

**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
DESIGN DIRECTIVE**

**DD-610
GEOMETRIC DESIGN CRITERIA FOR URBAN HIGHWAYS**
May 25, 2006

FUNCTIONAL CLASSIFICATION OF HIGHWAYS

The AASHTO functional classification system is to be used to classify highways for design purposes. This system consists of arterials, collectors, and local roads. Upon determining the functional classification of the highway (see the Road File Inventory maintained by the Intermodal and Special Project Section of the Planning and Research Division), the criteria as established in this directive which has been derived from the 2004 AASHTO publication "*A Policy on Geometric Design of Highways and Streets*", the 2005 AASHTO publication "*A Policy on Design Standards – Interstate System*", and the 2001 AASHTO publication "*Guideline For Geometric Design of Very Low-Volume Local Roads (ADT ≤ 400)*" as applicable is to be used in all designs unless otherwise directed.

The Designer should refer to the above referenced AASHTO publications for other geometric design criteria not established in this directive. In cases of discrepancy between the AASHTO publication and this directive, the AASHTO publication will govern on National Highway System (NHS) projects. This document will govern on non-NHS projects.

Attachment

GEOMETRIC DESIGN CRITERIA FOR URBAN HIGHWAYS**DESIGN SPEED**

Freeway – See following Table and Exhibits

CRITERIA	DESIGN SPEED (MPH)
Min. Radii (feet)*	See Exhibit 3-27
Min. Stopping Sight Distance (ft.)	See Exhibit 3-1
Max. Grade (Percent)	See Exhibit 8-1

*e max used in lieu of minimum degree of curvature

Design speed (mph)	Brake reaction distance (ft)	Braking distance on level (ft)	Stopping site distance	
			Calculated (ft)	Design* (ft)
15	55.1	21.6	76.7	80
20	73.5	38.4	111.9	115
25	91.9	60.0	151.9	155
30	110.3	86.4	196.7	200
35	128.6	117.6	246.2	250
40	147.0	153.6	300.6	305
45	165.4	194.4	359.8	360
50	183.8	240.0	423.8	425
55	202.1	290.3	492.4	495
60	220.5	345.5	566.0	570
65	238.9	405.5	644.4	645
70	257.3	470.3	727.6	730
75	275.6	539.9	815.5	820
80	294.0	614.3	908.3	910

Note: Brake reaction distance predicated on a time of 2.5 s; deceleration rate of $[11.2\text{ft/s}^2]$ used to determine calculated site distance.

* Use Design vs. Calculated.

Exhibit 3-1 Stopping Sight Distance

OTHER ARTERIALS – SEE FOLLOWING TABLE & EXHIBITS

DESIGN ELEMENT	CRITERIA
Minimum Curvature (ft)	SEE EXHIBITS 3-25 thru 3-27
Minimum Stopping Sight Distance (ft)	SEE EXHIBIT 3-1
Minimum Passing Sight Distance (ft)	SEE EXHIBIT 3-7
Maximum Distance Between Passing Opportunities (miles)	1.0
Maximum Grade (percent)	SEE EXHIBIT 7-10

e max = 4% for urban areas SEE EXHIBIT 3-25

e max = up to 8% for other areas

e max used in lieu of minimum degree of curvature

Design speed (mph)	Assumed speeds (mph)		Passing sight distance (ft)	
	Passed vehicle	Passing vehicle	From Exhibit 3-6	Rounded for design
20	18	28	706	710
25	22	32	897	900
30	26	36	1088	1090
35	30	40	1279	1280
40	34	44	1470	1470
45	37	47	1625	1625
50	41	51	1832	1835
55	44	54	1984	1985
60	47	57	2133	2135
65	50	60	2281	2285
70	54	64	2479	2480
75	56	66	2578	2580
80	58	68	2677	2680

Exhibit 3-7 Passing Sight Distance for Design of Two-Lane Highways

Type of terrain	Maximum grade (%) for specified design speed (mph)						
	30	35	40	45	50	55	60
Level	8	7	7	6	6	5	5
Rolling	9	8	8	7	7	6	6
Mountainous	11	10	10	9	9	8	8

Exhibit 7-10 Maximum Grades for Urban Arterials

Collectors - 30 mph minimum.

Local Streets - 20 to 30 mph minimum depending upon area controls (i.e. right of way, adjacent development).

SIGHT DISTANCE (Function of Design Speed)

Freeways - See Exhibit 3-1 (above)

Other Arterials - See Exhibits 3-1 and 3-7 (above)

Collectors - Stopping, See Exhibits below.

Passing - Not applicable.

Design speed (mph)	Stopping sight distance (ft)	Rate of vertical curvature, K ^a	
		Calculated	Design
15	80	9.4	10
20	115	16.5	17
25	155	25.5	26
30	200	36.4	37
35	250	49.0	49
40	305	63.4	64
45	360	78.1	79
50	425	95.7	96
55	495	114.9	115
60	570	135.7	136
65	645	156.5	157
70	730	180.3	181
75	820	205.6	206
80	910	231.0	231

^a Rate of vertical curvature, K, is the length of curve per percent algebraic difference intersecting grades (A). $K=L/A$

Exhibit 3-75 Design Controls for Sag Vertical Curves

Design speed (mph)	Stopping sight distance (ft)	Rate of vertical curvature, K ^a	
		Calculated	Design
15	80	3.0	3
20	115	6.1	7
25	155	11.1	12
30	200	18.5	19
35	250	29.0	29
40	305	43.1	44
45	360	60.1	61
50	425	83.7	84
55	495	113.5	114
60	570	150.6	151
65	645	192.8	193
70	730	246.9	247
75	820	311.6	312
80	910	383.7	384

^a Rate of vertical curvature, K, is the length of curve per percent algebraic difference intersecting grades (A). $K=L/A$

Exhibit 3-72 Design Controls for Stopping Sight Distance and for Crest Vertical Curves

Local Streets - Stopping, DESIGN SPEED, 20 mph, 115'
DESIGN SPEED, 30 mph, 200'

Passing - Not applicable.

GRADE (Function of Design Speed)

Freeway - See above Exhibits.

Other Arterials - See above Exhibits.

Collectors - As level as consistent with surrounding terrain.

Minimum 0.5%, Maximum 14%. To be consistent with design speed.

See Exhibit 6-8 below

Type of terrain	Maximum grade (%) for specified design speed (mph)								
	20	25	30	35	40	45	50	55	60
Level	9	9	9	9	9	8	7	7	6
Rolling	12	12	11	10	10	9	8	8	7
Mountainous	14	13	12	12	12	11	10	10	9

Note: Short lengths of grade in urban areas, such as grades less than 500 ft in length, one-way downgrades, and grades on low-volume urban collectors may be up to 2 percent steeper than the grades shown above.

Exhibit 6-8 Maximum Grades for Urban Collectors

Local Streets - As level as consistent with surrounding terrain. Minimum 0.5%. Maximum 15%. To be consistent with design speed.

ALIGNMENT

Arterials - See DD-601 (minimum radii - emax).

Collectors - Fit existing topography to minimize cuts and fills as well as not to sacrifice safety. To be consistent with design speed.

Local Streets - Fit existing topography to minimize cuts and fills as well as not to sacrifice safety. To be consistent with design speed.

PAVEMENT CROSS SLOPE (Tangent Sections)

Freeway (Interstate) - Same as rural, see DD-601.

Other Arterials - 2% to 3%. Lower values should be used in center lanes with increases of 0.5 to 1.0% per lane drained to a maximum of 3%.

Collectors - Same as "Other Arterials."

Local Streets - 2% (paved).
2% to 6% (unpaved).

SUPERELEVATION

Freeway (Interstate) - Same as rural, see DD-601.

Other Arterials - On major controlled access arterials and any arterial with design speed of 50 mph and above, see DD-601. For other arterials, generally not used, but if used, 4% maximum. See also Pages 148 to 152 of the 2004 publication *"A Policy on Geometric Design of Highways and Streets."*

Collectors - Usually impractical or undesirable due to adjacent development, etc.
4% maximum when used.

Local Streets - Usually impractical or undesirable due to adjacent development, etc.
4% maximum when used, 6% may be used where a curve is long enough to provide an adequate superelevation transition length.

NUMBER OF LANES

Freeway (Interstate) - Same as rural, see DD-601.

Other Arterials - Varies, dependent upon capacity analysis and available right of way.

Collectors - Should be based on highway capacity analysis. Usually there are 2 lanes.

Local Streets - Service to 3 or fewer parcels - 1.
 Service to more than 3 parcels - 2; which may consist of 2 individual one-way lanes (one-way pair).

LANE WIDTH

Freeway (Interstate) – 12 ft.

Other Arterials - 10 ft to 12 ft. If heavy truck traffic anticipated, desirable to add 1ft, up to a maximum width of 12 ft. If truck traffic restricted, may narrow by 1ft to a minimum width of 10 ft.

Collectors - Same as "Other Arterials."

Local Streets - Service to 3 or fewer parcels (one lane) – 12 ft total.
 One-way pairs – 12 ft total.
 Service to 10 or fewer parcels (two lanes) – 8 ft each.
 Industrial areas – 12 ft minimum.
 All others – 10 ft minimum.
 If right of way width controls, the width for industrial areas and all others may be reduced to 11 ft.

PARKING LANES

Freeway (Interstate) - Not applicable.

Other Arterials - Should only be considered when provision is required due to existing conditions. When a parking lane is provided, the width should meet lane width criteria if future traffic volumes warrant additional capacity. This lane can be used as an additional traffic lane during peak traffic hours by prohibiting parking at these times in addition to possibly being used as a storage lane. If there is no future demand for an additional traffic lane, 8 ft width may be used. Gutter pan width may be included in this width.

Collectors - 8 ft to 11ft wide on one or both sides if sufficient width is available. When a parking lane is provided, the width should meet lane width criteria if future traffic volumes warrant additional capacity. Gutter pan width may be included in this width.

Local Streets - 7 ft in residential areas and 8 ft in commercial and industrial areas. When a parking lane is provided, the width should meet lane width criteria if future traffic volumes warrant additional capacity. If there is no future demand for an additional traffic lane, 6 ft width may be used. Gutter pan width may be included in this width.

CURBS

See DD-663.

CURB RAMPS AND SIDEWALKS

See DD-811.

DRIVEWAYS

See DD-308.

ROADWAY WIDTHS FOR BRIDGES

Arterials - Principal - Same as rural, see DD-601.
Minor – 30 ft minimum.

Collectors - Roadway width 18 ft to 22 ft, match roadway width, minimum 18 ft.
Roadway width greater than 22 ft, ADT less than 1000, minimum 22 ft.
Roadway width greater than 30 ft, ADT greater than 1000, minimum 30 ft.

Local Streets - One-lane streets – 18 ft minimum, 16 ft may be used if mobile home movement is not anticipated or another route exists for mobile home movement.
Two-lane streets – 20 ft minimum.

****NOTE**** The minimum clear width for new bridges on arterial streets should be the same as the curb to curb width of the street.

HORIZONTAL CLEARANCE TO OBSTRUCTIONS

Freeway (Interstate) - Same as rural, see DD-601.

Other Arterials - Clear roadside recommended. If curbed, 1.5ft minimum between face of curb and object. 3 ft desirable particularly near turning radii at driveways and intersections.

Collectors - If curbed, 1.5 ft minimum between face of curb and object. If a continuous parking lane exists, no clearance required, but 1.5 ft setback to obstructions is desirable.

Local Streets - 1.5 ft minimum between face of curb and object.

VERTICAL CLEARANCE

Freeway (Interstate) - Same as rural, see DD-601.

Other Arterials - New or reconstructed, 16 ft clearance over entire roadway. In highly urbanized areas, 14 ft clearance may be provided if there is one route with 16 ft clearance. Additional clearance (0.5 ft) should be allowed for future overlays of the underpass.

Collectors - 14 ft over the entire roadway plus an allowance (0.5ft) for future overlays of the underpass.

Local Streets - Same as "Collectors."

BICYCLE / PEDESTRIAN ACOMMODATION

See DD-813