Sight Distance Values⁵

	SIGHT DISTANCE - FEET										
			DE	ECISION SIG	HT '						
DESIGN	STOPPING		AVOID	ANCE MANE	UVER ²		PASSING				
SPEED MPH	SIGHT DISTANCE ¹	А	В	С	D	Е	SIGHT DISTANCE ^{3, 4}				
25	155						450				
30	200	220	490	450	535	620	500				
35	250	275	590	525	625	720	550				
40	305	330	690	600	715	825	600				
45	360	395	800	675	800	930	700				
50	425	465	910	750	890	1030	800				
55	495	535	1030	865	980	1135	900				
60	570	610	1150	990	1125	1280	1000				
65	645	695	1275	1050	1220	1365	1100				
70	730	780	1410	1105	1275	1445	1200				
75	820	875	1545	1180	1365	1545	1300				

<u>Notes</u>

1 From <u>Table 3-1, page 3-4, 2018 GDHS</u>. (GDHS hyperlink is only available to WisDOT staff.)

2	Avoidance maneuver A:	Stop on rural road - t = 3.0 s			
	Avoidance maneuver B:	Stop on urban road - t = 9.1s			
	Avoidance maneuver C: Speed/path/direction change on rural road - t varies between 10.2 and 11.2 s				
	Avoidance maneuver D:	Speed/path/direction change on suburban road - t varies between 12.1 and 12.9 s			
	Avoidance maneuver E:	Speed/path/direction change on urban road - t varies between 14.0 and 14.5 s			
3	See Chapter 3 of the Wisconsin Traf	fic Engineering, Operations and Safety Manual (TEOpS) for No passing zone standards.			
4	See <u>Attachment 5.8</u> for vertical curve design for Passing Sight Distance.				
5	See Attachment 5.2 for Sight Distance	ce Category Application			

Sight Distance Categories - Application and Sight Distance Boundaries

		Sight Distance Boundaries (SDB)					
Category	Locations to Apply	Begin	End				
1	Default - All locations not in Category 2	End limit of Category 2	Begin limit of Category 2				
	Mainline approach to an Interchange entrance ramp where there is a continuous auxiliary lane to the next downstream interchange exit (See Example 1)	At a distance = DSD-C ¹ from the entrance ramp gore of the upstream interchange ²	At the entrance ramp gore of the upstream interchange ²				
	Crossroad approach to an Interchange ramp terminal where the posted speed is 40 mph or less	At a distance = DSD-C ¹ from the CL of the ramp terminal intersection	At the CL of the ramp terminal intersection				
	Lane drop on a non-freeway or non-expressway	At a distance = DSD-C ¹ from the start of the lane drop	At the end of the lane drop				
	Railroad / highway at-grade crossings (See Example 2)	At a distance = DSD-C ¹ from the stop bar upstream from the RR tracks	At the stop bar upstream from the RR tracks				
2	High speed multilane highway approach to an intersection with a right turn but no left turn in the direction of travel (See Example 3)						
	Approach to an intersection where a thru lane becomes a "turn only" lane						
	Two-lane highway or non-high speed multi-lane road approach to an Intersection with an unusual configuration, including multiple right-turn lanes or multiple left-turn lanes	At a distance = DSD-C ¹ from the back of the design queue ³	At the CL of the intersection				
	Side road approach to an at-grade intersection with a bypass roadway or expressway						
	High-speed 2-lane rural highway approach to an isolated stop sign, traffic signal, or roundabout where such control is unexpected because it is not typical						

FDM 11-10 Attachment 5.2	Sight Distance	Category Applications
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	Mainline thru lane that becomes an "exit only" lane at an interchange (See Example 4)	At a distance = DSD-C ¹ from the begin taper to exit ramp	At the exit ramp gore ²		
	Mainline approach to an interchange exit ramp (See Example 1)	At a distance = DSD-C ¹ from the begin taper to exit ramp	At the exit ramp gore ²		
	Mainline approach to an interchange entrance ramp, except an entrance ramp where there is a continuous auxiliary lane to the next downstream interchange exit.	At a distance = DSD-C ¹ from the entrance ramp gore ²	At the end taper from entrance ramp		
	(See Example 5 for entrance ramp)				
	Mainline approach to an Interchange with unusual features, e.g., multiple entrance or exit points; short weaving sections	At a distance = DSD-C ¹ from the 1st upstream feature, i.e., begin taper to exit ramp, or entrance ramp gore ²	At the last downstream feature, i.e., the exit ramp gore, or the end taper from entrance ramp 2		
2	High-speed multilane highway approach to an intersection with a left turn in the direction of travel (See Example 6)	At a distance = DSD-C ¹ from the back of the design queue ³	At the CL of the intersection		
	Crossroad approach to an interchange ramp terminal intersection where the posted speed is 45 mph or greater	At a distance = DSD-C ¹ from the CL of the ramp terminal intersection	At the CL of the ramp terminal intersection		
	Lane drop on freeways or expressways	At a distance = DSD-C ¹ from the start of the lane drop	At the end of the lane drop		
	Approach to a major fork on a freeway or expressway	At a distance = DSD-C ¹ from the start of widening	At the point of divergence		
	Approach to a branch connection on a freeway or expressway	At a distance = DSD-C ¹ from the point of convergence	At the end of lane reduction [or, if there is no lane reduction, at the point of convergence]		

Notes

1. DSD-C = Decision Sight Distance Avoidance Maneuver C (see <u>Table 3-3</u>, page 3-8, 2018 GDHS) (GDHS hyperlink is only available to WisDOT staff.)

2. Gore = "painted nose" as defined on page 10-114 and as depicted in Figure 10-63, 2018 GDHS

3. Check queue lengths for the thru, left turn, and right turn movement, and use whichever is furthest from the intersection. See <u>FDM 11-25-1</u>, <u>FDM 11-25-5</u>, and <u>FDM 11-25-10</u> for guidance on queue length requirements. Also, confer with region traffic staff.



* DCD-C = Decision Sight Distance Avoidance Maneuver C (See Table 3-3, Page 3-8, 2018 GDHS)

** see p. 2-3 of this Attachment



- * DCD-C = Decision Sight Distance Avoidance Maneuver C (See Table 3-3, Page 3-8, 2018 GDHS)
- ** see p. 2 of this Attachment



* DCD-C = Decision Sight Distance Avoidance Maneuver C (See Table 3-3, Page 3-8, 2018 GDHS)

** see p. 2 of this Attachment



Legend

I = SDB = Sight Distance Boundary **



- * DCD-C = Decision Sight Distance Avoidance Maneuver C (See Table 3-3, Page 3-8, 2018 GDHS)
- ** see p. 3 of this Attachment



Legend

= SDB = Sight Distance Boundary **



* DCD-C = Decision Sight Distance Avoidance Maneuver C (See Table 3-3, Page 3-8, 2018 GDHS)

** see p. 3 of this Attachment



Maximum Grades (%) for Rural Highways by Functional Classification ¹

RURAL ARTERIALS ²												
	DESIGN SPEED											
TYPE OF TERRAIN ⁵	20 MPH	30 MPH	40 MPH	50 MPH	60 MPH	70 MPH						
LEVEL	-	-	-	4	3	3						
ROLLING	-	-	_	5	4	4						

RURAL COLLECTORS ³										
		DESIGN SPEED								
TYPE OF TERRAIN ⁵	20 MPH	30 MPH	40 MPH	50 MPH	60 MPH	70 MPH				
LEVEL	7	7	7	6	5	-				
ROLLING	10	9	8	7	6	-				

RURAL LOCAL ROADS 4										
		DESIGN SPEED								
TYPE OF TERRAIN ⁵	20 MPH	30 MPH	40 MPH	50 MPH	60 MPH	70 MPH				
LEVEL	8	7	7	6	5	-				
ROLLING	11	10	10	8	6	-				

Notes:

1	For Max. Grades under Urban Conditions refer to:
	- Arterials: 2018 GDHS, Table 7-4a, Page 7-38; (GDHS hyperlink is only available to WisDOT staff.)
	- Freeways: <u>2018 GDHS, Table 8-1, Page 8-5;</u>
	 Interstate: AASHTO Interstate Design Standards 2016, Page 3;
	- Collectors: 2018 GDHS, Table 6-7, Page 6-15; and
	- Local Streets: 2018 GDHS, Section 5.3.1.5, Page 5-15
2	See 2018 GDHS, Table 7-2, Page 7-6
	See <u>2018 GDHS, Table 8-1, Page 8-5</u> for Freeways
	See AASHTO Interstate Design Standards 2016, Page 3 for Interstates
3	See <u>2018 GDHS, Table 6-2, Page 6-4</u>
4	See <u>2018 GDHS, Table 5-2, Page 5-4</u>
5	See Highway Capacity Manual, 7 th Edition (Chapter 12-3) for a discussion of terrain types



Object Height	When S > L	When S < L
24-inches	$L = 2S - \frac{2158}{A}$	$L = \frac{AS^2}{2158}$

L= Length of Vertical Curve (feet)

S = Sight Distance (feet) (either SSD or DSD value, depending on category)
 K = L/A ; L= KxA

A = Algebraic Grade Difference (Percent)

Crest Vertical Curves - Sight Distance, Object Height and Minimum Length Criteria

		DECISION DIGHT DISTANCE ^B					TOPPING SIG	HT DISTAN	CE ^B			
Design Speed (V) (mph)	Category		Sight Distance (feet) ^c	obj. hgt. (inches)	* Kcr		Sight Distance (feet) ^c	obj. hgt. (inches)	* Kcr	Min. VC L= 3 x V (feet) ^D	Category [⊿]	Design Speed (V) (mph)
25	2		375	24	66		155	24	12	75	1, 2	25
30	2		450	24	94		200	24	19	90	1, 2	30
35	2		525	24	128		250	24	29	105	1, 2	35
40	2		600	24	167		305	24	44	120	1, 2	40
45	2		675	24	212		360	24	61	135	1, 2	45
50	2		750	24	261		425	24	84	150	1, 2	50
55	2		865	24	347		495	24	114	165	1, 2	55
60	2		990	24	455		570	24	151	180	1, 2	60
65	2		1050	24	511		645	24	193	195	1, 2	65
70	2		1105	24	566		730	24	247	210	1, 2	70
75	2		1180	24	646		820	24	312	225	1, 2	75
80	2		1260	24	736		910	24	384	240	1, 2	80
85	2		1340	24	833		1010	24	473	255	1, 2	85

A See section "Stopping Sight Distance (SSD); Decision Sight Distance (DSD)" in text for definitions and criteria for Sight Distance Categories

B SSD = Stopping Sight Distance
 DSD = Decision Sight Distance for Avoidance Maneuver C

(GDHS hyperlink is only available to WisDOT staff)

C DSD Avoidance Maneuver C, See Table 3-3, Page 3-8, 2018 GDHS/SSD, See Table 3-1, Page 3-4, 2018 GDHS

D Minimum length of crest vertical curve = the greater of either (Kcr x A), OR a distance in feet equal to 3 x the design speed in mph (3 x V)



L = Length of Vertical Curve (feet)

S = Sight Distance (feet) (either SSD or DSD required, depending on category)

A = Algebraic Grade Difference (Percent)

K = L/A ; L= KA

Sag Vertical Curves - Sight Distance and Minimum Length Requirements

		DECISION SIGHT	DISTANCE	S	TOPPING SIGHT DIS	TANCE			
Design Speed (V) (mph)	Category A	Sight Distance (feet) ^c	K _{SAG}		Sight Distance (feet) ^c	K _{SAG}	Min. VC L= 3 x V (feet) ^D	Category	Design Speed (V) (mph)
25	2	375	83		155	26	75	1, 2	25
30	2	450	103		200	37	90	1, 2	30
35	2	525	124		250	49	105	1, 2	35
40	2	600	144		305	64	120	1, 2	40
45	2	675	165		360	79	135	1, 2	45
50	2	750	186		425	96	150	1, 2	50
55	2	865	219		495	115	165	1, 2	55
60	2	990	254		570	136	180	1, 2	60
65	2	1050	271		645	157	195	1, 2	65
70	2	1105	287		730	181	210	1, 2	70
75	2	1180	308		820	206	225	1, 2	75
80	2	1260	331		910	231	240	1, 2	80
85	2	1340	353		1010	260	255	1, 2	85

A See section "Stopping Sight Distance (SSD); Decision Sight Distance (DSD)" in text for definitions and criteria for Sight Distance Categories

B SSD = Stopping Sight Distance

DSD = Decision Sight Distance for Avoidance Maneuver C

(GDHS hyperlink is only available to WisDOT staff)

C See DSD Avoidance Maneuver C, See Table 3-3, Page 3-8, 2018 GDHS/SSD, See Table 3-1, Page 3-4, 2018 GDHS

D Minimum length of sag vertical curve = the greater of either (KSAG x A), OR a distance in feet equal to 3 x the design speed in mph (3 x V)

Passing Sight Distance for Crest Vertical Curves



When S > L	When S < L		
$L = 2S - \frac{2800}{A}$	$L = \frac{AS^2}{2800}$		

L = Length of Vertical Curve (feet)

A = Algebraic Grade Difference (Percent)

S = Sight Distance (feet)

Design Speed (mph)	AASHTO Passing Sight Distance	Minimum Crest K Value to achieve PSD	
25	450	72	
30	500	89	
35	550	108	
40	600	129	
45	700	175	
50	800	229	
55	900	289	
60	1000	357	
65	1100	432	
70	1200	514	
75	1300	604	
80	1400	700	

Source: A Policy on Geometric Design of Highway and Streets, 7th Edition, AASHTO 2018



Design Controls for Stopping Sight Distance (SSD) on Horizontal Curves



Design Controls for Decision Sight Distance for Avoidance Maneuver C (DSD-C) on Horizontal Curves

Profile and Cross Sections of Two-Lane Highway to the Right



A V.C. LT.& RT.EDGE v.c.* P.C. OF PAV'T. D CROWN RUNOFF 2/3 (L) 173 (L)

R.C.

L

NOTES

 ${f I}$ When normal shoulder is greater than superelevation, retain normal shoulder slope

② High-side shoulder slope = FLAT at section B-B

- V.C. = Vertical Curve
- P.C. = Beginning of Horizontal Curve
- е = Rate of superelevation (%)
- N.C. = Normal crown slope (%)

= Remove adverse crown slope (section C-C)

Х = Tangent runout = Minimum length of Runoff

See <u>FDM 11-10 Exhibit 5.1</u> for definitions, equations and values for L, X, and T.

Superelevation Transition of Divided Highway Curve to the Right



Profile and Cross Sections of Divided Highway Curve to Right



*ANGULAR BREAKS MUST BE APPROPRIATELY ROUNDED, SUGGESTED VERTICAL CURVE LENGTH IN FEET = DESIGN SPEED IN MPH (FOR EXAMPLE 50-FT FOR 50 MPH) (SEE <u>2018 GDHS, FIGURE 3-8</u> AND <u>SECTIONS 3.3.8.7 & 3.3.8.8</u> FOR ADDITIONAL GUIDANCE)

NOTES:

Superelevation rotation is about median edges of pavement.

- N.C. = Normal crown slope, (%)
- R.C. = Remove adverse crown slope superelevate at normal crown slope retain slope on both shoulders.
- P.C. = Beginning of Horizontal Curve
- V.C. = Vertical Curve
 - e = Rate of superelevation (%)
 - L = Minimum length of Runoff
 - X = Tangent runout

See <u>FDM 11-10 Exhibit 5.1</u> for definitions, equations and values for L, X, and T.

GUIDE DIMENSIONS FOR VISION TRIANGLES - STOP CONTROL ON MINOR ROAD, OR SIGNAL CONTROLLED INTERSECTION



				Example 1	4-LEG INTERSECTION (THRU MOVEMENT POSSIBLE ON SIDEROAD)		
				GIVEN	POSTED SPEED IS 55 MPH ON THE MAJOR ROAD POSTED SPEED IS 45 MPH ON THE SIDEROAD		
	Distance "Bvт" (feet)		SOLUTION	READING FROM THE TABLE: DISTANCE A _{VT} ON MAJOR ROAD = 180 FT DISTANCE B _{VT} ON SIDEROAD = 150 FT			
				Example 2	T INTERSECTION (NO THRU MOVEMENT POSSIBLE ON SIDEROAD)		
			***NO THRU	GIVEN	POSTED SPEED IS 55 MPH ON THE MAJOR ROAD POSTED SPEED IS 45 MPH ON THE SIDEROAD		
* Posted Speed (mph)	** Distance "A _{VT} " (feet)	**THRU movement possible from sideroad	movement possible from sideroad ("T" intersection)	SOLUTION	READING FROM THE TABLE: DISTANCE Avr ON MAJOR ROAD = 180 FT DISTANCE Bvt ON SIDEROAD = 75 FT		
25	90	90	75	* Use the posted speed of the Major Highway to determine distance "A"			
30	105	105	75	se the posted speed of the sideroad to determine distance "B".			
35	120	120	75	 *** Based on distance traveled in 2 seconds at Posted speed + 5 mpn. *** Based on distance traveled in 2 seconds at 25 mph because vehicle approaching intersection on sideroad has to slow down to make a turn. NO THRU Movement means either existing or proposed. <u>NOTES:</u> Distances are approximate and may be adjusted to fit site conditions. These guidelines are for the Vision Triangle only, and are not to be interpreted as Intersection Sight Distance (ISD) or Stopping Sight Distance (SSD) requirements. The Vision Triangle must be free of all obstructions. 			
40	135	135	75				
45	150	150	75				
50	165	165	75				
55	180	180	75				
65	210	210	75				

Example computation of Intersection Sight Distance for Cases B1, B2, and B3

Given

- Mainline: 4-lane divided bi-directional road (2 lanes in each direction); design speed = 50 mph; tangent alignment; lane width = 12 feet; median width = 30 feet; shoulder width = 10 ft
- Side road: arterial; grade < 3%; design speed = 40 mph
- Intersection: type B1 with 12 ft wide right turn lane

Find

- Design vehicle for intersection sight distance
- Required Intersection Sight Distances for both a passenger car and for the design vehicle



Solution

- From FDM 11-10 Table 5.1 the design vehicle for an arterial is a combination truck.
- Intersection Sight Distance to the LEFT is the greater of that required for Case B2 Right turn from the minor road, and Case B3 Crossing maneuver from the minor road.
- Intersection Sight Distance to the RIGHT is the greater of that required for Case B1 Left turn from the minor road, and Case B3 Crossing maneuver from the minor road.

Intersection Sight Distances (ISDs) to LEFT			Intersection Sight Distances (ISDs) to RIGHT	
Case B2	Case B3	PASSENGER CAR	Case B1	Case B3
8.0	7.0	UPPER MINIMUM time gap (sec) ^A	10.0	7.0
590	515	UPPER MINIMUM ISD (feet) ^A	735	515
19	19	Vehicle length (feet) ^B	19	19
NA	NA	Vehicle length+ 6'< Median width?	Yes	Yes
Cross 12-ft right turn lane	Cross 12-ft right turn lane	ADJUSTMENT description	None	None
0.5	0.5	Additional time (sec) ^C		
35	35	Additional ISD (feet)		
625	550	Total ISD (feet)	735	515
625		Controlling ISD (feet)	735	
14.5 ft from the edge of right turn lane= 26.5 ft from the edge of travel lane.		Side road decision point location	11.0 feet from the median edge of the far side travel lanes	
Case B2	Case B3	COMBINATION TRUCK (DESIGN VEHICLE)	Case B1	Case B3
12.0	13.0	UPPER MINIMUM time gap (sec) ^A	13.0	13.0
885	960	UPPER MINIMUM ISD (feet) ^A	960	960
Greater than 55 ft	Greater than 55 ft	Vehicle length (feet) ^B	Greater than 55 ft	Greater than 55 ft
NA	NA	Vehicle length+ 6'< Median width?	No	No
Cross 12-ft right turn lane	Cross 12-ft right turn lane	ADJUSTMENT description	Cross an additional 54- feet = 4.5 lanes (12' right turn lane + 12' travel lane + 30' median)	Cross an additional 66- feet = 5.5 lanes (12' right turn lane + 2x12' travel lanes + 30' median)
0.7	0.7	Additional time (sec) ^C	0.7 x 4.5 = 3.15	0.7 x 5.5 = 3.85
50	50	Additional ISD (feet)	230	285
935	1010	Total ISD (feet)	1190	1245
	1010	Controlling ISD (feet)		1245
14.5 ft from the edge of right turn lane=26.5 ft from the edge of travel lane.		Side road decision point location	14.5 ft from the edge of right turn lane= 26.5 ft from the edge of travel lane.	

A See FDM 11-10 Table 5.2.

B See Figure 2-23, Page 2-76 2018 GDHS (GDHS hyperlink is only available to WisDOT staff.)

C See FDM 11-10 Table 5.2, Notes B & C