Chapter 1260 Sight Distance

1260.01 General

Sight distance allows the driver to assess developing situations and take actions appropriate for the conditions. Sight distance relies on drivers being aware of and paying attention to their surroundings and driving appropriately for conditions presented. For the purposes of design, sight distance is considered in terms of stopping sight distance, passing sight distance, and decision sight distance.

For additional information, see the following:

Chapter 1250 Sight distance at railroad crossings

Chapter 1310 Sight distance at intersections at grade

Chapter 1320 Sight distance at roundabouts

Chapter 1340 Sight distance at driveways

Chapter 1515 Sight distance for shared-use paths

1260.02 References

1260.02(1) Design Guidance

Manual on Uniform Traffic Control Devices for Streets and Highways, USDOT, FHWA; as adopted and modified by Chapter 468-95 WAC "Manual on uniform traffic control devices for streets and highways" (MUTCD)

1260.02(2) Supporting Information

A Policy on Geometric Design of Highways and Streets (Green Book), AASHTO

Passing Sight Distance Criteria, NCHRP 605

1260.03 Stopping Sight Distance (Eye height – 3.5 ft, Object height – 2.0 ft)

1260.03(1) Design Criteria

Stopping sight distance is provided when the sight distance available to a driver equals or exceeds the stopping distance for a passenger car traveling at the design speed.

Stopping distance for design is very conservatively calculated, with lower deceleration and slower perception reaction time than normally expected from the driver. Provide design stopping sight distance at all points on all highways and on all intersecting roadways, unless a design analysis is deemed appropriate.

1260.03(1)(a) Stopping Sight Distance

Stopping sight distance is the sum of two distances: the distance traveled during perception and reaction time and the distance to stop the vehicle. The perception and reaction distance used in design is the distance traveled in 2.5 seconds at the design speed.

The design stopping sight distance is calculated using the design speed and a constant deceleration rate of 11.2 feet/second^2. For stopping sight distances on grades less than 3%, see Exhibit 1260-1; for grades 3% or greater, see Exhibit 1260-2.

1260.03(1)(b) Design Stopping Sight Distance

Exhibit 1260-1 gives the design stopping sight distances for grades less than 3%, the minimum curve length for a 1% grade change to provide the stopping sight distance for a crest (K_c) and sag (K_s) vertical curve, and the minimum length of vertical curve for the design speed (VCL_m). For stopping sight distances when the grade is 3% or greater, see Exhibit 1260-2.

Exhibit 1260-1 Design Stopping Sight Distance

Design Speed (mph)	Design Stopping Sight Distance (ft)	*Kc*	*Ks*	*VCLm* (ft)
25	155	12	26	75
30	200	19	37	90
35	250	29	49	105
40	305	44	64	120
45	360	61	79	135
50	425	84	96	150
55	495	114	115	165
60	570	151	136	180
65	645	193	157	195
70	730	247	181	210
75	820	312	206	225
80	910	384	231	240

1260.03(2) Effects of Grade

The grade of the highway has an effect on the stopping sight distance. The stopping distance is increased on downgrades and decreased on upgrades. Exhibit 1260-2 gives the stopping sight distances for grades of 3% and steeper. When evaluating sight distance with a changing grade, use the grade for which the longest sight distance is needed.

Exhibit 1260-2 Design Stopping Sight Distance on Grades

Design Speed (mph)	Stopping Sight Distance (ft)					
	Downgrade			Upgrade		
	-3%	-6%	-9%	3%	6%	9%
25	158	165	173	147	143	140
30	205	215	227	190	184	179
35	257	271	287	237	229	222
40	315	333	354	289	278	269
45	378	400	427	344	331	320
50	446	474	507	405	388	375
55	520	553	593	469	450	433
60	598	638	686	538	515	495
65	682	728	785	612	584	561
70	771	825	891	690	658	631
75	866	927	1,003	772	736	704
80	965	1,035	1,121	859	817	782

For stopping sight distances on grades between those listed, interpolate between the values given or use the equation in Exhibit 1260-3.

Exhibit 1260-3 Stopping Sight Distance on Grades

$$S = 1.47V(2.5) + \frac{V^2}{30\left[0.347826 \pm \left(\frac{G}{100}\right)\right]}$$

Where:

S = Stopping sight distance on grade (ft)

V = Design speed (mph)

G = Grade (%)

1260.03(3) Crest Vertical Curves

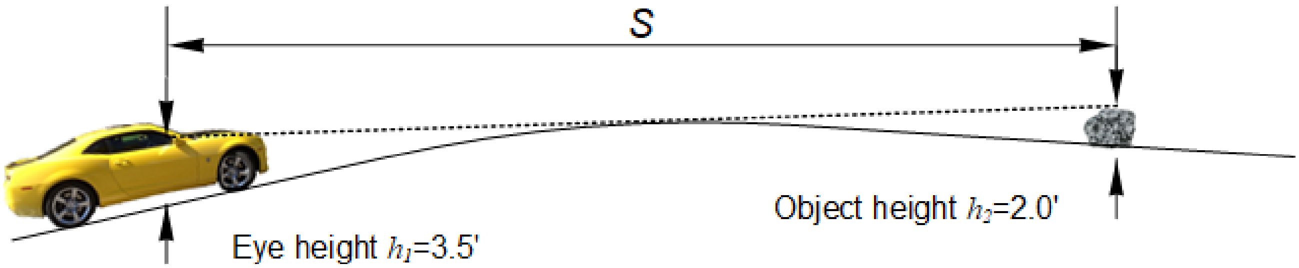
When evaluating an existing roadway, refer to Section 1260.03(7).

Use Exhibit 1260-4 or the equations in Exhibit 1260-5 to find the minimum crest vertical curve length to provide stopping sight distance when given the algebraic difference in grades. Exhibit 1260-4 does not show the sight distance greater than the length of curve equation.

When the sight distance is greater than the length of curve and the length of curve is critical, the *S>L* equation given in Exhibit 1260-5 shall be used to find the minimum curve length.

When a new crest vertical curve is built or an existing one is rebuilt with grades less than 3%, provide design stopping sight distance from Exhibit 1260-1. For grades 3% or greater, provide stopping sight distance from Section 1260.03(2).

Exhibit 1260-4 Stopping Sight Distance: Crest Vertical Curves



The minimum length can also be determined by multiplying the algebraic difference in grades by the K_C value from Exhibit 1260-1 ($L=K_C*A$). Both the exhibit and the equation give approximately the same length of curve. Neither use the $S>L$ equation.

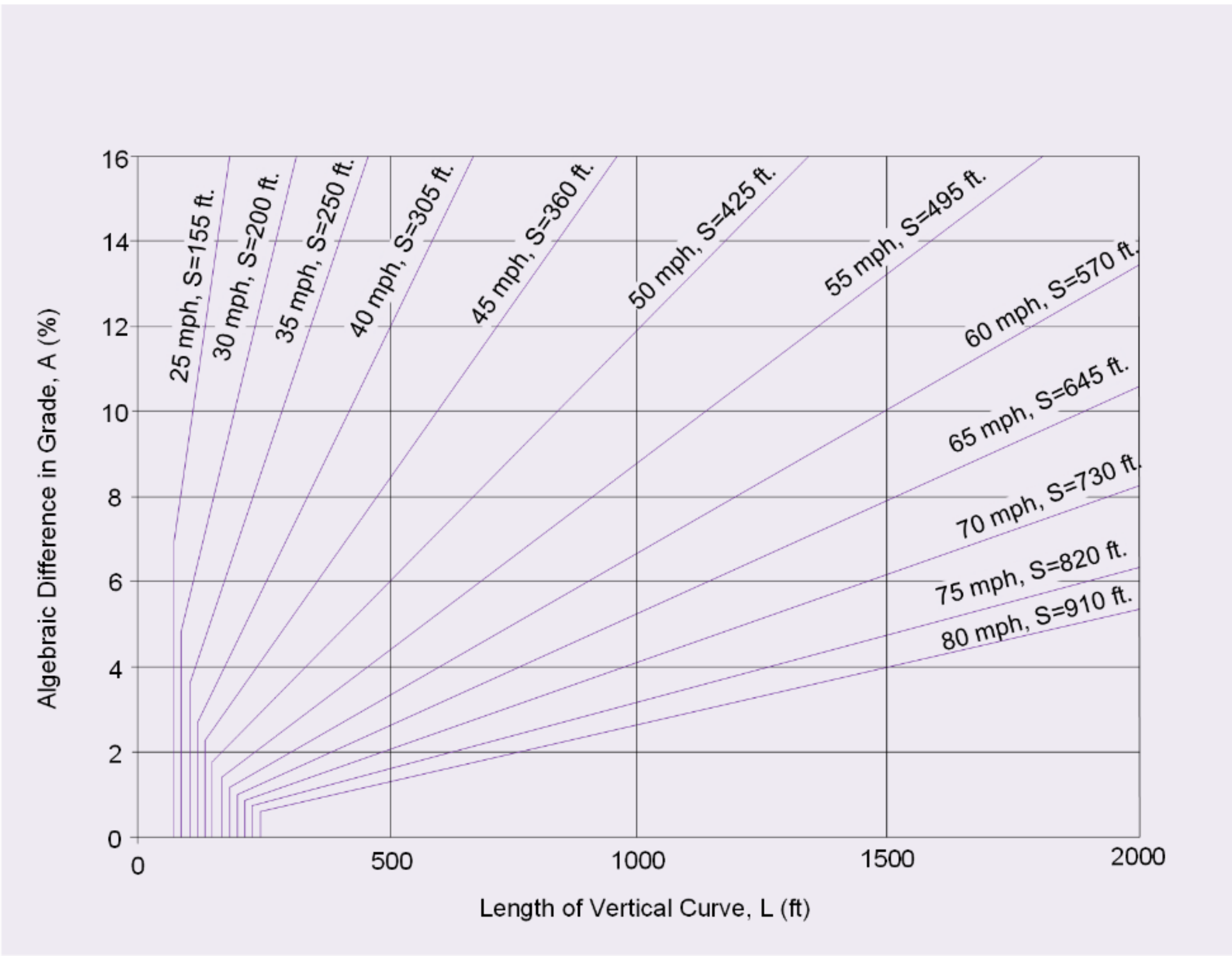


Exhibit 1260-5 Sight Distance: Crest Vertical Curve

When S>L $L = 2S - \frac{2158}{A}$ $S = \frac{L+\left(\frac{2158}{A}\right)}{2}$

When S<L $L = \frac{AS^2}{2158}$ $S = \sqrt{\frac{2158L}{A}}$

Where:

L = Length of vertical curve (ft)

S = Sight distance (ft)

A = Algebraic difference in grades (%)

1260.03(4) Sag Vertical Curves

When evaluating an existing roadway, refer to Section 1260.03(7).

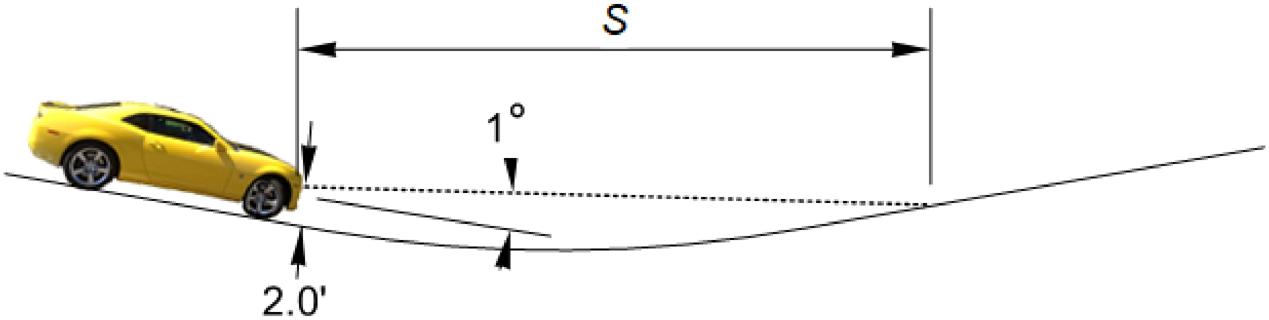
Sight distance is not restricted by sag vertical curves during the hours of daylight. Therefore, headlight sight distance is used for the sight distance design criteria at sag vertical curves. In some cases, a lesser length may be allowed. For guidance, see Chapter 1220.

Refer to Exhibit 1260-6 or the equations in Exhibit 1260-7 to find the minimum length for a sag vertical curve to provide the headlight stopping sight distance when given the algebraic difference in grades. The value for S is shown as the distance between the vehicle and the point where a 1-degree angle upward of the headlight beam intersects with the roadway.

The sight distance greater than the length of curve equation is not used in Exhibit 1260-6. When the sight distance is greater than the length of curve and the length of curve is critical, the *S>L* equation given in Exhibit 1260-7 shall be used to find the minimum length of curve.

When a new sag vertical curve is built or an existing one is rebuilt with grades less than 3%, provide design stopping sight distance from Exhibit 1260-1. For grades 3% or greater, provide stopping sight distance from Section 1260.03(2).

Exhibit 1260-6 Stopping Sight Distance for Sag Vertical Curves



The minimum length can also be determined by multiplying the algebraic difference in grades by the KS value from Exhibit 1260-1 $(L=KS*A)$. Both the exhibit and equation give approximately the same length of curve. Neither use the $S>L$ equation.

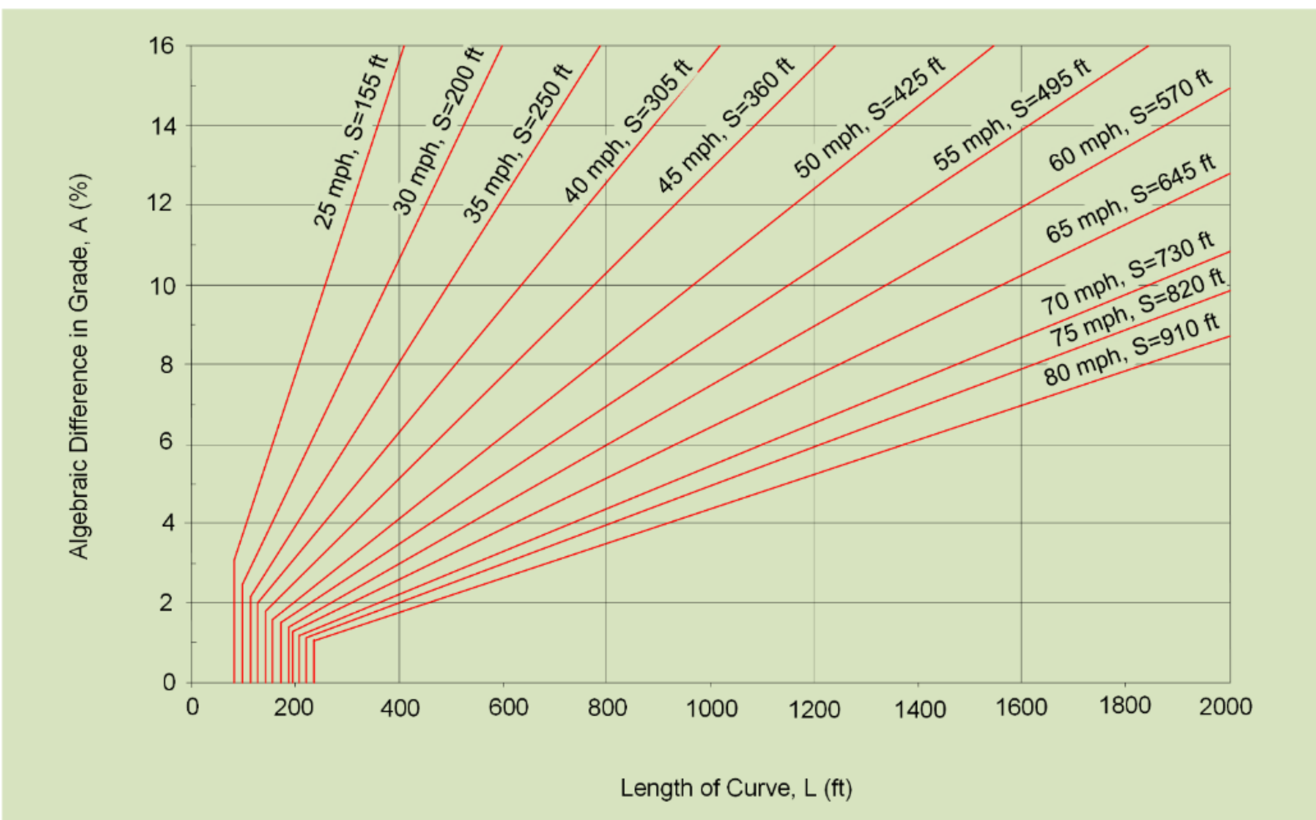


Exhibit 1260-7 Sight Distance: Sag Vertical Curve

When $S>L$ $\quad L = 2S - \frac{400+3.5S}{A} \quad S = \frac{LA+400}{2A-3.5}$

When $S<L$ $\quad L = \frac{AS^2}{400+3.5S} \quad S = \frac{3.5L \pm \sqrt{(3.5L)^2+1600AL}}{2A}$

Where:

L = Curve length (ft)

A = Algebraic grade difference (%)

S = Sight distance (ft)

Note:

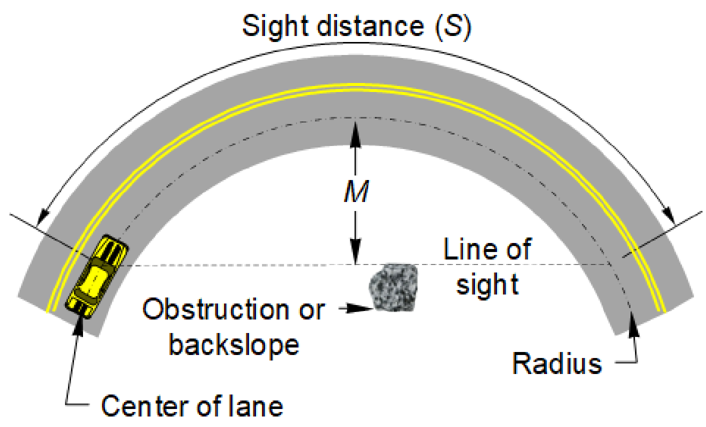
Values for A less than 1.75 are within the 1-degree diverge of the headlight beam and therefore do not need to be evaluated for SSD on sag curves.

1260.03(5) Horizontal Curves

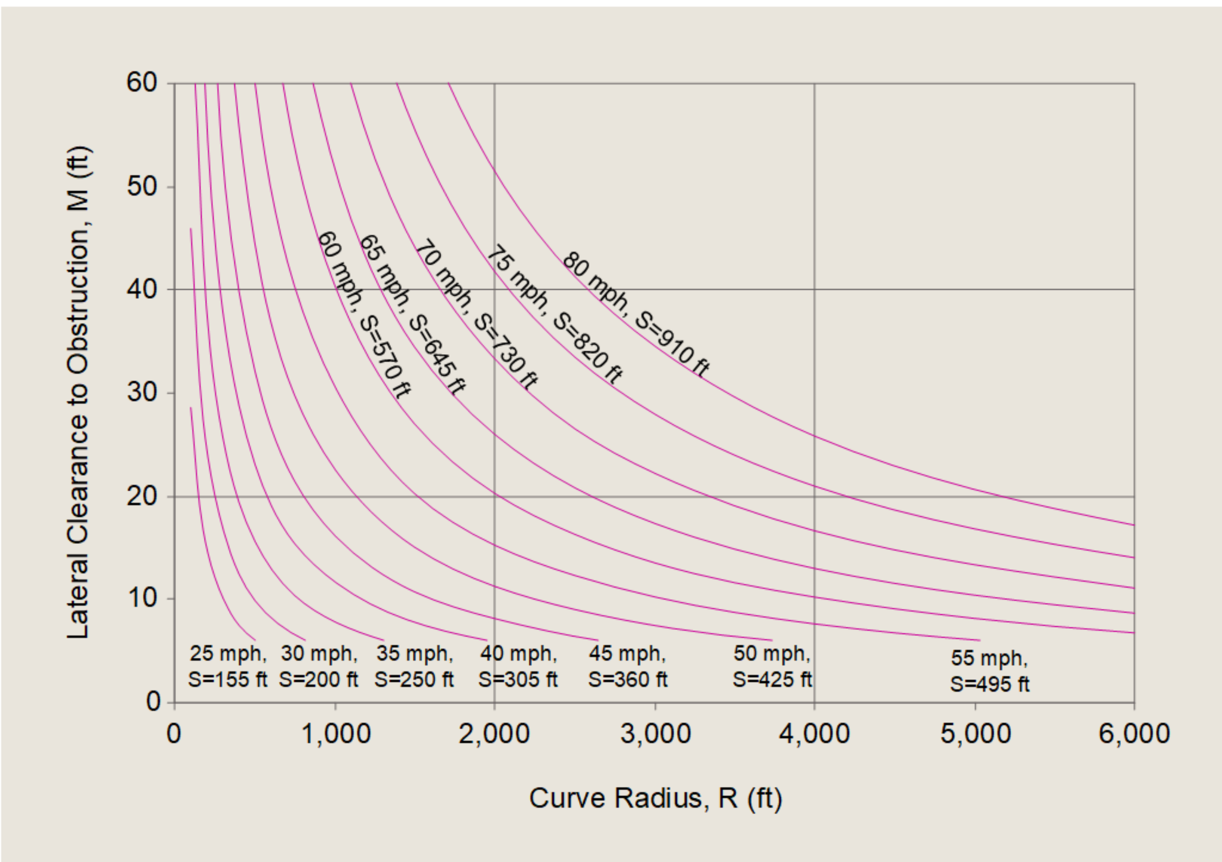
When evaluating an existing roadway, see Section 1260.03(7).

Use Exhibit 1260-8 or the equation in Exhibit 1260-9 to check stopping sight distance where sightline obstructions are on the inside of a curve. A stopping sight distance sightline obstruction is any roadside object within the horizontal sightline offset (*M*) distance (such as median barrier, guardrail, bridges, walls, cut slopes, buildings or wooded areas), 2.0 feet or greater above the roadway surface at the centerline of the lane on the inside of the curve (h_0). Exhibit 1260-8 and the equation in Exhibit 1260-9 are for use when the length of curve is greater than the sight distance and the sight restriction is more than half the sight distance from the end of the curve. Where the length of curve is less than the stopping sight distance or the sight restriction is near either end of the curve, the desired sight distance may be available with a lesser *M* distance. When this occurs, the sight distance can be checked graphically.

Exhibit 1260-8 Horizontal Stopping Sight Distance



A sightline obstruction is any roadside object within the horizontal sightline offset (M) distance, 2.0 feet or greater above the roadway surface at the centerline of the lane on the inside of the curve.



When the road grade is less than 3%, provide design stopping sight distance from Exhibit 1260-1. When the grade is 3% or greater, provide stopping sight distance from Section 1260.03(2).

Roadside objects with a height (h_0) between 2.0 feet and 2.75 feet might not be a stopping sight distance sightline obstruction. Objects with an h_0 between 2.0 feet and 2.75 feet can be checked graphically to determine whether they are stopping sight distance sightline obstructions.

Where a sightline obstruction exists and site characteristics preclude design modifications to meet criteria, consult with the Region Traffic Engineer and Assistant State Design Engineer for a determination of appropriate action.

Exhibit 1260-9 Sight Distance: Horizontal Curves

$$M = R\left[1 - \cos\left(\frac{28.65S}{R}\right)\right] \qquad S = \frac{R}{28.65}\left[\cos^{-1}\left(\frac{R-M}{R}\right)\right]$$

Where:

M = Horizontal sightline offset measured from the centerline of the inside lane of the curve to the sightline obstruction (ft)

R = Radius of the curve (ft)

S = Sight distance (ft)

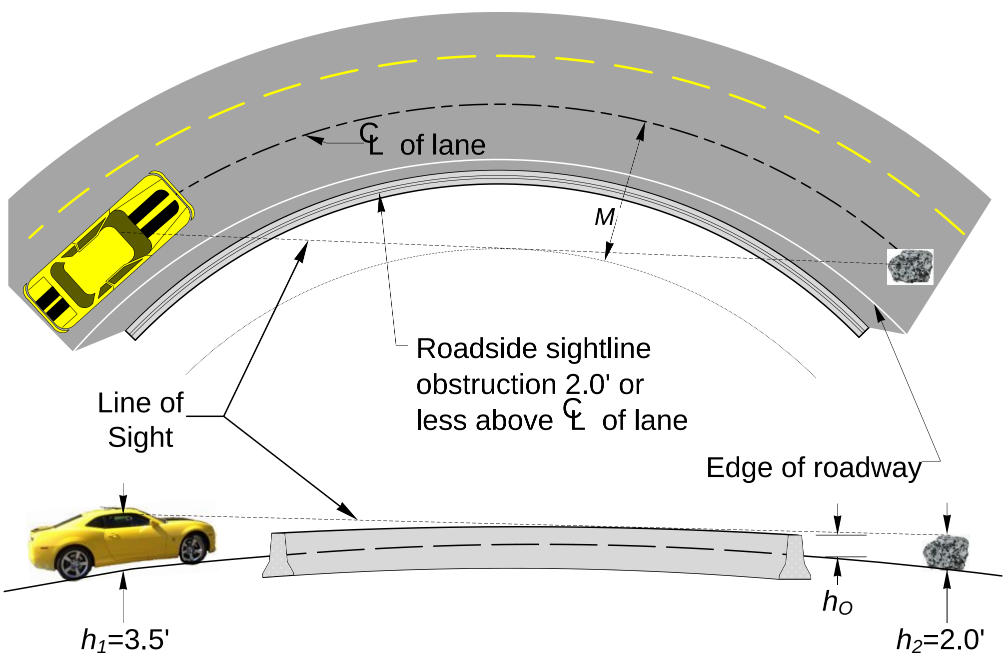
1260.03(6) Overlapping Horizontal and Vertical Curves

Vertical curves on a horizontal curve have an effect on which roadside objects are sightline obstructions. Crest vertical curves make roadside objects *more* likely to become sightline obstructions. Sag vertical curves make roadside objects *less* likely to be sightline obstructions.

Exhibit 1260-10 can be used to determine the sight distance for crest vertical curves on horizontal curves with:

- Sightline obstructions inside the *M* distance.
- Sightline obstruction height (h_0) of 2.0 feet or less.

For other locations, the sight distance can be checked graphically.



The following equation may be used to determine the sight distance for roadside sightline obstructions inside the horizontal sightline offset (*M*) distance (see Exhibit 1260-9) with a height of 2.0 feet or less above the centerline of the lane on the inside of the curve on overlapping horizontal and crest vertical curves.

$$S = \sqrt{\frac{100L\left[\sqrt{2(h_1 - h_0)} + \sqrt{2(h_2 - h_0)}\right]^2}{A}}$$

Where:

L = Length of vertical curve (ft)

S = Sight distance (ft)

A = Algebraic difference in grades (%)

h1 = Eye height (3.5 ft)

h2 = Object height (2.0 ft)

h0 = Height of roadside sightline obstructions above the centerline of the inside curve lane (2.0 ft or less)

Note:

The above equation cannot be used for sightline obstruction height (h0) more than 2.0 ft above the centerline of the lane on the inside of the curve. The available sight distance must be checked graphically for these sightline obstructions.

1260.03(7) Existing Stopping Sight Distance

Existing stopping sight distance values from Exhibit 1260-10 may be used at all horizontal and vertical curves where all of the following are met at the curve:

- There is no identified collision trend.
- The existing vertical and horizontal alignment is retained.
- The existing roadway pavement is not reconstructed.
- The roadway will not be widened, except for minor shoulder widening requiring no work past the bottom of the ditch.
- The sightline obstruction is existing.
- Roadside improvements to sight distance are within existing right of way.

Crest Vertical Curves – The minimum length of an existing crest vertical curve may be found using the equations in Exhibit 1260-5 or using the K_C values from Exhibit 1260-10.

Sag Vertical Curves – The minimum length of an existing sag vertical curve may be found using the equations in Exhibit 1260-7 or using the K_S values from Exhibit 1260-10.

Exhibit 1260-10 Existing Stopping Sight Distance

Design Speed (mph)	Existing Stopping Sight Distance (ft)	*KC*	*KS*
20	115	6	16
25	145	10	23
30	180	15	31
35	220	22	41
40	260	31	52
45	305	43	63
50	350	57	75
55	400	74	89
60	455	96	104
65	495	114	115
70	540	135	127
75	585	159	140
80	630	184	152

1260.04 Passing Sight Distance (Eye height – 3.5 ft, Object height – 3.5 ft)

1260.04(1) Design Criteria

Minimum passing sight distance is the distance (on a two-lane highway) used for a driver to execute a normal passing maneuver based on design conditions and design speed.

The potential for passing maneuver conflicts is ultimately determined by the judgments of the driver and the conditions present at the time of the maneuver. Exhibit 1260-12 gives the passing sight distances for various design speeds.

Exhibit 1260-11 Passing Sight Distance

Design Speed (mph)	Minimum Passing Sight Distance (ft)
20	400
25	450
30	500
35	550
40	600
45	700
50	800
55	900
60	1000
65	1100
70	1200
75	1300
80	1400

On two-lane two-way highways, provide passing opportunities to meet traffic volume demands. This can be accomplished with roadway sections that provide passing sight distance or by adding passing lanes at locations that would provide the greatest benefit to passing (see Chapter 1270).

In the design stage, passing sight distance can be provided by adjusting the alignment either vertically or horizontally to increase passing opportunities.

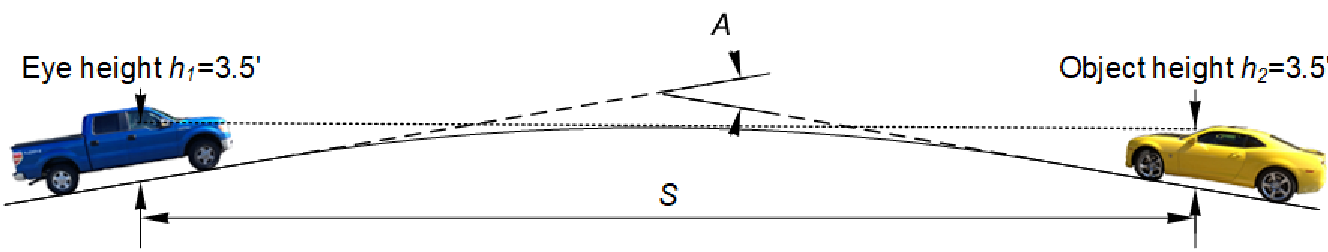
These considerations also apply to multilane highways where staged construction includes a two-lane two-way operation as an initial stage. Whether auxiliary lanes are provided, however, depends on the time lag proposed between the initial stage and the final stage of construction.

1260.04(2) Passing Sight Distance Vertical Curves

Exhibit 1260-14 gives the length of crest vertical curve used to provide passing sight distance for two lane highways. The distance from Exhibit 1260-12 and the equations in Exhibit 1260-13 may also be used to determine the minimum length of vertical curve to meet the passing sight distance criteria.

Sag vertical curves are not a restriction to passing sight distance.

Exhibit 1260-12 Passing Sight Distance: Crest Vertical Curve Calculations



When $S>L$

$$L = 2S - \frac{2800}{A} \quad S = \frac{L}{2} + \frac{1400}{A}$$

When $S<L$

$$L = \frac{AS^2}{2800} \qquad S = \sqrt{\frac{2800L}{A}}$$

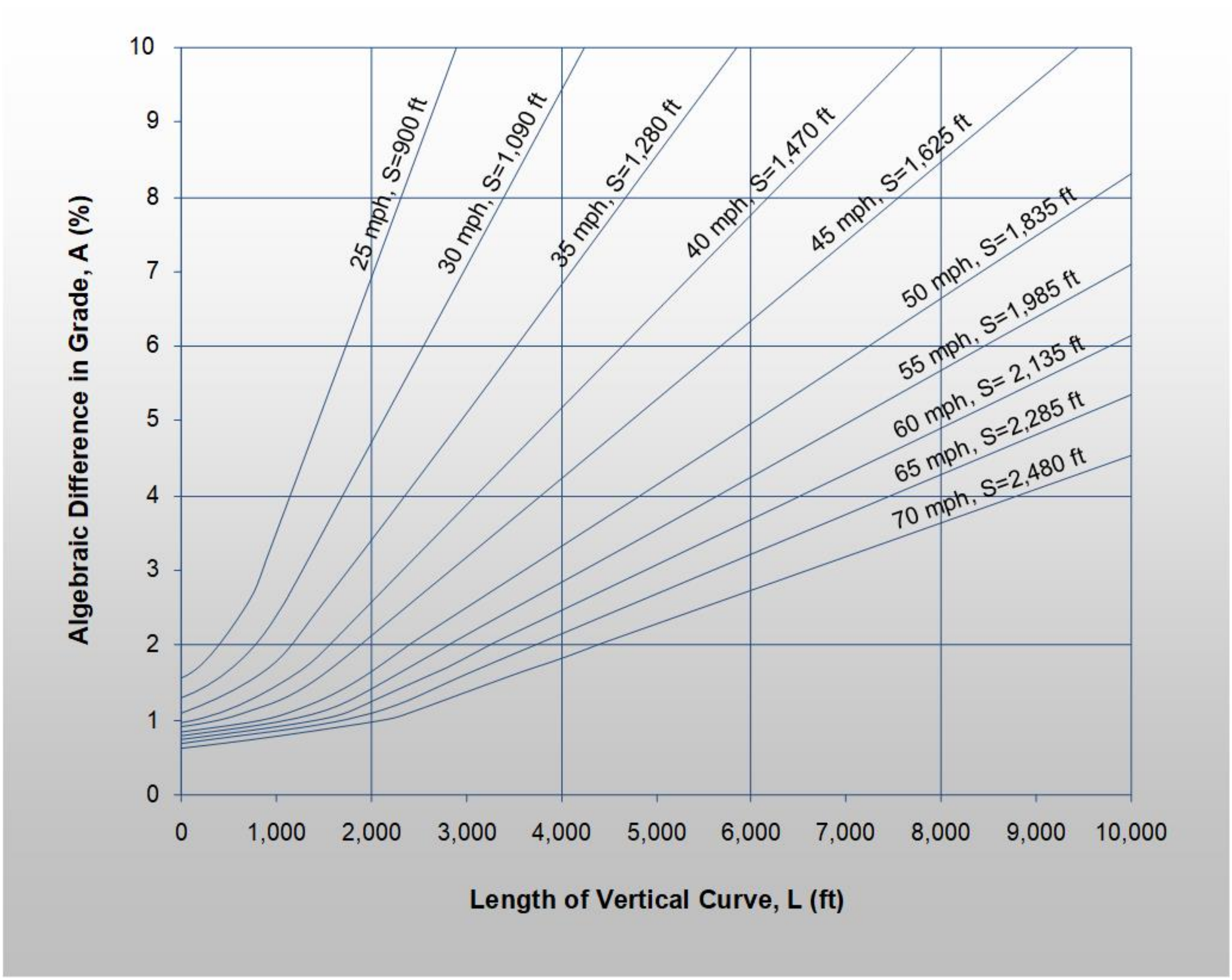
Where:

L = Length of vertical curve (ft)

A = Algebraic grade difference (%)

S = Sight distance (ft)

Exhibit 1260-13 Passing Sight Distance: Crest Vertical Curves



1260.04(3) Passing Sight Distance Horizontal Curves

Passing sight distance can be restricted on the inside of a horizontal curve by sightline obstructions that are 3.5 feet or more above the roadway surface. Use the distance from Exhibit 1260-12 and the equation in Exhibit 1260-9 to determine whether the object is close enough to the roadway to be a restriction to passing sight distance. The equation assumes that the curve length is greater than the sight distance. Where the curve length is less than the sight distance, the desired sight distance may be available with a lesser sightline offset (*M*) distance.

1260.05 Decision Sight Distance (Eye height – 3.5 ft, Object height – 2.0 ft)

Decision sight distance values are greater than stopping sight distance values because they give the driver an additional margin for error and afford sufficient length to maneuver at the same or reduced speed rather than to just stop.

Consider decision sight distances (see Exhibit 1260-14) at locations where there is high likelihood for driver error in information reception, decision making, or control actions. If site characteristics and budget allow, locate these highway features where decision sight distance can be provided. If this is not practicable, use suitable traffic control devices and positive guidance to give advanced warning of the conditions.

Exhibit 1260-14 Decision Sight Distance

Design Speed (mph)	Decision Sight Distance for Maneuvers (ft)				
	A	B	C	D	E
30	220	490	450	535	620
35	275	590	525	625	720
40	330	690	600	715	825
45	395	800	675	800	930
50	465	910	750	890	1030
55	535	1030	865	980	1135
60	610	1150	990	1125	1280
65	695	1275	1050	1220	1365
70	780	1410	1105	1275	1445
75	875	1545	1180	1365	1545
80	970	1685	1260	1455	1650

The maneuvers in Exhibit 1260-14 are as follows:

A = Rural stop

B = Urban stop

C = Rural speed/path/direction change

D = Suburban speed/path/direction change

E = Urban speed/path/direction change

Use the equations in Exhibit 1260-5, Exhibit 1260-7, and Exhibit 1260-9 to determine the available decision sight distance for crest vertical curves, sag vertical curves, and horizontal curves.