APPENDIX B(2)

MULTIMODAL DESIGN STANDARDS FOR MIXED-USE URBAN CENTERS

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APPENDIX B(2)

MULTIMODAL DESIGN STANDARDS FOR MIXED-USE URBAN CENTERS

SECTION B(2) - 1 – INTRODUCTION

INTRODUCTION

The Virginia Department of Transportation's (VDOT) *Road Design Manual* Appendix B(2) on Multimodal Design Standards for Mixed-Use Urban Centers has been developed in accordance with Chapter 498 (*http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+33.2-327)*[*] of the 2010 Acts of Assembly, which amended the Code of Virginia by adding 33.2-327, relating to design standards and methodologies for state secondary highway system components in certain jurisdictions.

Appendix B(2) serves to provide any interested localities an optional mechanism within the Road Design Manual to implement the methodology of the Department of Rail and Public Transportation's (DRPT) Multimodal System Design Guidelines and establish multimodal design standards for mixed-use urban centers.

Multimodal System Design Guidelines

The Multimodal System Design Guidelines were developed by DRPT in conjunction with VDOT and local jurisdictions. DRPT is the owner of the Multimodal System Design Guidelines and will remain responsible for any future revisions to the Guidelines in coordination with VDOT. The DRPT Multimodal System Design Guidelines can be found on the DRPT website at
http://www.drpt.virginia.gov/planning/multimodal-guidelines/
It is noted that, for the purposes of establishing multimodal design standards, this Appendix is intended to facilitate the implementation of the *methodology* of the Multimodal System Design Guidelines; some elements of the Guidelines, apart from the methodology, may not be directly applicable to this process.

Multimodal System Design Guidelines Methodology

The methodology contained within the Multimodal System Design Guidelines constitutes a "Complete Streets" approach. Complete Streets are streets that are designed and operated to enable safe access for all travelers regardless of travel mode, age and ability. The overriding purpose of the methodology is the same as that of Complete Streets – to rethink the design of transportation infrastructure to attempt to provide all pedestrians, bicyclists, and transit riders equal access to all destinations. In doing so, the methodology addresses the common limitation of constrained rights of way by affording localities additional flexibility to attempt to accommodate all transportation modes.

[*] Rev. 10/14

Where all modes cannot be accommodated, the methodology embraces the concept of modal emphasis, described in detail within the Guidelines, in which localities can identify which modes to prioritize. Finally, the methodology of corridor design used in these Guidelines does not address issues of motorized vehicular capacity in a corridor, or address any changes to the number of travel lanes.

Guidelines Implementation/Multimodal System Plan

Localities that wish to implement the methodology of the Multimodal System Design Guidelines and use the multimodal design standards shall prepare a Multimodal System Plan for review by DRPT and VDOT. The Multimodal System Plan shall include components that address locality plans for each transportation mode (consistent with *§15.2-2223* of the Virginia Code), as applicable, and identify several key elements in map form, including the types of Multimodal Centers, key networks by travel mode, and modal emphasis on each corridor (where applicable). The "Guide for Preparing a Multimodal System Plan" can be found on the DRPT website at http://www.drpt.virginia.gov/planning/multimodal-guidelines/
VDOT and DRPT recognize that some localities have already developed and adopted the components of a Multimodal System Plan. In these instances, the locality should not need to develop an entirely new plan, but rather, existing components may be compiled to form the basis of a Multimodal System Plan submittal.

Additional Information on Multimodal System Design Guidelines

The DRPT web site also contains three instructional videos, as well as an executive summary of the Multimodal System Design Guidelines, to further introduce the basic concepts and methodology in the Guidelines. The three videos are: "Why Multimodal Planning?", "Multimodal System Design Guidelines" and "Applying the Design Guidelines." Localities considering applying these Guidelines are encouraged to watch these three videos.

Benefits of Multimodal System Design Guidelines

The benefits of applying this process to future road design in urban mixed-use contexts are many. In addition to ensuring that the final corridor design conforms to the best industry standards for complete streets and VDOT requirements, this design process can ensure an efficient and economical road design. Furthermore, by following a clear and logical step by step design process, the process of roadway design can ensure that all potential end users of the future corridor are considered appropriately. The remaining sections of this Appendix are intended to facilitate localities' implementation of the Multimodal System Design Guidelines in order to use the multimodal design standards to develop roadway typical sections.

Multimodal System Plan Review and Approval Process

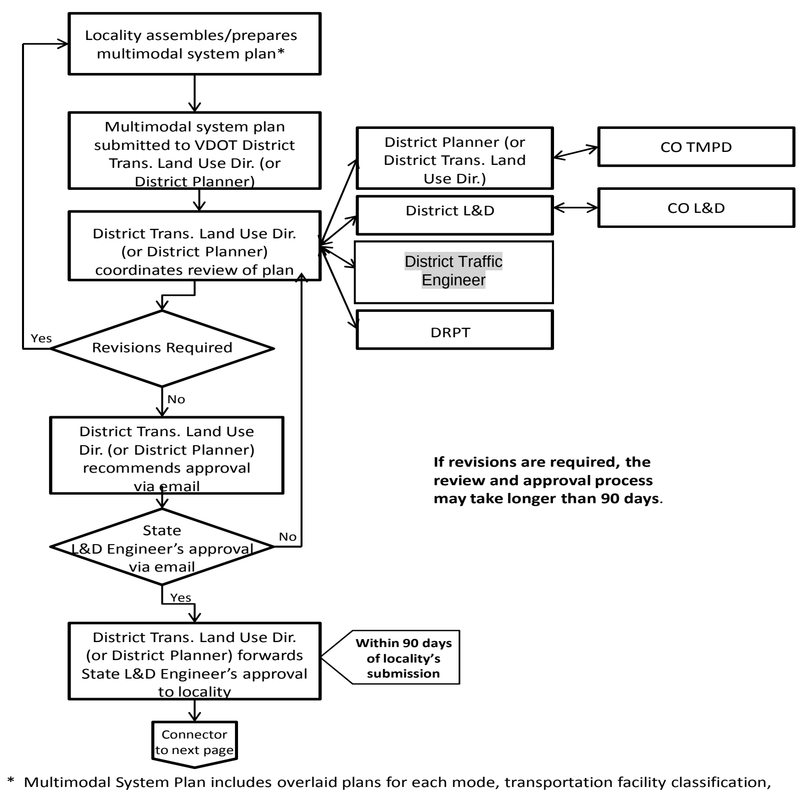
The Multimodal System Plan review and approval process is a two phase process conducted by DRPT and VDOT staff.

Phase 1 involves the review and approval of the Multimodal System Plan itself, which shall include components that address locality plans for each transportation mode (consistent with *§15.2-2223* of the Virginia Code), as applicable, and identify several key elements in map form, including the types of Multimodal Centers, key networks by travel mode, and modal emphasis on each corridor (where applicable). Seven (7) hard copies of the Multimodal System Plan shall be submitted to the VDOT District Land Use Director (or District Planner).

Once Phase 1 has been approved, the locality will use the multimodal design standards to develop the roadway typical sections based on the center type, roadway typology and modal emphasis indentified in the Multimodal System Plan.

For the Phase 1 review and approval process, see Flow Chart below:*

Process for Adoption of Multimodal Design Approach to Development Areas within a Locality
(Multimodal System Plan Activity Centers, Corridors, And Modal Emphasis)



* Multimodal System Plan includes overlaid plans for each mode, transportation facility classification, activity center identification with densities, and designation of corridor modal emphasis.

Note: If any revisions are made to the Multimodal System Plan once approved, it shall be resubmitted to DRPT and VDOT staff for review and approval.

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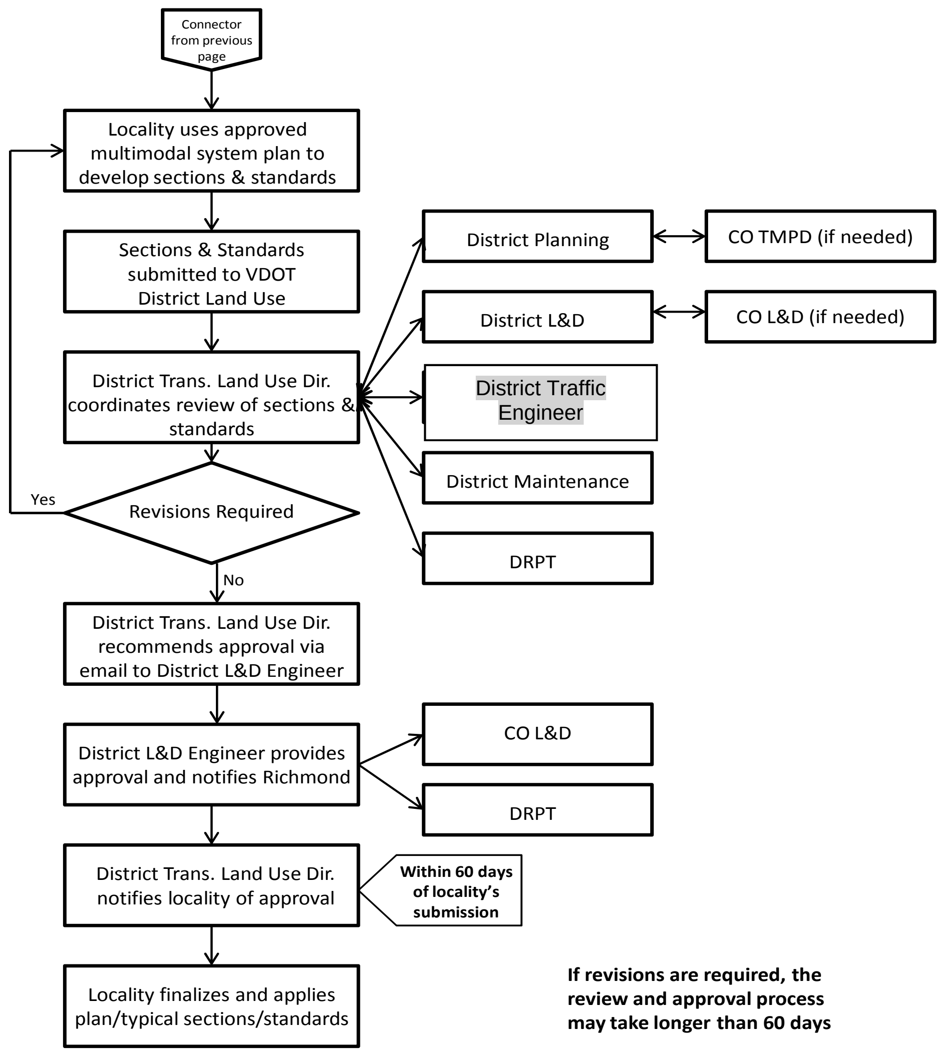
[*] Rev. 1/17

Phase 2 involves the review and approval of the roadway typical sections using the multimodal design standards based on the center type, roadway typology and modal emphasis identified in the Multimodal System Plan. Ten (10) hard copies of the roadway typical sections shall be submitted to the VDOT District Land Use Director.

For the Phase 2 review and approval process, see Flow Chart below:*

Process for Adoption of Multimodal Design Approach to Development Areas within a Locality
(Typical Sections and Design Standards)



* Rev. 1/17

FUNDAMENTAL CONCEPTS AND DEFINITIONS

The following concepts and definitions are fundamental to the implementation of the Multimodal System Design Guidelines and the establishment of multimodal design standards. They are included in this Appendix for quick reference.

Multimodal Center

The type of Multimodal Center is determined by the Activity Density, which is defined as the sum of jobs plus population per acre. Multimodal Center Types are designated as P6 (most dense) through P1 (least dense), and consist of: P6 Urban Core, P5 Urban Center, P4 Large Town or Suburban Center, P3 Medium Town or Suburban Center, P2 Small Town or Suburban Center and P1 Rural or Village Center. An example of a P6 Urban Core Multimodal Center is Tysons Corner, located in Fairfax County, which has an Activity Density above 70.

Modal Emphasis

Modal Emphasis, based upon local modal plans, may consist of automobiles, biking, walking, transit and rail within the type of Multimodal Center being developed. In addition, parking and green space are included in the consideration of Modal Emphasis because they have a significant impact on the roadway cross section design.

Roadway Typology

Roadway (Street) Typology, similar in concept to functional classification, consists of Multimodal Through Corridors, Transit Boulevards, Boulevards, Major Avenues, Avenues and Local Streets.

Below is a translation matrix that compares VDOT Functional Classification Classes to the Multimodal Corridor Types.

Comparison of VDOT Functional Classification Classes to the Multimodal Corridor Types

<table>
<tr><th>VDOT Functional Class (Design Speed)</th><th>Interstate, Freeway or Expressway (50 – 70 mph)</th><th>Urban Other Principal Arterial (30 – 60 mph)</th><th>Urban Minor Arterial (30 – 60 mph)</th><th>Urban Collector (30 – 50 mph)</th><th>Local Street (20 –30 mph)</th></tr>
<tr><td rowspan="6">Multi Modal Street Typology (Design Speed)</td><td colspan="3">Multimodal Through Corridor (35 – 55 mph)</td><td></td><td></td></tr>
<tr><td></td><td colspan="2">Transit Boulevard (30 – 35 mph)</td><td></td><td></td></tr>
<tr><td></td><td colspan="2">Boulevard (30 – 35 mph)</td><td></td><td></td></tr>
<tr><td></td><td></td><td colspan="2">Major Avenue (30 – 35 mph)</td><td></td></tr>
<tr><td></td><td></td><td colspan="3">Avenue (25 – 30 mph)</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Local Street (25 mph)</td></tr>
</table>

Notes:

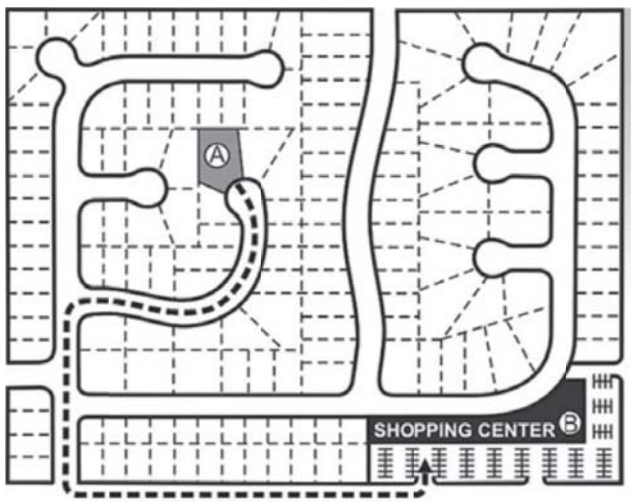
1. See Road Design Manual, Appendix A for geometry design criteria
2. Posted Speed = Design Speed when Design Speed is 45 mph or less.
3. Roadway (Street) can be posted for less than the Design Speed.

Roadway Typical Section

By combining Multimodal Center Type with Corridor Modal Emphasis and Roadway Typology, the appropriate dimensions (minimum, optimum or in between) of the elements of design that define the roadway typical section are determined. However, if the optimum valve(s) cannot be met for the modal emphasis primary element(s) a design waiver shall be submitted in accordance with IIM-LD-227.

Street Network and Connectivity

The Conventional Suburban Hierarchical Network (A), which frequently does not include a grid pattern layout, channels traffic from local streets with lower traffic volumes onto collector streets with higher volumes of traffic and then finally onto the arterial streets, where volumes and speeds are even higher. This type of network (layout) forces nearly all trips onto the arterial streets with very few alternate routes for travelers.

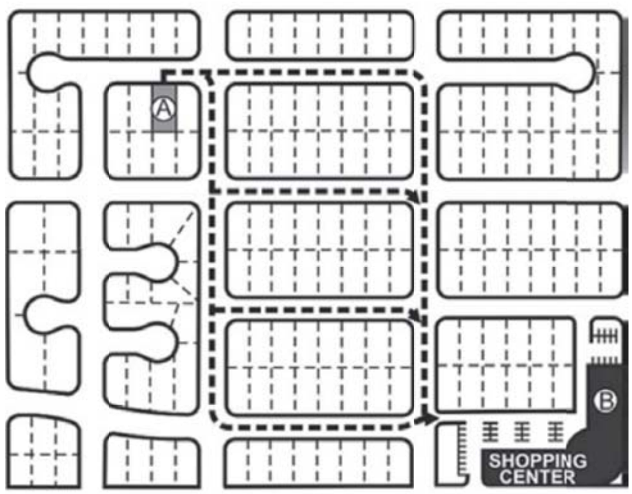


(A) Conventional suburban hierarchical network.

Source: *An ITE Recommended Practice – Designing Walkable Urban Thoroughfares: A Context Sensitive Approach*, 2010

The Traditional Urban Connected Network (B) with a grid pattern layout is a system of parallel connector streets that provide multiple and direct routes between origins and destinations. This network still uses different categories of streets, but it relies on a stronger integration of multimodal solutions to addresses transportation options for all users while providing routing options to distribute traffic.

A Traditional Urban Connected Network need not be laid out in a strict grid, with all streets either exactly parallel or perpendicular to other streets, but may incorporate some curves, off-set intersections, and other design features necessary to fit the terrain. The important defining feature is that multiple, reasonably direct routes are available for travelers to reach their destinations within or when moving through the area.



(B) Traditional urban connected network.

Source: _An ITE Recommended Practice – Designing Walkable Urban Thoroughfares: A Context Sensitive Approach_, 2010

SECTION B(2) – 2 – ROADWAY GEOMETRIC DESIGN CRITERIA

The following geometric design criteria have been determined to be appropriate for the implementation of the Multimodal System Design Guidelines and establishment of multimodal design standards.

GEOMETRIC DESIGN STANDARDS

See APPENDIX A and APPENDIX B(1)

INTERSECTION SPACING STANDARDS

Intersection spacing standards have been modified from the standards found in the APPENDIX F, TABLE 2-2 for Multimodal Mixed-Use Urban Centers (P4, P5 and P6) with an urban connected network that provide alternate routes and diversions of traffic as shown in the following table.

Intersection Spacing Standards for P5 and P6 with Urban Connected Network

Minimum Access Point Spacing within P5 and P6 Multimodal Activity Centers				
Street Typology	Speed (MPH)	Signalized Intersections	Roundabouts or Unsignalized Intersections or Crossovers	Right-in / Right-out Intersections
Through Corridor	≥ 35	1000	500	300
Transit Boulevard	30 - 35	600	400	300
Boulevard & Major Avenue	30 - 35	600	300	200
Avenue	25-30	500	250	150
Local Street	25 ≥	See RDM, Appendix B(1) and Appendix F		

Notes:

(1) "Intersection" may be a public or private street intersection or a commercial entrance.

(2) Spacing may be reduced based upon the results of a site specific traffic engineering operational analysis conducted by a licensed PE and if agreed to by VDOT.

(3) Signalized intersection may only be permitted by VDOT after a signal warrant analysis conducted in accordance with the MUTCD by a licensed PE and an evaluation showing that the installation of a roundabout or other alternate treatment is not appropriate for that location.

(4) Any proposed signalized intersection within 600 feet of a connection to an NHS highway must be analyzed to determine if the proposed signal negatively impacts operation of the NHS highway.

(5) Intersections or entrances on Avenues or Local Streets must be at least 200' from the intersection of that facility with a higher order highway, unless a reduced spacing is justified by a site specific traffic engineering operational analysis conducted by a licensed PE and if agreed to by VDOT.

(6) Connections other than right-in/right-out on any highway within 600 feet of an interchange ramp connection may only be allowed based upon the results of a site specific traffic engineering operational analysis conducted by a licensed PE and if agreed to by VDOT.

(7) Minimum access point spacing on Local Streets may be found in the *Road Design Manual*, Appendix B(1) (Figure 3) and Appendix F (Table 2-2 and Figure 4-11).

Intersection Spacing Standards for P4 with Urban Connected Network

Minimum Access Point Spacing within P4 Grid Pattern Multimodal Activity Centers				
Street Typology	Speed (MPH)	Signalized Intersections	Roundabouts or Unsignalized Intersections or Crossovers	Right-in / Right-out Intersections
Through Corridor	≥ 35	See RDM, Appendix F, Table 2-2		
Transit Boulevard & Boulevard	30 - 35	800	400	200
Major Avenue & Avenue	25 – 35 **	660	330	200
Local Street	25 ≥	See RDM, Appendix B(1) and Appendix F		

** Major Avenue speed range is 30-35 mph and Avenue speed range is 25-30 mph.

Notes:

(1) "Intersection" may be a public or private street intersection or a commercial entrance.

(2) Spacing may be reduced based upon the results of a site specific traffic engineering operational analysis conducted by a licensed PE and agreed to by VDOT.

(3) Signalized intersection may only be permitted by VDOT after a signal warrant analysis conducted in accordance with the MUTCD by a licensed PE and an evaluation showing that the installation of a roundabout or other alternate treatment is not appropriate for that location.

(4) Any proposed signalized intersection within 600 feet of a connection to an NHS highway must be analyzed to determine if the proposed signal negatively impacts operation of the NHS highway.

(5) Intersections or entrances on Avenues or Local Streets must be at least 200' from the intersection of that facility with a higher order highway, unless a reduced spacing is justified by a site specific traffic engineering operational analysis conducted by a licensed PE and agreed to by VDOT.

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(6) Connections other than right -in/right-out on any highway within 600 feet of an interchange ramp connection may only be allowed based upon the results of a site specific traffic engineering operational analysis conducted by a licensed PE and if agreed to by VDOT.

(7) Minimum access point spacing on Local Streets may be found in the Road Design Manual, Appendix B(1) (Figure 3) and Appendix F (Table 2-2 and Figure 4-11).

Intersection Spacing Standards for P4 through P6 without an Urban Connected Network and for all P1 thru P3 shall be in accordance with the APPENDIX F, TABLE 2-2 MINIMUM SPACING STANDARDS FOR COMMERCIAL ENTRANCES, INTERSECTIONS AND CROSSOVERS

STOPPING SIGHT DISTANCE

Stopping Sight Distance may be used for intersection design for P5 and P6 with Urban Connected Network for streets with design speeds of 35 mph or less as shown in CHAPTER 2D, TABLE 2D-1[*] STOPPING SIGHT DISTANCE AND TABLE 2D-2 STOPPING SIGHT DISTANCE ON GRADES. However, Intersection Sight Distance shall be used for all Multimodal Through Corridors.

If stopping sight distance cannot be obtained, a Design Exception shall be submitted in accordance with IIM-LD-227, which can be accessed at *http://www.extranet.vdot.state.va.us/locdes/electronic_pubs/iim/iim-table-of-contents.pdf*

Stopping sight distances exceeding those shown in the Tables 2-5 and 2-6 mentioned above should be used as basis for design wherever and whenever practical.

In computing and measuring stopping sight distances, the height of the driver's eye is estimated to be 3.5 feet and the height of the object to be seen by the driver is 2 feet, equivalent to the taillight height of a passenger car. The "K Values" shown are a coefficient by which the algebraic difference in grade may be multiplied to determine the length in feet of the vertical curve that will provide minimum sight distance. Crest vertical curves shall meet or exceed AASHTO design criteria for Stopping Sight Distance, not the "k" Values. Sag vertical curves shall meet or exceed the AASHTO design criteria for headlight sight distance and "k" Values.

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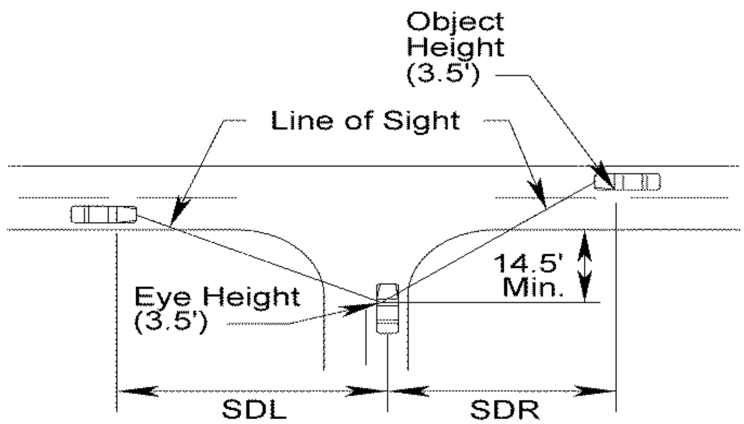
[*] Rev. 1/16

INTERSECTION SIGHT DISTANCE

Intersection sight distances exceeding those shown in the **APPENDIX F, TABLES 2-5** should be used as basis for design wherever and whenever practical.



SDR = Sight Distance Right (For a vehicle making a left turn)

SDL = Sight Distance Left (For a vehicle making a right or left turn)

Intersection Sight Distance shall be used for all P1 thru P4 with and without Urban Connected Network in accordance with APPENDIX F, TABLE 2-5 INTERSECTION SIGHT DISTANCE

SIGHT DISTANCE TRIANGLE

See APPENDIX F and APPENDIX B(1)

SECTION B(2) - 3 - ELEMENTS OF TYPICAL SECTION

The following elements of typical section have been determined to be appropriate for the implementation of the Multimodal System Design Guidelines and establishment of multimodal design standards.

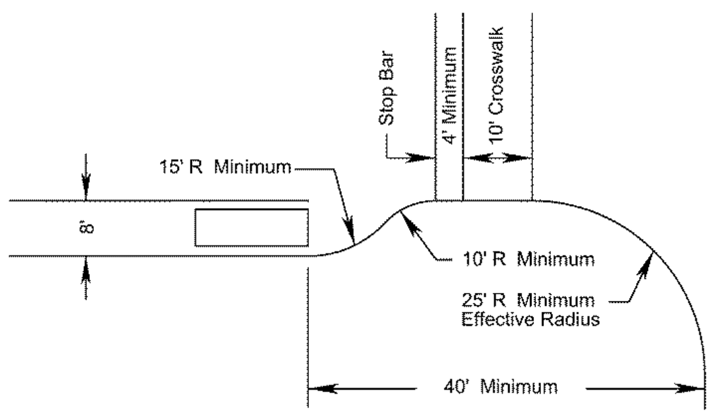
BICYCLE AND PEDESTRIAN FACILITIES

See APPENDIX A, SECTION A-5 – BICYCLE AND PEDESTRIAN FACILTIES GUIDELINES, APPENDIX B(1) – 4 – ELEMENTS OF TYPRICAL SECTION and IIM-LD-55 at *http://www.extranet.vdot.state.va.us/locdes/electronic_pubs/iim/iim-table-of-contents.pdf*

PARALLEL ON-STREET PARKING LANE WIDTHS

Parallel parking is the preferred arrangement for on-street parking. Provisions for on-street parallel parking are allowed on roadways where the posted speed limit is 35 mph or less.
Residential and Mixed-Use – 7 feet in width measured from the face of curb.
Commercial and Industrial – 8 feet in width measured from the face of curb.
For more details, see APPENDIX C, SECTION C-1- DESIGN FEATURES.

CURB EXTENSIONS (BULB-OUTS)



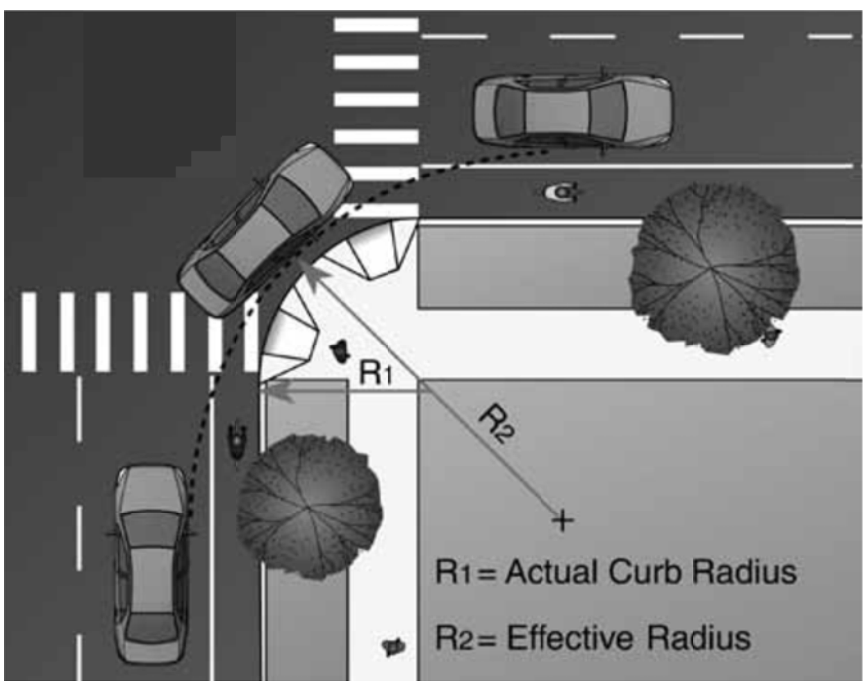
Curb Extension (Bulb-Out)

Note:

1. The sight distance triangle shall be free of any obstructions that block a driver's view of potential conflicting vehicles or pedestrians entering the traveled way. Examples of obstructions that limit sight distance include vehicles in adjacent lanes, parked vehicles, bridge piers and abutments, large signs, poorly pruned tress, tall shrubs and hedges, walls, fences and buildings.
2. Curb extensions shall only be used where there is on-street parking and where only a small percentage of turning vehicles are larger than the design vehicle.
3. Curb extensions are not applicable to intersections with exclusive right-turn lanes adjacent to the curb, or intersections with a high volume of right-turning trucks or buses turning into narrow cross streets.

CURB RADII – ACTUAL AND EFFECTIVE

Actual Curb Radius (R_1) and Effective Radius (R_2) for Right-Turn Movement at Intersections



Source: *An ITE Recommended Practice – Designing Walkable Urban Thoroughfares: A Context Sensitive Approach*, 2010

The Effective Turning Radius is the minimum radius appropriate for a vehicle turning from a right-hand travel lane on the approach street to the appropriate lane of the receiving street. This radius is determined by the selection of a design vehicle appropriate for the streets being designed and the lane on the receiving street into which that design vehicle will turn.[*] **The minimum effective turning radius is 25 feet.**

The Actual Curb Radius should be no greater than that needed to accommodate the design turning radius. The actual curb radius shall be such that the design vehicle does not encroach into the adjacent or opposite lanes when making a turn. **The minimum actual curb radius is 15 feet.**

If Intercity Buses or City Transit Buses are the design vehicle the minimum radius should be increased to accommodate the turning radius of such vehicles. Minimal encroachment into the opposing lane of traffic of the receiving street is expected.

Auto-TURN® diagrams shall be used to demonstrate the impact on the opposing lane of the receiving street and the sufficiency of the street widths to accommodate the vehicles without scrubbing curbs.

TURN LANE TAPERS

Turn Lane Tapers shall be determined using an 8:1 ratio for design speeds 45 mph and less, based on the width of the turn lane. However, the minimum turn lane taper for a single turn lane shall not be less than 80 feet. The turn lane taper for a dual turn lane shall be 1 ½ times the length of the single turn lane taper. This results in a longer length of full-width pavement for the auxiliary lane.

ROADWAY DRAINAGE

See APPENDIX B(1), SECTION B(1) – 4 – ELEMENTS OF TYPICAL SECTION.

RIGHT OF WAY

See APPENDIX B(1), SECTION B(1) – 4 – ELEMENTS OF TYPICAL SECTION.

[*] Rev. 7/14

SECTION B(2) – 4 - OTHER DESIGN CONSIDERATIONS

The following are other design considerations for the implementation of the Multimodal System Design Guidelines and establishment of multimodal design standards.

CLEAR ZONE

See APPENDIX B(1), SECTION B(1) – 5 – OTHER DESIGN CONSIDERATIONS.

TRAFFIC CALMING

See APPENDIX B(1), SECTION B(1) – 5 – OTHER DESIGN CONSIDERATIONS.

ROUNDABOUTS

See APPENDIX B(1), SECTION B(1) – 5 – OTHER DESIGN CONSIDERATIONS.

MAINTENANCE ITEMS

For locality-maintained urban projects, the locality is responsible for maintaining the project. On VDOT maintained projects, VDOT only maintains those items that are necessary for the safe functioning of the transportation purposes of the street. Non-transportation elements and transportation elements constructed using non-standard materials will generally be maintained by others under a land use permit.

UTILITY PLACEMENT

See APPENDIX B(1), SECTION B(1) – 5 – OTHER DESIGNCONSIDERATIONS.

ROADWAY LIGHTING

The installation, maintenance and operation of roadway lighting shall be provided by and at the sole expense of the locality. Roadway lighting within VDOT right of way is permitted by land use permit only. (See RDM, APPENDIX B(1), SECTION B(1) – 5 – OTHER DESIGN CONSIDERATIONS).

SIDEWALK / CROSSWALK PAVERS

See IIM-LD-218
http://www.extranet.vdot.state.va.us/locdes/electronic_pubs/iim/iim-table-of-contents.pdf

STREETSCAPE AND LANDSCAPE CONSIDERATIONS

See APPENDIX B(1), SECTION B(1) – 5 – OTHER DESIGN CONSIDERATIONS.

ACTIVITY CENTER AMENITIES SUMMARY*

See *http://www.virginiadot.org/VDOT/Info/asset_upload_file482_62127.pdf*

* Rev. 7/14