (BRT or express bus), light rail, or other transit technologies with a separate right-of-way. Other transit types that share lanes with general traffic, such as streetcar or local bus service, could be accommodated on a Boulevard, Major Avenue, or Avenue, but the dedicated transit-only right-of-way defines the Transit Boulevard corridor type. Design speeds for Transit Boulevards range from 30 to 35 mph.

Boulevard

A Boulevard is the corridor type of highest multimodal capacity that accommodates multiple motorized and non-motorized modes. Boulevards allow for higher traffic volumes and greater efficiency of vehicular movements than Major Avenues, Avenues, and Local Streets, and typically have four to six lanes of traffic but may grow to eight in particularly dense centers such as Tysons Corner. Boulevards provide safe and convenient pedestrian and bicycle access to adjacent land uses. Boulevards feature a median, landscaped amenity elements, street trees, and wider sidewalks. Design speeds for Boulevards range from 30 to 35 mph.

Major Avenue

Major Avenues contain the highest density of destinations, intensity of activity, and mix of modes. Because of the close proximity of destinations, pedestrians and street activity are common on Major Avenues. Major Avenues have wide sidewalks to accommodate high numbers of pedestrians and a variety of outdoor activities, including sidewalk cafes, kiosks, vendors, and other street activities. Major Avenues can be areas of high transit ridership for local bus routes. Traffic is low speed and localized. Due to the intensity of destinations, longer regional trips do not use Major Avenues; rather they would

typically be on Boulevards or Multimodal Through Corridors. Autos and buses on Major Avenues travel at slow speeds because pedestrian crossings and on-road bicyclists are frequent. Major Avenues typically have four or fewer lanes for motor vehicle travel while providing adequate facilities for bicycling and typically providing roadway space dedicated to on-street parking. Design speeds for Major Avenues range from 30 to 35 mph.

Avenue

Avenues provide a balance between access to the businesses and residences that front upon them and the collection of vehicular and pedestrian traffic. While having fewer destinations than Major Avenues, pedestrian and bicycle activity is very common, as Avenues serve as critical links in the non-motorized network. Avenues are low speed roadways that facilitate shorter trips, but still contain a fair amount of destinations. Avenues typically have three travel lanes or fewer, and do not exceed four lanes. Avenues may have roadway space dedicated for on-street parking and provide adequate bicycle facilities. Design speeds for Avenues range from 25 to 30 mph.

Local Street

Local Streets see the lowest amount of activity and have the slowest speeds and the highest access. Bicyclists typically can share the road with autos, because speeds are slow and auto traffic is sparse, although they have separate sidewalks and trails for pedestrian accommodation. Local Streets are primarily in more residential areas and are intended to serve only trips that originate or end along them. They connect to Avenues, Boulevards or Major Avenues, funneling longer trips to these higher capacity corridor types. Local Streets are characterized by slow design speeds, wider setbacks; they may not have lane striping, and they emphasize on-street parking. Local Streets have a 25 mph design speed.

Corridor Intensity Zones

Just as the Transect Zones were used to define intensity zones in the Multimodal Centers, they are also used to define intensity levels among Multimodal Corridors. Within each Multimodal Corridor type, there is a spectrum of intensity levels ranging from T-1 to T-6. The intensity levels directly correspond to the Transect Zones.

Not all intensity levels exist in all Multimodal Corridor types. For example, the intensity levels for a Boulevard range from T-6 to T-2, since a very low intensity Boulevard is not practical. In the least dense Multimodal Center (P-1), roads that provide a high level of mobility will not correspond with the description and function of a Boulevard. In these cases, a Major Avenue or Avenue will serve as the primary Multimodal Corridor within the Multimodal Center and will provide the facilities for multimodal transportation scaled to their less dense context. The Multimodal System Design Guidelines are designed to address urban and rural areas of many scales and intensities. A Rural or Village Center may be a village crossroads through which two regional routes (or a regional route and a smaller road) intersect. For example, in the small town of Palmyra in Fluvanna County, US 15 intersects with Courthouse Road. Outside of this local center, US 15 has a posted speed limit of 55 mph with no sidewalks and is used for high speed regional auto travel. But within the primary watershed of the center, the road serves a different function. It becomes more like a Major Avenue as described above, although it is located within what could be described as a P-2 (Small Town or Suburban Center) context.

In this example, in particular, the Transect Zones differentiate the intensity levels of similar Multimodal Corridor types. For example, a Major Avenue in downtown Richmond looks and feels different from the Major Avenue just described in Palmyra, but the functions of the two roads are similar. They both serve more localized traffic, contain destinations for pedestrians, have slower speeds to allow safe pedestrian crossings, and are more focused on destinations and access than mobility. The T-Zones, however, help differentiate the intensities and characteristic features of the two examples of Major Avenue corridors – one rural and one urban. **Table B-1** specifies which of the Multimodal Corridor types exist within each Transect Zone.

Table B-1 – Multimodal Corridor Types and Transect Zones. Not all Multimodal Corridor types apply to all Transect Zones. Transit Boulevards and Boulevards only apply to the moderate and high intensity Transect Zones. Major Avenues, Avenues, Local Streets and Multimodal Through Corridors can be found in any of the Transect Zones.

	Transect Zone (Intensity Zone)					
	T-6 High Intensity	T-5 Medium High Intensity	T-4 Medium Intensity	T-3 Medium Low Intensity	T-2 Low Intensity	T-1 Very Low Intensity
Multimodal Corridor Types	Transit Boulevard					
	Boulevard					
	Major Avenue					
	Avenue					
	Local Street					
	Multimodal Through Corridor					

Correlation to VDOT Functional Classes

The VDOT Transportation and Mobility Planning Division maintains an official functional classification system for all roads within the Commonwealth. A road’s functional classification is determined by criteria including trip types, traffic volumes, system connections, and mileage percentage thresholds.¹

VDOT classifies roads as either urban or rural based on whether they are located within an urbanized area. Urban roads are those roads located within an urbanized area or urban cluster; rural roads are those outside of urbanized areas and urban clusters.² Roads are further classified based on the ability to access land and the mobility through an area. Local facilities emphasize the land-access function.

¹ More information about VDOT’s functional classification criteria and process can be found on VDOT’s website at http://www.virginiadot.org/projects/fxn_class/home.asp.

² Urbanized areas are defined as areas designated by the U.S. Census Bureau having a population of 50,000 or more. Urban clusters are areas having a population of 5,000 or more and are not part of an urbanized area.

Arterials emphasize a high level of mobility for through traffic. Collectors offer a compromise between the two functions. **Figure B-2** shows the VDOT functional classification types as applied to the downtown area of Richmond.

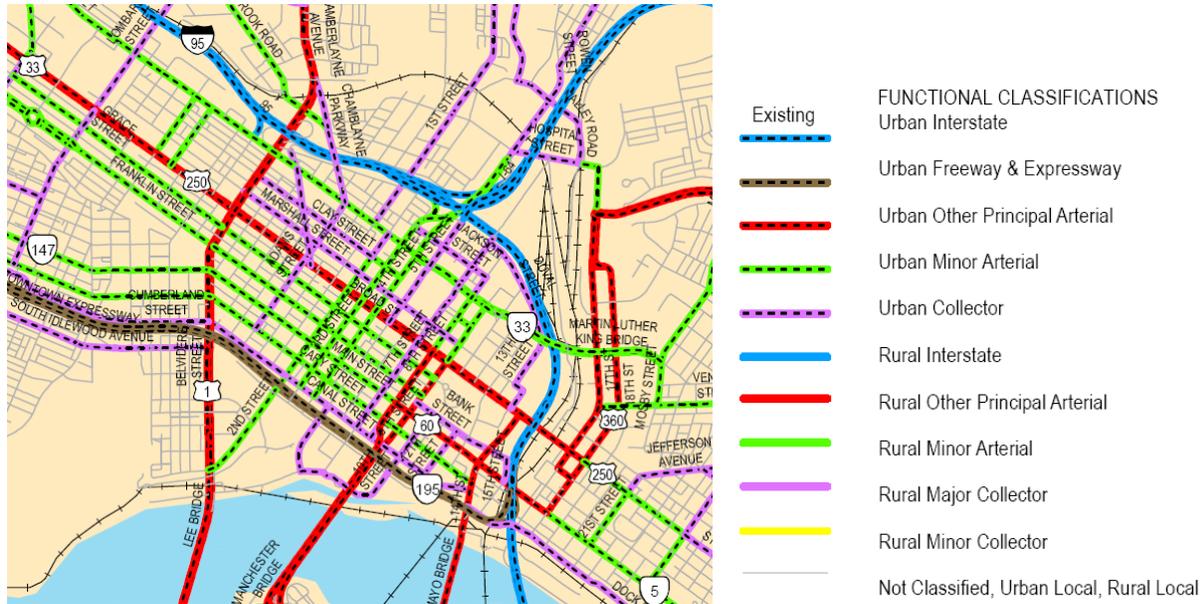


Figure B-2 – VDOT Functional Classification Example. This functional classification map of downtown Richmond illustrates that different roads are designated into different functional classes depending on the ability to provide mobility and access land. The functional classes work together as a system.

The Multimodal Corridor types within the Multimodal System Design Guidelines generally correlate to the VDOT functional classification types as illustrated in **Table B-2**.

Table B-2 – Correlation of Multimodal Corridor Types and VDOT Functional Classes. The Multimodal Corridor types are similar, but not identical to VDOT functional classes. Local planners will designate Multimodal Corridor types as part of the Multimodal System Plan, to establish each corridor’s multimodal role in the overall region.

	VDOT Functional Classification				
	Freeway	Urban Principal Arterial	Urban Minor Arterial	Urban Collector	Local Street
Multimodal Corridor Types	Multimodal Through Corridor				
		Transit Boulevard			
		Boulevard			
			Major Avenue		
			Avenue		
					Local Street

Each individual locality will determine the Multimodal Corridor type designation through the development of a Multimodal System Plan, a holistic multimodal planning process involving Multimodal Centers and Multimodal Districts as described in the Guidelines. As such, the Multimodal Corridor type correlation to the VDOT functional class is not a perfect one-to-one relationship.

VDOT uses functional classification for a variety of applications; the most relevant to the Multimodal System Design Guidelines is to determine road design and access management features. As mentioned previously, the recommended standards within the Corridor Matrix meet or exceed the VDOT Road Design standards for each corridor type and functional class.

Correlation to ITE/CNU Guidebook Corridor Types

The ITE/CNU Guidebook provides the foundation of thoroughfare types on which the Multimodal Corridor types in these Multimodal System Design Guidelines are based. These Guidelines expand upon and delve deeper into general thoroughfare typology established by ITE and CNU.

The ITE/CNU Guidebook establishes seven thoroughfare types, of which three are considered to be within walkable urban areas and thus are the focus of the ITE/CNU Guidebook. The following chart from the ITE/CNU Guidebook shows a similar relationship between thoroughfare type and functional classification, and highlights the three thoroughfare types applicable to the urban walkable thoroughfare concept (Boulevards, Avenues, and Streets).

Thoroughfare Types							
Functional Classification	FREEWAY/ EXPRESS-WAY/PARK-WAY	RURAL HIGHWAY	BOULEVARD	AVENUE	STREET	RURAL ROAD	ALLEY/REAR LANE
Principal Arterial							
Minor Arterial							
Collector							
Local							

Shaded cells represent thoroughfare types that are not addressed in this report.

Figure B-3 – ITE/CNU Thoroughfare Types & Relationship to Functional Class. The three walkable urban thoroughfare types in the ITE/CNU Guidebook are the foundational basis for the Multimodal Corridor types in these Multimodal System Design Guidelines. The Multimodal Corridor types in these Guidelines expand upon the corridor type concept to offer a more robust and flexible system for designing Multimodal Corridors. Image source: Institute of Transportation Engineers and Congress for the New Urbanism. *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach.*

The Multimodal Corridor types in these Multimodal System Design Guidelines are more expansive than the three focus thoroughfare types of the ITE/CNU Guidebook. The ITE/CNU Guidebook focuses only on medium to higher intensity context zones (Transect Zones T-3 and higher), and it specifies different parameters for areas with primarily commercial or primarily residential land uses. The Multimodal

System Design Guidelines provide a larger range of Multimodal Corridor types and applicable Transect Zones, as previously discussed in the Corridor Intensity Zones section.

All Multimodal Centers should ideally have a mix of residential and commercial uses. This mix of land uses is what makes multimodal transportation viable. Origins and destinations need to be within walking distance to support walking and bicycling as viable means of transportation, even if only for a small portion of trips within a rural place. It is this mix of uses that is a key feature of a Multimodal Center. Based on this assumption, the recommended metrics in the Corridor Matrix are not dependent upon the prevailing type of land use.

Places do not need to be urban or even moderately dense to have Multimodal Centers. The *closeness* of destinations, not the *number* of destinations, is what creates a Multimodal Center. Thus even in very low density rural places, Multimodal Centers can be identified. Walkability and bikability within these low density Multimodal Centers is still possible. The Corridor Matrix includes standards for Multimodal Corridors within a broad spectrum of Transect Zones, which are applicable to all Multimodal Centers, from Urban Cores to Rural Centers.

Recommended Corridor Metrics by Context Zone

The elements of corridor design are organized into three distinct Context Zones, each of which has a unique purpose and specific design considerations. **Figure B-4** illustrates the three distinct Context Zones for these Multimodal System Design Guidelines:

1. Building Context Zone
2. Roadway Edge Zone
3. Roadway Zone

The Roadway Zone describes the space between the edges of curb, or between the edges of pavement if curb and gutter is not present. Autos, buses, and bicycles move within the Roadway Zone, and it includes on-street parking. The Roadway Edge Zone includes space for pedestrian travel, and it includes amenities for pedestrians such as buffer space, lighting, bus shelters, benches, etc. Signage, utility poles, and other features will be located within the Roadway Edge Zone. The Building Context Zone generally describes the space between the pedestrian travel way (sidewalk or shared use path) and the buildings along the street.

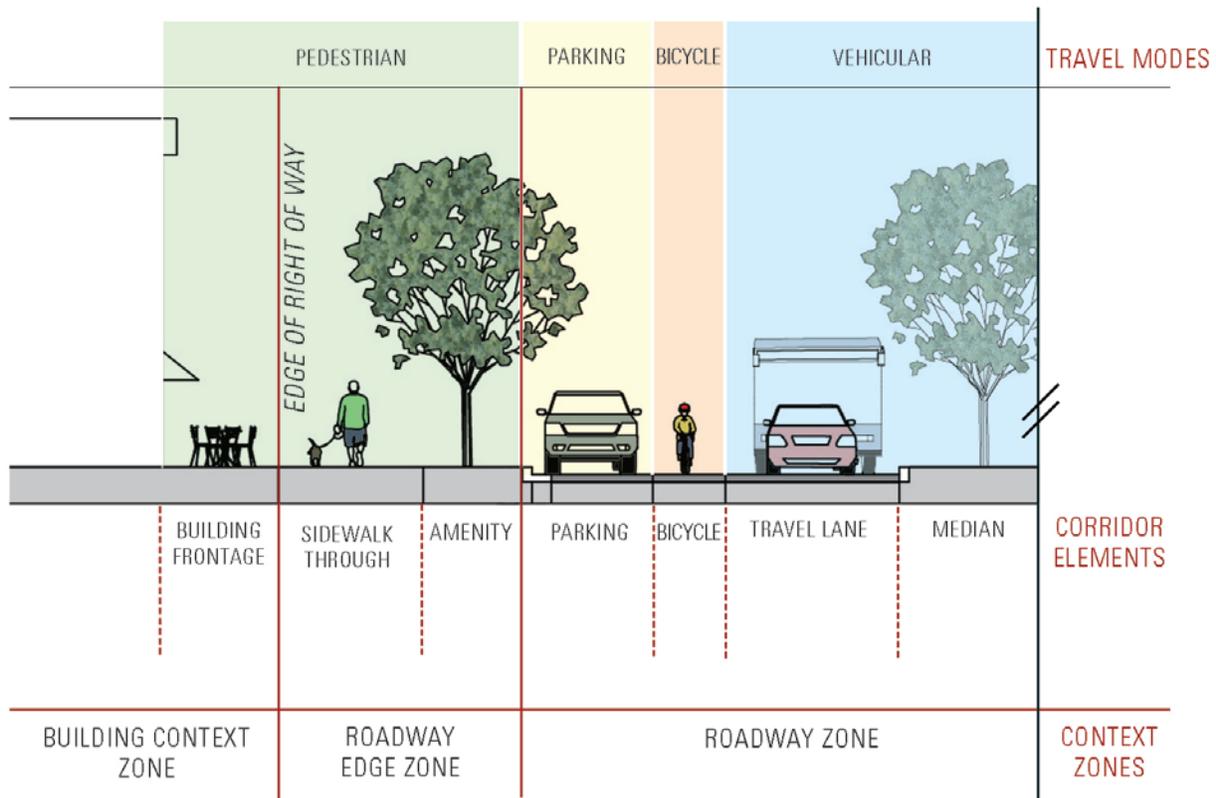


Figure B-4 – Multimodal Corridor Context Zones & Corridor Elements. The different Corridor Elements are organized into three Context Zones. Each Corridor Element can be optimized or minimized, depending on which travel modes are emphasized.

Building Context Zone

The Corridor Elements within the Building Context Zone affect how adjacent buildings ‘interact’ with pedestrians, bicyclists, and motorists. When this zone is small, pedestrians interact with the buildings more easily. Buildings that are closer to the sidewalk are simply easier to enter. Windows close to the sidewalk invite pedestrians to look in. Front lot parking can create conflicts between motorists who are parking and pedestrians who are entering the building or just walking by, and is therefore discouraged. This zone can include space for street activities like café tables, sidewalk sales, and other extensions of building activity. These activities should be kept within the Building Context Zone and should not encroach upon the space for the clear pedestrian travel way in the Roadway Edge Zone.

All of the elements in the Building Context Zone are usually outside of the roadway right-of-way. VDOT road design standards do not address these elements; local planners and site plan reviewers should review local ordinances for these metrics during development review. The building owner would generally be responsible for maintenance for these elements.

Table 6.4 on pages 70 to 71 in the ITE/CNU Guidebook guided the recommended metrics within the Building Context Zone portion of the Corridor Matrix. However, in some T-Zones, these setbacks were increased since the ITE/CNU standards are not clear on where the public right-of-way is located within the Building Context Zone.

A: Building Frontage Element

The Building Frontage Element is the typical width of the setback between the wall, porch, patio, or outdoor stairs of a building and the Sidewalk Through Element. Setbacks are typically specified in a locality's zoning ordinance with intention to fit within a desired streetscape design and sense of place. As such, the typical front building setbacks shown in the Corridor Matrix are simply advisory.

Generally buildings in more urban multimodal areas will have retail or other non-residential uses on the first floor. Minimal setbacks provide a sense of enclosure within the streetscape and are desirable to encourage street life. Large windows next to the sidewalk draw interest from pedestrians and maintain a sense of security with 'eyes on the street'. In less intense areas, larger setbacks are suitable, especially when residential uses are on the first floor. Generally, as explained in the Off-Street Parking Location section, parking should be located in the back of buildings, not between the right-of-way and the building.

VDOT & ITE/CNU Guidance

VDOT gives no guidance on building setback, as localities generally provide their own setback standards in the local zoning code. The ITE/CNU Guidebook provides maximum setbacks ranging from 0 feet to 20 feet, as shown in Table 6.4 on pages 70-71. These values do not include pedestrian lateral or shoulder clearance; that is the space needed between the edge of the clear pedestrian travelway and the edge of the building. Pedestrian lateral clearance should be a minimum of 18 inches when the edge of the building meets the sidewalk (pg. 123 in ITE/CNU). Pedestrian lateral clearance can be zero if the remaining setback includes lawn or groundcover between the sidewalk and the building edge. Twelve inches will suffice along low walls and fences and hedges; and 18 inches is necessary along facades and tall walls and fences. The ITE/CNU Guidebook includes the pedestrian lateral (shoulder) clearance in the frontage zone.

The ITE/CNU values for setbacks vary depending on whether the area is primarily commercial or primarily residential. Setbacks in commercial areas vary from 0 to 5 feet; in residential areas from 10 to 20 feet. These maximum setback values are exclusive of sidewalk frontage zone, which has a minimum of 18 inches for lateral or shoulder clearance. Table 8.1 on page 124 specifies frontage zone widths (where frontage zone is the recommended lateral or shoulder clearance) by transect. As previously mentioned, the ITE/CNU Guidebook is limited to Transect Zones T-3 and above. No guidance is provided for T-2 or T-1 zones.

Optimal Recommendations

The Building Frontage Element is most important for pedestrians; it is also beneficial for transit and for landscaping (such as for the 'Green' Modal Emphasis). Designers should use the optimal recommendations when a corridor has Pedestrian Modal Emphasis. If sufficient right-of-way exists, the optimal values for this element should also be used with Transit or Green Modal Emphasis, but not to the detriment of other Primary and Secondary Elements.

The optimal values used for the Building Frontage Element are slightly larger than the recommended values from ITE/CNU because the values in this Corridor Matrix include pedestrian lateral or shoulder

clearance, and because the ITE/CNU standards are not clear on where the public right-of-way is located within the Building Context Zone. The recommended Corridor Matrix values for the Building Frontage Element represent the recommended pedestrian lateral clearance (frontage zone) plus the building setback. The minimum total setback is five feet to account for ease of construction. However, if existing buildings are built at the zero lot line, the setback for future construction should be continuous to keep a consistent line at which the building meets the sidewalk.

Minimum Recommendations & Potential Modifications

Corridors that do not have Pedestrian, Transit or Green Modal Emphasis may use the minimum recommendations for the Building Frontage Element.

In general, setbacks within the primary walk-shed (e.g. T-6 in a P-6) would be smaller than setbacks in the secondary walk-shed (e.g. T-5 in a P-6). The setback metrics may be taken as relative values. Designers may increase setbacks in secondary walk-sheds or decrease setbacks in primary walk-sheds. These values may also be modified depending on local ordinances.

Additionally, communities may wish to increase setbacks particularly in the more intense Transect Zones to allow space for café tables, retail sidewalk sale clearance racks, and other streetside items.

Location of Off-Street Parking

Generally off-street parking should be located behind or beside buildings. Building facades that open directly onto the sidewalk without parking in front are more inviting to pedestrians and have more aesthetic quality. Parking spaces in front of buildings create conflicts between pedestrians and parking vehicles, and require curb cuts which are dangerous for on-road bicyclists.

VDOT & ITE/CNU Guidance

The ITE/CNU Guidebook recommends rear parking for all walkable urban thoroughfares, and allows side parking for slower streets and in less intense areas. Front parking is not recommended.

Optimal Recommendations

The Corridor Matrix recommends rear parking for all street types, including Multimodal Through Corridors. Side parking is appropriate for all Local Streets and for Major Avenues and Avenues in T-Zones T-1 through T-4. Front parking is discouraged in all circumstances.

Minimum Recommendations & Potential Modifications

Rear parking is preferable to side parking in all areas. Front parking is discouraged in all circumstances.

Typical Building Entry Locations

Buildings with front doors that face the street create a better environment for pedestrians.

VDOT & ITE/CNU Guidance

The ITE/CNU guidebook recommends front access for all walkable urban thoroughfares, and allows side access for slower streets and in less intense areas.

Optimal Recommendations

The Corridor Matrix recommends front entry for all Multimodal Corridor types, including Multimodal Through Corridors. Side entry is appropriate for all Local Streets and for Major Avenues and Avenues in T-Zones T-1 through T-4. This is consistent with the recommendations for off-street parking location.

Minimum Recommendations & Potential Modifications

Front entry is preferable to side entry in all areas. Rear entry may be convenient for automobiles when parking is in the back and may be provided as a secondary entrance location. The main entry point should be along the street in front of the building.

Roadway Edge Zone

The Roadway Edge Zone describes the space between the travelway of on-road vehicles and the Building Context Zone, see **Figure B-4** shown previously on page B-10. This space is generally designed to maximize pedestrian safety and comfort. It includes the pedestrian travelway (Sidewalk Through Element) and space for streetside amenities like benches, trashcans, and newspaper boxes (Amenity Element). It also includes space where lighting fixtures and signs are placed, and provides buffer space between traveling vehicles and streetside activity.

The Roadway Edge Zone is measured from the back of curb to the outside edge of the Sidewalk Through Element (the space kept clear of obstructions for pedestrian travel). For roads without curb and gutter, the Roadway Edge Zone is typically measured from the edge of pavement.

B: Sidewalk Through Element

The Sidewalk Through Element is the space where pedestrians walk. It should be kept clear of any obstructions like utility poles, signage, trash cans, and other streetside amenities. These objects should be placed in the Amenity Element.

VDOT & ITE/CNU Guidance

The Geometric Design Standards in Appendix A of the VDOT Road Design Manual specify a minimum sidewalk width of five feet for all roads with curb and gutter, and footnotes that a width of eight feet or more may be needed in commercial areas. The VDOT Road Design Manual also states that a minimum of eight feet of sidewalk is necessary when the sidewalk is placed adjacent to the curb (i.e. no buffer space) and on-street parking exists to allow vehicle doors to open and people to exit from parked vehicles without blocking the pedestrian access route (see SIDEWALKS section in Appendix A-5).

The ITE/CNU Guidebook is generally consistent with the VDOT Road Design Manual. It recommends an absolute minimum width of five feet for the pedestrian travel way in residential areas, and six feet in commercial areas (see Table 5.2 on pg. 65 in ITE/CNU Guidebook). In more intense context zones, the minimum sidewalk width increases. Avenues need more sidewalk width than Local Streets, and Boulevards need more sidewalk width than Avenues.

Optimal Recommendations

The Sidewalk Through Element is a Primary Element for Pedestrian Modal Emphasis, and a Secondary Element for Transit Modal Emphasis. This element has the highest priority in Pedestrian Modal

Emphasis; optimal values should be used in corridors with Pedestrian Modal Emphasis and if possible, in corridors with Transit Modal Emphasis.

The Corridor Matrix recommends 10 feet for Boulevards and Transit Boulevards in T-6 and T-5, with widths generally decreasing to 5 feet for Local Streets in T-2 and T-1.

Shared use paths are recommended for Multimodal Through Corridors. These streets have generally higher speeds, and a shared use path will allow bicyclists to ride off-street. A shared use path is typically accompanied by wider buffer space, which will increase pedestrian comfort and safety.

Minimum Recommendations & Potential Modifications

The Corridor Matrix generally reflects the recommendations from the ITE/CNU Guidebook, and specifies an absolute minimum sidewalk width of five feet for Local Streets and Avenues, and six feet for Major Avenues and Boulevards. Major Avenues in T-1 or T-2 have a minimum width of five feet as these are in very low intense Multimodal Centers.

Multimodal Through Corridors with design speeds of 45 mph or less may use a sidewalk instead of a shared use path.

The Corridor Matrix standards for the Sidewalk Through Element may be increased wherever possible to provide more space for pedestrians. This is especially relevant for corridors within the primary walk-sheds in the more intense Multimodal Centers, as these places typically see more pedestrian travelers than in the less intense Multimodal Centers and secondary walk-sheds. This space may also be increased for plaza or other public space uses.

C: Amenity Element

The Amenity Element describes the space between the back of curb and the edge of the pedestrian travel way (Sidewalk Through Element). This space separates pedestrians from moving vehicles, and can be referred to as the buffer or planting strip. It does not include the curb, gutter pan, parked cars, bicycle lanes, or other items within the roadway. The Amenity Element is the ideal place for streetside amenities and lateral obstructions including street trees, transit stops, bicycle racks, food carts, fire hydrants, street lights, parking meters, signal control boxes, signs, and utility poles. These objects are outside of the clear pedestrian travel way and serve as a physical barrier between pedestrians and moving vehicles. Ideally the Amenity Element includes landscaping to add aesthetic quality to the streetscape and prevent pedestrians from jaywalking.

VDOT & ITE/CNU Guidance

For curb and gutter urban roadways with design speeds less than or equal to 45 mph, VDOT requires a minimum of four feet of buffer space between the back of curb and the sidewalk (see Road Design Manual, Appendix A, Figure A-2-1).

VDOT does have several options to the four foot minimum for the buffer space (refer to the discussion of buffer width in the Road Design Manual, Appendix A, Section A-5). Three feet may be appropriate when using smaller signs. If trees are to be planted in the buffer strip, it shall be a minimum of six feet

wide and the trees should be planted so that the center of the trees are three feet minimum behind the back of curb. It is also important to make sure that trees will not block road signs once they reach a mature height.

Appendix B(1) Subdivision Street Design Guide in the VDOT Road Design Manual restates the six-foot minimum buffer from the back of curb for trees. Buffers without trees may be four feet wide measured from the back of curb, and for streets with a posted speed of 25 mph or slower, a three-foot buffer zone measured from the back of curb may be appropriate for smaller signs (see Figure 6 and Figure 10 in Appendix B(1).)

At intersections and driveway openings, VDOT requires a minimum lateral offset of three feet between the face of curb and obstructions to provide sufficient clearance for truck overhangs (Road Design Manual, Appendix A-2).

The ITE/CNU Guidebook defines the space of the Amenity Element into two separate zones: the Edge Zone and the Furnishings Zone (these two terms should not be confused with the terminology of the Corridor Elements in the Multimodal System Design Guidelines Corridor Matrix). The ITE/CNU Guidebook's Edge Zone is the lateral offset, the distance between the face of curb and any lateral obstructions. The ITE/CNU Guidebook recommends a minimum of 1.5 feet for the Edge Zone, and recommends widening the Edge Zone to a minimum of 4 feet at transit stops with bus shelters to allow people with wheelchairs to maneuver in front of the shelter (see pg. 122 in the ITE/CNU Guidebook). The ITE/CNU Guidebook's recommended widths for the Furnishings Zone vary between six to eight feet; wider widths are recommended for Boulevards and narrower widths for Local Streets. The ITE/CNU Guidebook also recommends tree wells in more intense areas and areas with predominantly commercial ground floor use. Landscape strips with trees and grasses or groundcovers are recommended in more residential areas.

For shared use paths that are adjacent to roads with curb, the VDOT Road Design Manual requires a minimum separation of eight feet between the face of curb and the edge of the shared use path. The necessary separation between a shared use path and a road with shoulder and ditch (instead of curb) varies depending on travel speed. Shared use paths should be placed behind the ditch.

Optimal Recommendations

The Amenity Element is a Primary Element for Green Modal Emphasis, and a Secondary Element for Pedestrian Modal Emphasis. It is a Contributing Element for Bicycle and Transit Modal Emphasis. Corridors with Green Modal Emphasis should always use the optimal recommendations. If possible, optimal values should be used for Pedestrian, Bicycle and Transit Modal Emphasis.

Optimal values range from nine feet to six feet for the five Placemaking corridors, to be consistent with the recommendations in the ITE/CNU Guidebook. Optimal widths for the Amenity Elements in T-Zones T-2 and T-1 are slightly wider than those in T-Zones T-6 through T3 to reflect the change in context.

The surface treatment for the Amenity Element for Placemaking Corridors in T-Zones T-6 through T-3 should typically be tree wells that provide a continuous walking surface between the Sidewalk Through

Element and the back of curb. The surface treatment for Placemaking Corridors in T-Zones T-2 and T-1 should be landscaped grass, or other natural surfaces. Corridors with a Green Modal Emphasis in the higher intensity T-Zones (and no Pedestrian Modal Emphasis) may incorporate bioswales or have a landscaped surface (either grass, dirt, or such surface to treat the stormwater runoff). Corridors in the lower intensity T-Zones with a Pedestrian Modal Emphasis may have a hard surface like tree grates that pedestrians can walk on.

Multimodal Through Corridors typically have higher traffic volumes and higher speeds than Placemaking Corridors. Ideally, shared use paths would be provided on Multimodal Through Corridors to provide a safe facility for pedestrians and bicyclists that is set back from the roadway. The recommendations for the Amenity Element for Multimodal Through Corridors follow the VDOT Road Design Manual requirements and recommendations for shared use paths.

Minimum Recommendations & Potential Modifications

The minimum recommendations for the Amenity Element are six feet for all Placemaking Corridors, as this is the minimum width VDOT allows for trees. Six feet with trees (in tree wells for T-6 through T-3 and with grass for T-2 and T-1) is recommended as the minimum element because trees are desired on all Placemaking Corridors.

If trees cannot be planted because of funding or other constraints, six feet is still recommended as the minimum because communities may decide to plant trees in the future as part of a streetscaping initiative, and six feet would allow them to do so without needing additional right-of-way.

In cases of severely constrained right-of-way, designers can use the absolute minimums in the VDOT Road Design Manual, Appendix A. Section A-5 in the VDOT Road Design Manual allows a minimum buffer width of four feet for posted speeds of 25 mph or greater, and a minimum of three feet with smaller signs and posted speeds of 25 mph or less. Please note these absolute minimum buffer widths do not allow trees to be planted.

The optimal values should be used wherever possible when Green, Pedestrian, Bicycle, or Transit modal emphasis is applied. The lateral offset of the Amenity Element should be increased at transit shelters for adequate wheelchair access between the transit shelter and the back of curb. In low intensity Transect Zones like T-1 and T-2, the minimum widths may be further reduced if adequate space exists between the far edge of the pedestrian way and the property line. However, this is not recommended as buffer space for pedestrians should always be at least four feet, or three feet if the posted speed is 25 mph or less and smaller signs are used.

In instances of severely constrained right-of-way for Multimodal Through Corridors, a shared use path may not be feasible. If a sidewalk is provided, the maximum amount of buffer space should be provided between the sidewalk and the edge of road. The minimum buffer distance for Multimodal Through Corridors with sidewalk and curb is four feet. If a sidewalk is used on a Multimodal Through Corridor with shoulder and ditch, the sidewalk shall be placed behind the ditch (see VDOT Road Design Manual Appendix A, Section A-5).

Roadway Zone

The Roadway Zone can be defined as the space from face of curb to face of curb (or between the edges of asphalt pavement if there is no curb). It includes the vehicle travel lanes, bus only lanes, bike lanes, on-street parking spaces, medians, and gutter pans. This space is where higher speed travel occurs and is usually separated from the Roadway Edge Zone by the curb.

The Placemaking Corridors within these Guidelines are assumed to have a curb and gutter design (VDOT urban road design). A shoulder design is highly discouraged for corridors within Multimodal Centers and Multimodal Districts. Drivers on curb and gutter roadways are likely to travel at slower speeds and be aware of the possible presence of pedestrians and bicyclists. A shoulder design may be appropriate only for a Multimodal Through Corridors in T-2 and T-1 transect zones, and if used should have enough buffer space between the pedestrian travel way (sidewalk or shared use path) and the vehicle travel lanes to meet VDOT's clear zone requirements.

The following sections describe the Corridor Elements within the Roadway Zone. **Figures B-5 through B-7** illustrate how the Corridor Elements fit together in a typical cross-section, and show where each Corridor Element is measured from and to. **Figure B-5** shows a cross-section with bicycle lanes and on-street parallel parking in both directions. **Figure B-6** shows bicycle lanes with no on-street parking. **Figure B-7** shows a cross-section with no bicycle lanes and no on-street parking.

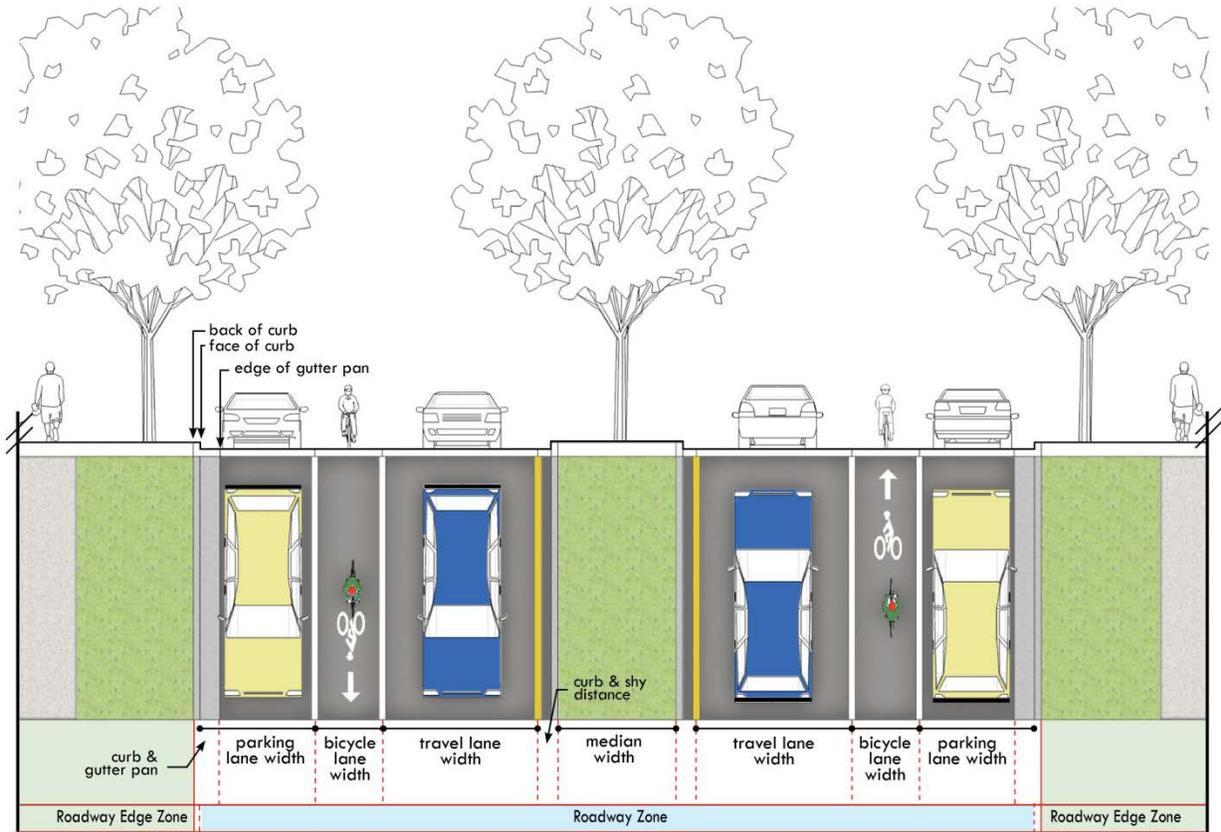


Figure B-5 - Roadway Zone Cross-Section with Bicycle Lanes and On-Street Parallel Parking. On-street parking lane widths include the width of the gutter pan.

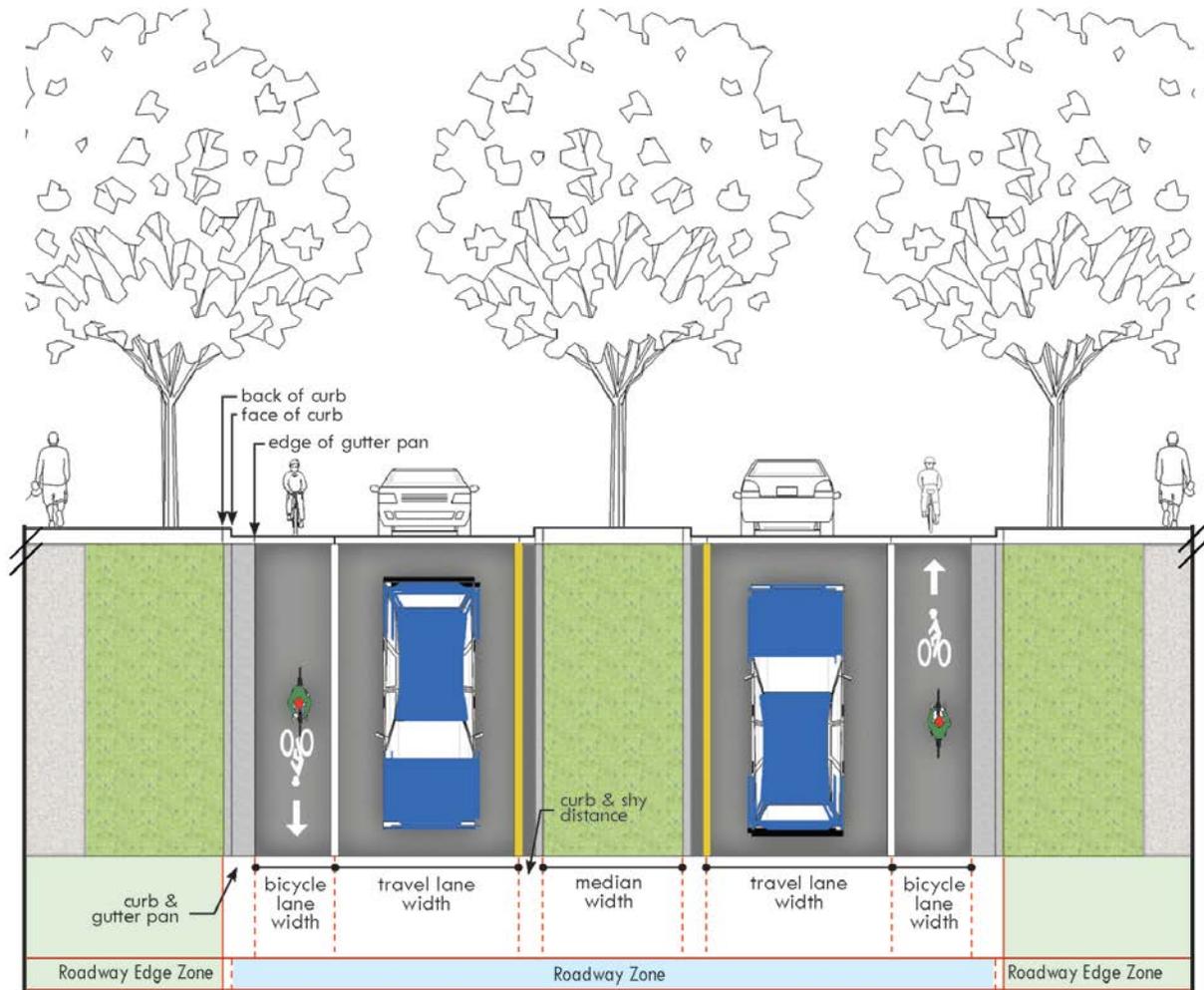


Figure B-6 – Roadway Zone Cross-Section with Bicycle Lanes and No On-Street Parking. When the bicycle lane is adjacent to the curb and gutter, the width of the bicycle lane does not include the gutter pan.

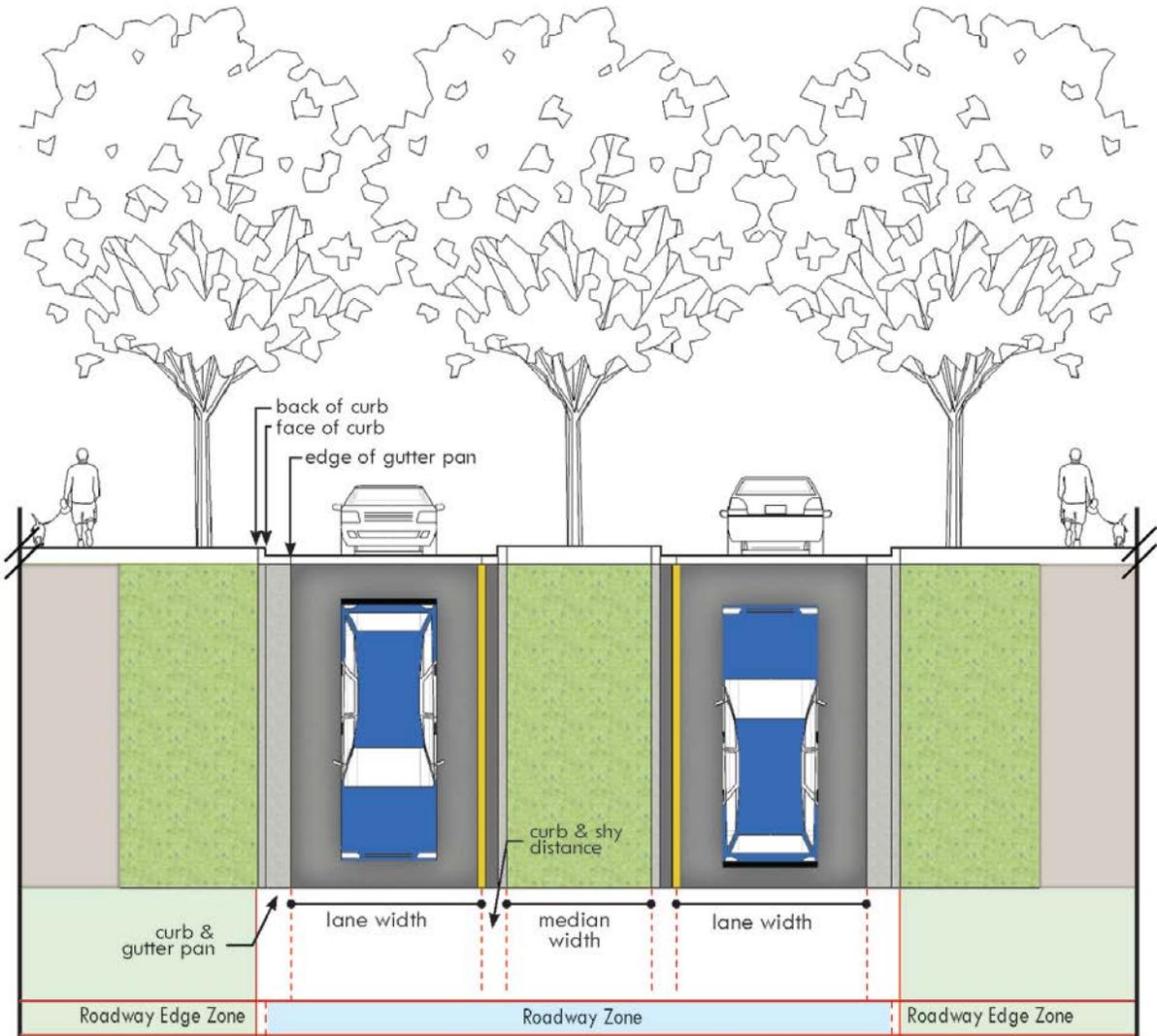


Figure B-7 – Roadway Zone Cross-Section with No Bicycle Lanes and No On-Street Parking. When the travel lane is adjacent to the curb and gutter, the travel lane width does not include the width of the gutter pan.

D: Parking Element

The Parking Element describes the width of parallel on-street parking. On-street parking is usually desirable for lower speed roads (35 mph or less) for a variety of reasons. Local businesses prefer on-street parking to attract customers. Parked cars serve as a physical buffer between moving vehicles and pedestrians, increasing pedestrian safety and comfort. On-street parking adds to street activity and promotes a vibrant street life for a neighborhood corridor.

On-street parking may not be appropriate on all streets. Opening parked car doors on the driver’s side can create serious safety conflicts for on-road bicyclists. Parking maneuvers also create conflicts for

moving vehicles. On-street parking reduces the capacity of the adjacent travel lane, anywhere from three to 30 percent depending on the frequency of parking maneuvers.³

VDOT & ITE/CNU Guidance

The Subdivision Street Design Guide (SSAR) in Appendix B(1) of the VDOT Road Design Manual specifies on-street parking should be seven feet wide on residential and mixed-use local streets, and eight feet wide on commercial and industrial streets. These values include the width of the gutter pan (see **Figure B-5**, shown previously on page B-17). When combined with a bicycle lane, 12 feet of combined bicycle travel and parking should be the minimum for this type of shared use (see Figure A-5-1 in SHARED ROADWAYS section of Appendix A-5 in the VDOT Road Design Manual). The SSAR states that the use of curb and gutter anticipates on-street parking, and parking along streets with shoulder and ditch design is not desirable.

The ITE/CNU Guidebook recommends against providing parking for streets with speeds greater than 35 mph due to potential hazards associated with maneuvering in and out of spaces. In developing and redeveloping areas, provide the amount of on-street parking for planned, rather than existing, land use densities. Table 6.4 in the ITE/CNU Guidebook recommends a range of widths for on-street parking ranging from seven feet in less intense areas and eight feet in more dense areas.

Optimal Recommendations

The optimal recommendations are most important for corridors that have a Parking Modal Emphasis. Optimal values are also encouraged for corridors with Pedestrian Modal Emphasis as a Contributing Element.

The recommended parallel on-street parking lane widths are consistent with the VDOT and ITE/CNU guidance. Eight-foot widths are recommended for Boulevards. Major Avenues may have seven- to eight-foot widths. Seven-foot widths are appropriate for all Local Streets and for Avenues in lower intensity areas. These widths include the width of the gutter pan. The Corridor Matrix values for Transit Boulevards assume that the dedicated right-of-way for transit is located in the median, allowing space for on-street parking next to the curb without conflicting with the transit right-of-way.

Minimum Recommendations & Potential Modifications

In all cases, no on-street parking is an option in instances with constrained rights-of-way. On-street parking is appropriate for Transit Boulevards if the dedicated right of way for transit is in the median and the parking is located on the outside lanes. On-street parking is not recommended for Transit Boulevards where the dedicated right-of-way is curbside. On-street parking is also not recommended for Multimodal Through Corridors, as the safety hazards of parking maneuvers become too great at speeds higher than 35 mph.

E: Bicycle Element

Bicycle accommodations serve a variety of bicyclists with a range of experience and confidence. Experienced bicyclists may prefer to ride in the street sharing travel lanes with traffic to reach higher

³ ITE/CNU Guidebook. Pg. 146.

speeds. Less experienced bicyclists prefer to have a dedicated space such as a bicycle lane. Very inexperienced bicyclists will only feel comfortable on a shared use path with physical separation from moving traffic.

Localities can choose from an extensive array of bicycle facilities and treatments to implement. Typical facilities for bicyclists can range from an on-street bicycle lane, shared lane markings, and wide outside curb lanes or shoulders to an off-road shared use path that may or may not run parallel to a roadway. Some low speed low volume streets may be appropriate for bicycle travel without any special pavement treatment or signage. Cities across the U.S. and abroad are implementing newer and more innovative bicycle features such as bicycle boulevards, cycle tracks, contra-flow bike lanes, and shared bicycle and bus facilities. Many of these new innovative features are not included in these Multimodal System Design Guidelines, but communities should pursue options for these more innovative features if they desire. The Urban Bikeway Design Guide,⁴ published by the National Association of City Transportation Officials (NACTO), and referred to as the NACTO Bike Guide in future references, provides guidance on where these facilities might be appropriate and provides important design considerations.

It is important to note that bicycle facility design should not begin at the detailed corridor scale. As with other travel modes, planning at the **systems** level is a critical first step. Cities, counties and towns usually prepare regional bicycle or greenway trail plans that provide connections throughout a region or city. When these plans are prepared, planners usually have specific facilities in mind for each corridor. The recommendations for the Bicycle Element in these Guidelines are intended to supplement, not replace, regional bicycle planning efforts.

VDOT & ITE/CNU Guidance

VDOT's policy for integrating bicycle and pedestrian accommodations states that VDOT will initiate every construction project with the presumption that the project shall accommodate bicycling and walking.

Section A-5 Bicycle and Pedestrian Facility Guidelines of the VDOT Road Design Manual provides recommendations for facilities for each bicyclist type (Group A advanced, Group B basic, and Group C children), however these tables are based on previous tables from the Federal Highway Administration, which have been superseded by the release of the Guide for the Development of Bicycle Facilities, 4th Edition (published by AASHTO in 2012, and referred to as the AASHTO Bike Guide in future references). The ITE/CNU Guidebook provides recommendations for bicycle lanes and references the previous edition of the AASHTO Bike Guide for other types of accommodations. The ITE/CNU Guidebook recognizes that bicycle lanes may not be appropriate for all road types. With the exception of freeways and streets where bicycling is specifically prohibited, bicyclists are permitted to use any street for travel. The ITE/CNU Guidebook explains that bicycle lanes are desirable on major thoroughfares with target speeds of 30 mph or greater, and on streets with high traffic volumes. The ITE/CNU Guidebook also states that availability of parallel bicycle facilities does not eliminate the need to have a bicycle lane on thoroughfares, as bicyclists need to access properties along corridors. Furthermore, walkable urban thoroughfares should at least meet the needs of Group B Basic bicyclists. Table 6.4 in the ITE/CNU

⁴ <http://nacto.org/cities-for-cycling/design-guide/>

Guidebook recommends a preferred width of six feet for bicycle lanes and a minimum width of five feet for all walkable urban corridor types.

The AASHTO Bike Guide is a comprehensive resource and contains recommendations for a variety of different bike facilities. Determining which facility is appropriate depends on a wide array of characteristics including traffic volume, speed, traffic mix, expected users, road conditions, driveways and access points, topography, adjacent land uses, and cost. Bike lanes are most appropriate on major roads that provide direct, convenient, quick access to major land uses and on collector roads and busy urban streets with slower speeds.

The AASHTO Bike Guide recommends five-foot wide bicycle lanes in most circumstances. Bicycle lanes that are adjacent to a curb and gutter should have a usable width of four feet, measured from the longitudinal joint (where the gutter pan meets the asphalt pavement) to the center of the bicycle lane stripe. On roads with on-street parking, bicycle lanes should be placed between the parking lane and the travel lane. AASHTO recommends six feet for the width of bicycle lanes in these locations, and a minimum of not less than five feet. On streets with narrow parking lanes (seven feet wide) and high parking turnover, a wider bicycle lane (six to seven feet wide) may be desirable to provide more operating space for bicyclists to ride out of the area of opening vehicle doors. See AASHTO Bike Guide Sections 4.6.4 and 4.6.5.

Please note the recommendations for the Bicycle Element in the Corridor Matrix are generalized; a different type of facility may be more appropriate for the unique characteristics of the corridor and surrounding transportation network. Please refer to the AASHTO Bike Guide for all corridors with Bicycle Modal Emphasis. For example, these Multimodal System Design Guidelines do not give detailed information on bicycle boulevards, contra-flow bike lanes, signage, street markings, or other bicycle facility design considerations.

Optimal Recommendations

For corridors with Bicycle Modal Emphasis, it is critical to provide the optimal bicycle accommodation as specified in the Corridor Matrix (or other appropriate accommodation as directed by the AASHTO Bike Guide); the bicycle accommodation will take higher priority than the ideal metrics for other design elements. Optimal bicycle accommodations would also be beneficial for corridors with Transit or Parking Modal Emphasis, as they are a Contributing Element.

On-road bicycle lanes are appropriate for all of the Placemaking Corridors except for Local Streets. The appropriate width of a bicycle lane varies between four and seven feet. The bicycle lane widths in the Corridor Matrix assume the bicycle lane is located adjacent to a curb and gutter pan, and that there is no on-street parking. The bicycle lane widths do not include the width of the gutter pan. If the bicycle lane is adjacent to a curb without a gutter pan (no on-street parking), add one foot of width. If eight-foot wide on-street parking is provided, add one foot of width. If seven-foot wide on-street parking is provided, add two feet of width.

Four-foot wide bicycle lanes are recommended for all Avenues and for Major Avenues, Boulevards, and Transit Boulevards in T-4 and lower transect zones, meaning the width of the bicycle lane would be four

feet plus the width of the gutter pan assuming no on-street parking (see **Figure B-7**), or five feet if there is curb but no gutter pan assuming no on-street parking (see **Figure B-8**). If an eight-foot wide parking lane is provided, the bicycle lane would be five feet wide (see **Figure B-9**), and if a seven-foot wide parking lane is provided, the bicycle lane would be six feet wide (see **Figure B-10**).

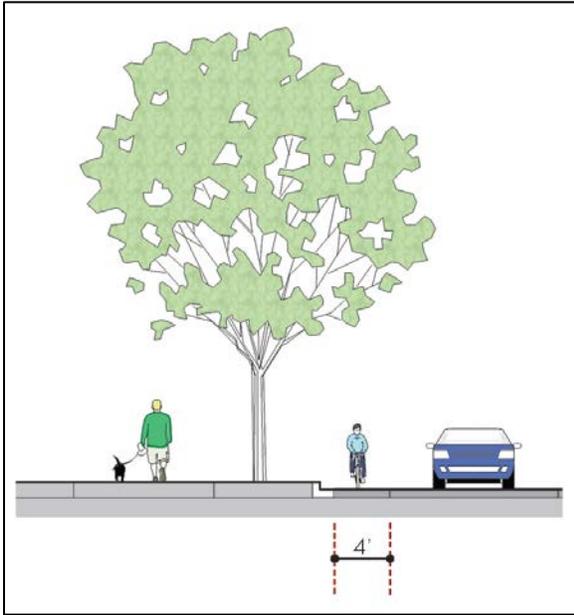


Figure B-7 – Optimal Bicycle Element for Avenues and Major Avenues (Illustration A). Four-foot wide bicycle lanes do not include the width of the gutter pan when adjacent to curb and gutter.

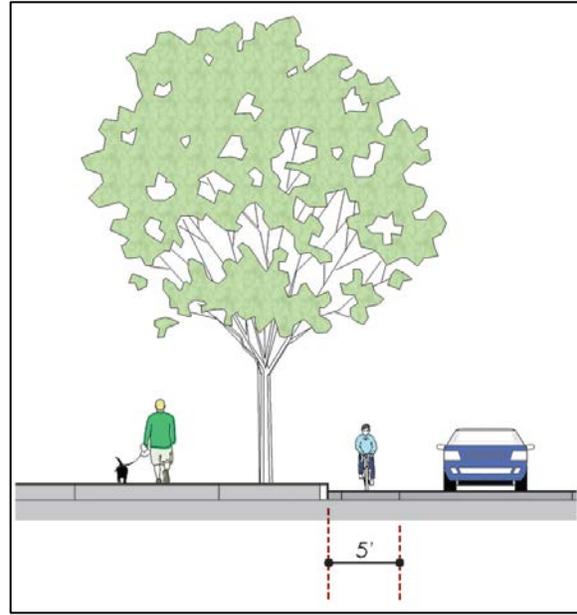


Figure B-8 – Optimal Bicycle Element for Avenues and Major Avenues (Illustration B). A four-foot wide bicycle lane becomes a five-foot wide bicycle lane when located adjacent to curb without a gutter pan.

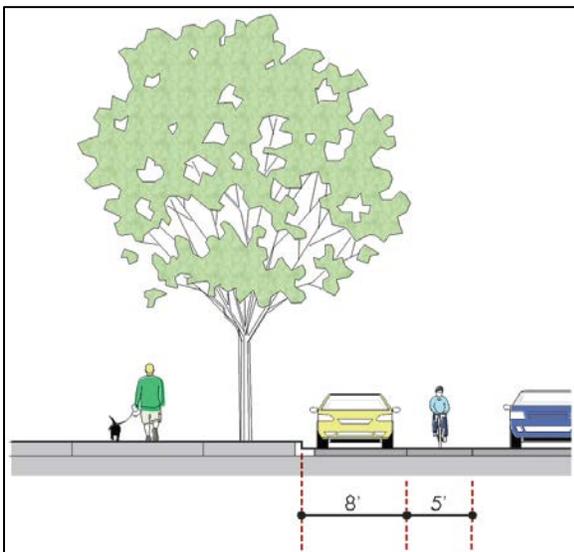


Figure B-9 – Optimal Bicycle Element for Avenues and Major Avenues (Illustration C). A four-foot wide bicycle lane becomes a five-foot wide bicycle lane when paired with an eight-foot wide parking lane.

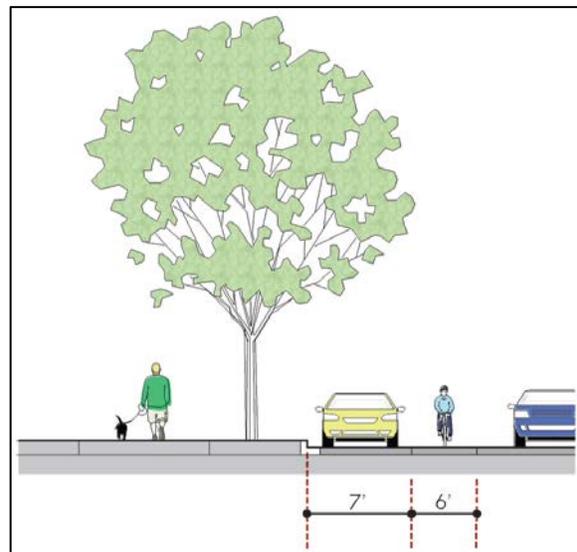


Figure B-10 – Optimal Bicycle Element for Avenues and Major Avenues (Illustration D). A four-foot wide bicycle lane becomes a six-foot wide bicycle lane when paired with a seven-foot wide parking lane.

Transit Boulevards, Boulevards, and Major Avenues in the T-6 and T-5 Transect Zones typically have higher bicycle use and higher traffic volumes. The optimal Bicycle Element for these Multimodal Corridor types is a five-foot wide bicycle lane, which would translate to a six-foot wide bicycle lane if an eight-foot wide parking lane is provided; and a seven-foot wide bicycle lane if a seven-foot wide parking lane is provided. *Note: Five feet is the minimum allowable width for an exclusive bicycle lane for T-6 and T-5 Transit Boulevards, Boulevards and Major Avenues. A four-foot wide bicycle lane is not appropriate on these Multimodal Corridor types. If insufficient space exists for a five-foot wide exclusive bicycle lane on these Multimodal Corridor types, designers may choose to use the minimum treatment of a 14-foot wide curb lane with shared lane markings.

It is important to note these bicycle lane widths are ideal treatments, but that other more innovative options should be considered. Planners and designers should consult the AASHTO Bike Guide, and possibly the NACTO Bike Guide, for further design treatment options like buffered bicycle lanes.

Generally bicycle lanes are unnecessary on Local Streets in all Transect Zones because of the low volume of traffic and low speeds, however shared lane markings are recommended for corridors with Bicycle Modal Emphasis to encourage bicyclists to ride outside of the 'door zone' where they risk being hit by opening car doors. Shared lane markings also help alert motorists to the possible presence of bicyclists.

As part of the regional bicycle planning process, localities may designate some local roads as bicycle boulevards. These are low volume, low speed road connections that provide critical links in the bicycle network, but typically have traffic calming features like in road planting boxes, curb treatments, or other design elements to discourage cut through road traffic. Traffic diverters should not be used on corridors with transit modal emphasis. Planners and designers should refer to the AASHTO Bike Guide for more detailed guidance on bicycle boulevards.

Shared use paths that are separated from the road with buffer space are recommended for Multimodal Through Corridors as basic level bicyclists generally do not feel comfortable on these higher speed roads. Regional bike plans should also identify areas for off-road bicycle trails for other potential connections.

Minimum Recommendations & Potential Modifications

On corridors that do not have Bicycle Modal Emphasis, the optimal accommodations are not as critical. It is imperative to design corridors to allow for the safe travel of bicyclists. The minimum recommendation for all Avenues and for Major Avenues, Boulevards, and Transit Boulevards in a T-4 or lower Transect Zone is shared lane markings with no additional lane width. This recommendation is consistent with the AASHTO Bike Guide, which recommends shared lane markings on collectors and minor arterials where the speed limit is 35 mph or less, particularly on space-constrained roads with narrow travel lanes or road segments where bicycle lanes are not selected due to space constraints or other limitations (see Table 2-3 in the AASHTO Bike Guide).

T-6 and T-5 Transit Boulevards, Boulevards, and Major Avenues will likely have high volumes of motorized vehicle traffic, and additional lane width on the outside lane will likely increase bicyclist safety and comfort. The minimum Bicycle Element recommendation for these Multimodal Corridor types is a

14-foot wide curb lane with shared lane markings. This recommendation is consistent with the AASHTO Bike Guide, which recommends wide outside shared lanes on arterials and collectors intended for major motor vehicle traffic movements (see Table 2-3 in the AASHTO Bike Guide). The wide outside curb lane measurement does not include the gutter pan; it is measured from the longitudinal joint.

Local Streets in all transect zones may not need any special provisions for bicyclists, as bicyclists can comfortably ride with traffic on the low speed low volume streets. However, if the traffic volume exceeds 1,000 vehicles per day, designers may consider using shared lane markings to simply alert motorists to the possible presence of bicyclists.

On Multimodal Through Corridors, a shared use path separated from the roadway is recommended, but if space is constrained, a bicycle lane is the preferred alternate treatment. The minimum bicycle accommodation on Multimodal Through Corridors in Transect Zones T-6 through T-3 should be a 14-foot wide curb lane with shared lane markings, and in Transect Zones T-2 and T-1, either a six-foot wide paved shoulder or a 15-foot wide outside curb lane with shared lane markings.

In addition to these recommendations, a range of alternative treatments are available, and the AASHTO Bike Guide and NACTO Bike Guide should be consulted for further options. For example, if a four-foot bicycle lane on both sides is not possible on a T-4 Transit Boulevard, a designer may consider a range of alternatives such as providing a bicycle lane in the uphill direction and shared lane markings in the downhill direction, providing a wide outside curb lane, or using shared lane markings on both sides of the street. All of these alternatives are better than relegating a facility to a parallel corridor, but many of these alternatives are not appropriate in certain circumstances. Refer to the latest AASHTO Bike Guide to design a bicycle facility that best accommodates bicyclists given the right-of-way constraints and roadway characteristics for a particular corridor.

Facilitating interaction between bicyclists and transit buses is often difficult. Special considerations at transit stops and at intersections must be given to safely accommodate bicyclists on transit routes.

F: Travel Lane Element

The Travel Lane Element describes the width of each travel lane for motorized vehicles. Lane width influences the speed at which vehicles will drive. Typically lane width is determined by the design speed of a roadway. Traditionally, designers and engineers consider wider lanes to be safer, as vehicles have more room to self-correct before going outside of the travel lane. However, this 'overdesign' results in vehicles driving faster, which creates more severe safety problems when crashes do occur.

VDOT & ITE/CNU Guidance

The VDOT Road Design Manual contains minimum lane widths for each functional class based on minimum design speed. The minimum lane width for urban arterials and collectors is 12 feet if the design speed is 50 mph or greater and 11 feet if the design speed is 45 mph or lower. If heavy truck traffic is anticipated, 12-foot widths are recommended even if the design speed is 45 mph or lower. Similarly roads with design speeds of 50 mph or greater may have 11-foot widths if there are restrictions on truck traffic. Urban local streets have a minimum lane width of 10 feet. Urban collector streets may

have 10 foot lane widths under the following conditions (see Table 6-5 in A Policy on Geometric Design of Highways and Streets, published by AASHTO):

- a) Design speed is 50 mph or less and traffic volumes are less than 400 vehicles per day
- b) Design speed is 30 mph or less and traffic volumes are less than 1,500 vehicles per day

Lane widths in the VDOT Road Design Manual do not include the curb and gutter (See VDOT Road Design Manual Appendix A).

The ITE/CNU Guidebook acknowledges that lane width will vary and provides a number of useful design considerations (see pg. 137 in ITE/CNU Guidebook). Most thoroughfare types can effectively operate with 10- to 11-foot wide lanes, with 12-foot lanes desirable on higher speed transit and freight facilities. The ITE/CNU Guidebook recommends 10- to 11-foot lane widths for all corridor types in all areas, except in C3 and C4 commercial boulevards, where 10- to 12-foot lane widths are recommended.

Optimal Recommendations

The Travel Lane Element is a Primary Element for Transit Modal Emphasis. For all other modes, it is a Non-Contributing Element. 12-foot lanes are appropriate for corridors with transit routes or heavy truck traffic. Twelve-foot lanes should *only* be used when a corridor has a Transit Modal Emphasis, or serves as a major freight route. All other Multimodal Corridors should use the minimum recommended lanes widths, as specified in the Corridor Matrix.

Minimum Recommendations & Potential Modifications

The recommended lane widths in the Corridor Matrix meet the ITE/CNU and VDOT guidelines and comply with the AASHTO standards. The Corridor Matrix recommends 10 to 11 feet for Local Streets, 11 feet for Avenues and Major Avenues, 11 feet for Boulevards and Transit Boulevards in T-6 and T-5 T-Zones, and 11 to 12 feet for Boulevards and Transit Boulevards in T-4 and T-3 T-Zones.

Wider outside lanes may be preferable to encourage bicyclists to share the outside travel lane with automobiles; up to 15 feet may be advisable if no other bicycle facilities are possible within the right of way (refer to the previous section on the Bicycle Element for more detail on the wide outside curb lane option and the use of shared lane markings). Avoid using all minimum dimensions for lane width, bicycle lane, and on-street parking lanes.

Design Speed

Vehicle speed is the most influential factor in roadway design. In the conventional road design process, designers select a minimum design speed. The minimum design speed determines most of a roadway's physical characteristics including horizontal and vertical curvature, stopping sight distance, lane width, buffer (or shoulder) width, slope, bridge widths and vertical clearances, etc. Design speed is a function of roadway classification (rural or urban; arterial, collector, or local) and terrain (level, rolling, or mountainous). In traditional roadway design, designers will design the road for the minimum design speed and post the speed limit at usually five to ten miles per hour slower than the minimum design speed. Designers are traditionally encouraged to select the minimum design speed to be as high as practical. This conventional approach leads to 'overdesigning' roadways to be able to go faster than the

posted speed. While it reduces the crash rate for vehicles going over the posted speed, it also encourages more vehicles to drive faster than the posted speed.

Target speed is the anticipated operating speed of a roadway, and the basis for the selection of the design speed. In the traditional road design process, target speed and design speed are assumed to be the same without much if any discussion, and usually set to five miles per hour higher than the expected posted speed limit. Recent developments in the road design process, particularly in Context Sensitive Solutions⁵ projects, have included the determination of target speed as a discussion amongst all involved stakeholders including community members to ensure that the anticipated operating speed is appropriate for the land use context and safe for pedestrians and bicyclists. The term ‘target speed’ simply implies that the selection of this speed has been agreed upon by stakeholders and not just assumed. For the purposes of selecting the physical design elements of the roadway, target speed is equal to design speed.

Posted speeds for newly constructed high speed roads are typically set to five miles per hour below the design speed. Occasionally, communities may perform a speed study to see if the current posted speed is appropriate, and change the posted speed to match the 85th percentile speed from the speed study.

When designing slower speed roads (generally 45 mph or less), designers may assume the anticipated posted speed will be the same as the minimum design speed. Road design projects that involve the selection of target speed usually result in the purposeful selection of the same speed for the target speed, design speed, and posted speed. Once a road is constructed, communities may decide to post the speed limit lower than a roadway’s design speed for a variety of safety and community benefits. Posted speeds may be lower than design speeds.

VDOT & ITE/CNU Guidance

The Geometric Design Standards in the VDOT Road Design Manual Appendix A provide a range of appropriate design speeds for each functional classification and terrain type. Design speeds for Urban Arterials generally range from 40 to 60 mph and occasionally may be as low as 30 mph. The lower (40 mph and below) speeds apply in the central business district and intermediate areas. The higher speeds are more applicable to the outlying business and developing areas.” Design speeds for Urban Collectors range from 30 mph to 60 mph. Urban local streets have design speeds ranging from 20 to 30 mph. Urban freeway design speeds range from 50 to 70 mph.

⁵ [Context Sensitive Solutions](#) (CSS) is a type of design process that is more collaborative and interdisciplinary than the traditional road design processes. CSS involves all stakeholders in providing a transportation facility that fits its setting to encourage all community members early and continuously throughout the process.

Table B-3 – Design Speeds & VDOT Functional Classes. The Geometric Design Standards in Appendix A of the VDOT Road Design Manual specify a range of design speeds for each functional class.

	VDOT Design Speed Range					
	20 mph	30 mph	40 mph	50 mph	60 mph	70 mph
VDOT Functional Classification	Urban Local Street					
		Urban Collector				
		Urban Minor Arterial				
		Urban Other Principal Arterial				
				Urban Freeway		

The ITE/CNU Guidebook recommends basing thoroughfare design on target speed. The ITE/CNU Guidebook recommends target speeds of 25 to 35 mph for the thoroughfare types it describes, which generally include all of the corridor types except the Multimodal Through Corridor. The ITE/CNU Guidebook recommends a 25 mph target speed for all local streets, a range of 25 to 30 mph for avenues generally, and a range of 25 to 35 mph for boulevards. Note, these recommendations from the ITE/CNU Guidebook are slightly different from the design speed recommendations in the Corridor Matrix in Appendix A of these Multimodal System Design Guidelines.

In May 2011, VDOT instituted IIM-LD-117 which allows the posted speed to equal the design speed on facilities with a minimum design speed of 45 mph or less, which is consistent with the target speed concept.

Recommended Metrics

The design speeds recommended in the Corridor Matrix are based on the theoretical approach of the ITE/CNU Guidebook and are consistent with the VDOT Road Design Manual. These speeds should be considered both the design speed and also the posted speed, although communities may choose to post speed limits lower than the design speeds. The values for design speed were based on the target speed recommendations in the ITE/CNU Guidebook. These are generally at the lower end of the design speeds from the VDOT Road Design Manual which says that roads in central business districts should have slower design speeds.

The ITE/CNU recommendation for the 25 mph lower end of the design speed range for Boulevards and Major Avenues is not consistent with the VDOT Road Design Manual, which states the lowest acceptable design speed for collectors and arterials is 30 mph. The design speeds in the Corridor Matrix have a smaller range but are acceptable to both the ITE/CNU Guidebook and the VDOT Road Design Manual.

Design speeds for Multimodal Through Corridors are higher than the other corridor types. The ITE/CNU Guidebook does not provide recommendations for this type of corridor. Because this corridor type is focused on moving higher volumes of traffic at higher speeds, the design speeds are higher than the other corridor types. In Transect Zones T-4 through T-6, 45 mph is recommended as the upper limit

because of the higher number of pedestrians and bicyclists and the closeness of buildings to the street. However, pedestrian and bicycle travel can still be safely and comfortably accommodated on a 55 mph speed corridor in Transect Zones T-1 through T-3 with the recommended facilities in the Roadway Edge Zone Including a shared use path and wide buffer zone.

Table B-4 shows the design speeds for each Multimodal Corridor type and compares them to the design speeds of the VDOT functional classes for clarity.

Table B-4 – Comparison of VDOT Functional Classes to the Multimodal Corridor Types with Design Speeds. The design speeds for each Multimodal Corridor type fit within the range of appropriate design speeds of the VDOT functional classes. The design speeds of all five Placemaking Corridor types are 35 mph or slower.

	VDOT Functional Classification (Design Speed)				
	Interstate, Freeway, or Expressway (50 – 70 mph)	Urban Other Principal Arterial (30 – 60 mph)	Urban Minor Arterial (30 – 60 mph)	Urban Collector (30 – 50 mph)	Local Street (20 – 30 mph)
Multimodal Corridor Types (Design Speed)	Multimodal Through Corridor (35-55 mph)				
		Transit Boulevard (30-35 mph)			
		Boulevard (30-35 mph)			
			Major Avenue (30-35 mph)		
			Avenue (25-30 mph)		
					Local Street (25 mph)

See Road Design Manual, Appendix A for geometry design criteria based on Design Speed.

Posted Speed = Design Speed when Design Speed is 45 mph or less.

Roadway (Street) can be posted less than the Design Speed.

Potential Modifications

Exceptions to the design speeds are not recommended. The design speeds in the Corridor Matrix specifically represent reasonable vehicular speeds that balance the needs for all road users. Access management techniques are recommended to reduce delay rather than the selection of a higher design speed. By following the comprehensive multimodal planning process described in the Multimodal System Design Guidelines, communities will outline networks for each mode that ensure a balance of mobility for all travelers.

Number of Through Lanes

The number of through lanes has a large effect on the character of a corridor. Fewer through lanes are generally desirable for streetside activities, and are generally safer for pedestrians, bicyclists and vehicles. Roads with fewer lanes take less time for pedestrians to cross, and passing maneuvers are

minimized. More lanes provide more vehicular capacity, but also increase noise and potential safety hazards.

VDOT & ITE/CNU Guidance

According to the VDOT Road Design Manual, capacity analysis of traffic data will determine the number of through lanes necessary for operation at a satisfactory level of service.⁶

The ITE/CNU Guidebook provides a range for each thoroughfare type. Four to six lanes are recommended for all Boulevards, two to four lanes are recommended for all Avenues, and two to four lanes are recommended for local streets in C6, C5, and C4 commercial areas, and two lanes are recommended for local streets in C4 residential and C3 areas.

The ITE/CNU Guidebook recommends weighing a number of different factors when determining the number of through lanes. These factors include community objectives, thoroughfare type, long-range transportation plans, and corridor-wide and network capacity analysis.

Recommended Metrics

The recommended number of through lanes in the Corridor Matrix includes both directions of travel. A road with four to six through lanes would have two to three lanes in each direction. These values do not include bus-only lanes, bike lanes, or parking lanes. The recommended values are consistent with the ITE/CNU Guidebook.

Potential Modifications

In more intense areas like T-6 and T-5, the street network may include one-way pairs that together function as a Boulevard or Transit Boulevard. In these instances, more than three travel lanes may exist. Generally more than three travel lanes is discouraged even in one-way pairs for safety reasons and to maintain a comfortable context for pedestrians and bicyclists.

Typical Traffic Volume Range

Average annual daily traffic (AADT) volumes indicate how many vehicles use a road on a daily basis.

VDOT & ITE/CNU Guidance

The ITE/CNU Guidebook provides a typical traffic volume range for each Multimodal Corridor type to help determine the characteristics of thoroughfares.

Recommended Metrics

The volume ranges provided in the Corridor Matrix are adapted from Table 6.4 in the ITE/CNU Guidebook, with a finer range to distinguish between the corridor types. This range is provided to give an idea of the typical usage of a facility and compare to other roadways with similar AADTs.

⁶ VDOT Road Design Manual. Chapter 2B, Section 2B-3: Determination of Roadway Design.

Potential Modifications

The AADT ranges provided are not intended to serve as upper or lower bounds for design. Instead they are simply provided for comparison. Traffic volumes widely vary on all Multimodal Corridor types.

G: Medians

Medians can be designed to enhance the aesthetic value of a corridor with landscaping and trees thereby increasing the urban green canopy, and provide a buffer between multiple travel lanes, and are especially important for pedestrians on high speed roads.

Medians can provide pedestrian refuge at intersections when crossing multiple travel lanes. However, medians also increase the distance a pedestrian must travel to cross from one side of the road to the other. Depending on the design of the signal phasing and timing, the increase in pedestrian crossing time can increase the green time for side-streets, which in turn may take away green time from the mainline movements at an intersection. Medians have both positive and negative tradeoffs and the effects for all travel modes should be considered when designing the corridor cross-section.

VDOT & ITE/CNU Guidance

Section 2E-3 Detailed Plan Design of the VDOT Road Design Manual discusses medians from the perspective of motor vehicle safety. Generally, wider medians are better in rural contexts and narrower medians are preferred in urban contexts. The VDOT Road Design Manual states that raised medians should have a minimum width of four feet, with one foot offset from the through lane edge in each direction, but four feet is not suitable for use as a pedestrian refuge. When the raised median's primary purpose is to provide space for left turn storage, the minimum width of the median is the required lane width plus four feet, with one foot on either side. Six feet from back-of-curb to back-of-curb is the minimum width for a median that is to be used as a pedestrian refuge. Six feet provides adequate space for two feet of detectable warning surface (truncated domes) on curb ramps for both sides of the median, plus two feet of flat surface in the middle where pedestrians who are visually impaired can detect that they are in a safe space (see **Figure B-11**). The minimum width for planting street trees is six feet. The 2008 VDOT Road and Bridge Standards provide more detailed specifications for median and refuge island applications (see Section 200: Curbs, Median, and Entrances).

The ITE/CNU Guidebook recommends that wherever medians are provided at intersections, they should be at least six feet wide to accommodate groups of pedestrians for refuge. Median width should not exceed 18 feet to keep streets compact and pedestrian-scaled. Table 6.4 in the ITE/CNU Guidebook recommends no medians on Local Streets, optional medians for Avenues, and medians with four to 18 foot widths for Boulevards. Continuous medians that narrow at intersections to provide left turn lanes should be 16 to 18 feet wide to allow for a turn lane (10 to 12 feet wide) plus a pedestrian refuge (six feet wide). Additionally, road designers must include one foot on either side of the median between the curb and the road stripe.

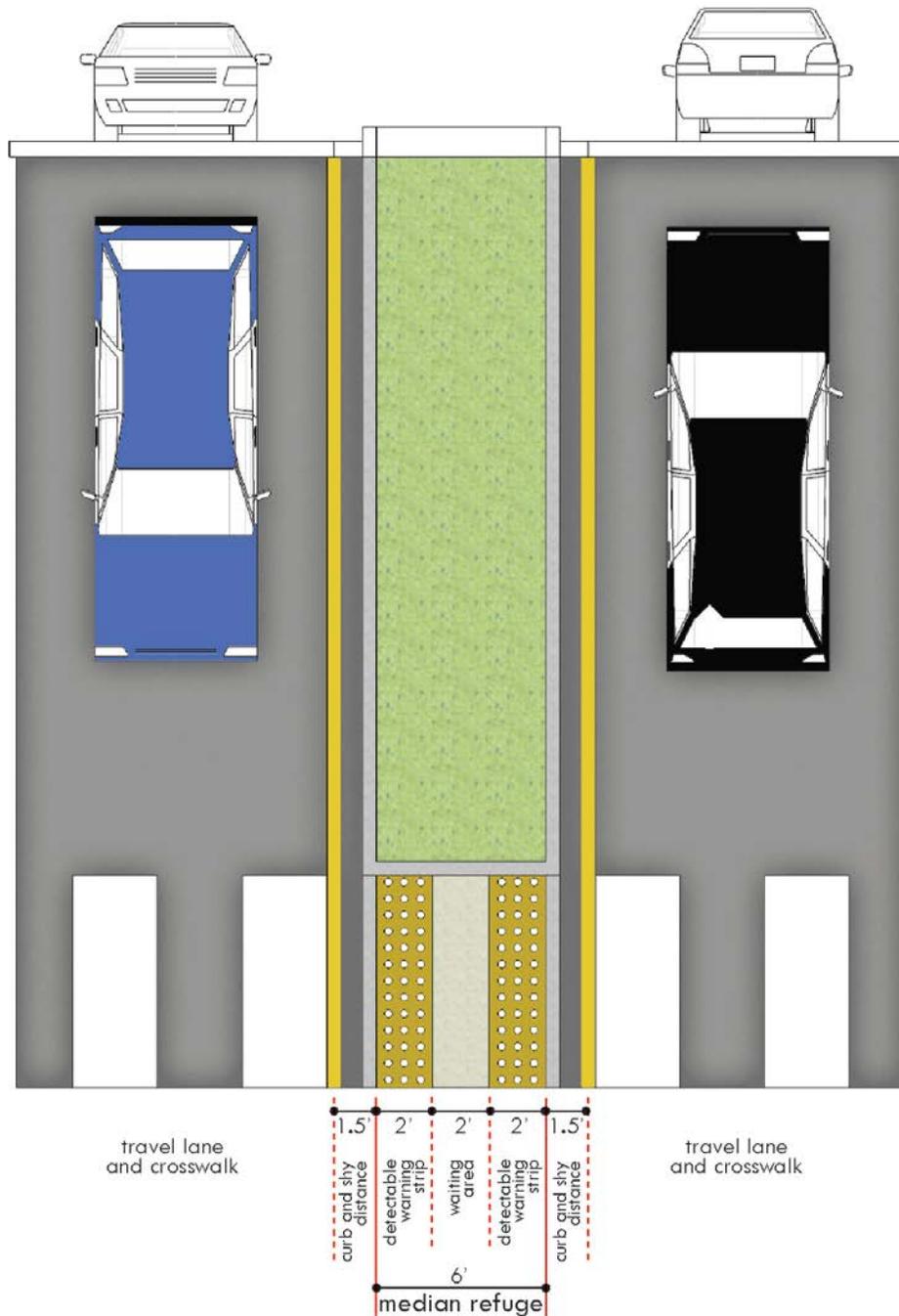


Figure B-11 – Detail of Six-Foot Wide Median Refuge. A median can serve as a pedestrian refuge if it is a minimum of six-feet wide from the back of curb to back of curb. This provides two feet of detectable warning surface ramps on either side of a two-foot wide smooth waiting area.

Optimal Recommendations

The Median Element is a Secondary Element for Green Modal Emphasis. At intersections, medians are very important for pedestrians, and thoughtful consideration should be given as to whether they would be more beneficial or detrimental to pedestrians at intersections. The values for Median Element width

are measured from back of curb to back of curb. Median widths do not include the width of the curb and the one foot shy distance on either side between the road stripe and the median curb. The recommendations in the Corridor Matrix follow the ITE/CNU guidance very closely, where medians are recommended for Boulevards and Transit Boulevards and optional for Major Avenues and Avenues. Medians are inappropriate for Local Streets. Where medians are combined with left turn lanes, the recommended width is 18 feet to provide a 12-foot turn lane with a six-foot pedestrian refuge.

Optimal values for the Median Element assume optimal travel lane widths and include space for a left turn lane at intersections of the same width. If minimum travel lane width is used, reduce the optimal median width by the same width. I.e. if the optimal travel lane width is 12 feet, but the minimum lane width of 11 feet should be used, reduce the optimal median width by one foot (from 18 feet to 17 feet).

Medians are especially recommended for Multimodal Through Corridors. In T-1 and T-2 areas, 40 foot medians may be appropriate on Multimodal Through Corridors if future widening is anticipated. However, medians this wide substantially decrease walkability, and should be critically considered for alternatives.

The median for Transit Boulevard assumes transit will run in the median; in this case median widths will likely vary between 24 and 36 feet, depending on the design of the transit alignment and station location.

Minimum Recommendations & Potential Modifications

A six-foot minimum median is recommended for Transit Boulevards (with curbside transit) and Boulevards to provide the adequate width for a pedestrian refuge. Major Avenues and Avenues with limited right-of-way may choose to forgo a median for another element that is more beneficial for the corridor's modal emphasis.

Minimum recommendations for Multimodal Through Corridors depend on the number of lanes. T-1 and T-2 Multimodal Through Corridors may have no median if they are two lanes (one lane in each direction). Roads with four lanes should have a median.