INTERNATIONAL SIGHT DISTANCE DESIGN PRACTICES

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This paper reviews the geometric design practices related to sight distance of a number of countries. The purpose of this paper is to present the sight distance design practices of a variety of countries as a resource to highway agencies in any country that may be considering possible modifications and updates to their own policies and practices. It is hoped that this paper will serve as a resource presenting ideas and concepts that may be new to some, but are in actual use elsewhere in world. International exchanges of this type of information are valuable in that they provide practicing engineers and researchers with a perspective that goes beyond their own country and their own part of the world.

The ability to see ahead and observe potentially conflicting traffic is critical to safe highway operations. Sight distance, an important element in the geometric design of highways, refers to the length of roadway over which a driver has an unobstructed view. This paper deals with the criteria used in geometric design for three key aspects of sight distance: (1) stopping sight distance; (2) passing sight distance; and (3) intersection sight distance. Each of these types of sight distance is discussed below.

STOPPING SIGHT DISTANCE

Stopping sight distance (SSD) is the most fundamental of the sight distance considerations in highway geometric design, since adequate stopping sight distance is required at every point along the roadway. SSD is the distance that a driver must be able to see ahead along the roadway in order to identify hazards in the roadway and bring his/her vehicle safely to a stop where necessary. SSD can be limited by both horizontal and vertical curves. Thus, horizontal and vertical curves on roadways must be designed with SSD in mind.

A review has been conducted of the SSD criteria used in Australia, Austria, Britain, Canada, France, Germany, Greece, South Africa, Sweden, Switzerland, and the United States. This review has found that most countries have SSD criteria are based on the same model, but that assumptions made by different countries concerning the parameters used in that model vary.

Stopping Sight Distance Models

SSD is generally defined as the sum of two components, perception-reaction distance and braking deceleration distance. The SSD design situation assumes that there is a hazard in the roadway, such as an object, and that the driver of a vehicle approaching that object must first detect its presence and then brake to a stop. The perception-reaction distance is the distance traveled by the vehicle from the instant the object comes into view to the instant at which the driver applies the brakes. The braking deceleration distance is the distance traveled by the vehicle from the instant the brakes are applied until the instant the vehicle comes to a complete stop. The SSD model, which follows from the basic principles of physics, is:

SSD = Reaction Distance + Deceleration Distance

or more specifically,

$$SSD = 0.278\ V_o t + \frac{V_o^2}{254f} \qquad (1)$$

where:
- SSD = stopping sight distance (m)
- V_o = design or initial speed (km/h)
- t = driver perception-reaction time (sec)
- f = coefficient of braking friction between the tires and the pavement surface (also known as the longitudinal friction factor)

Stopping sight distance is also affected by roadway grade, i.e., stopping distances decrease on upgrades and increase on downgrades. Specifically, grade effects on stopping sight distance can be expressed by the following equation:

$$SSD = 0.278 V_o t + \frac{V_o^2}{254(f \pm G)} \qquad (2)$$

where:
- G = percent grade/100, + for upgrades and − for downgrades

Stopping sight distances on vertical curves can be based on the average grade (G) over the deceleration distance.

The minimum length of vertical curves is controlled by required stopping sight distance, driver eye height, and object height. This required length of curve is such that at a minimum, the stopping sight distance calculated by Equation (2) is available at all points along the curve. The following formulas can be used for determining the required length of crest and sag vertical curves from assumptions concerning the adjacent grades and the object and eye heights.

For crest vertical curves:

$$L = \frac{AS^2}{200\left(\sqrt{h_1} + \sqrt{h_2}\right)^2} \qquad when\ S < L \qquad (3)$$

and

$$L = 2S + \frac{200(\sqrt{h_1} + \sqrt{h_2})^2}{A} \qquad when\ S > L \qquad (4)$$

where: L = required length of vertical curve (m)
S = sight distance (m)
A = algebraic difference in grade (percent)
h_1 = eye height above the roadway surface (m)
h_2 = object height above the roadway surface that is hidden from the driver's view (m)

For sag vertical curves:

$$L = \frac{AS^2}{2\,(h_3 + S \tan \psi)} \qquad when\ S < L \qquad (5)$$

and

$$L = 2S - \frac{2\,(h_3 + S \tan \psi)}{A} \qquad when\ S > L \qquad (6)$$

Three countries--Austria, Germany, and Greece--use a slightly different SSD model, which incorporates the effect of a speed-dependent longitudinal friction factor and the aerodynamic drag on the decelerating vehicle. This model uses the same term for brake reaction distance as Equation (1), but uses a modified term for deceleration distance, shown in Equation 8.

$$SSD = 0.278\ V_o\ t + \frac{(0.278)^2}{g} \int_{V_0}^{0} \frac{V}{f_T(V) + \frac{G}{100} + \frac{F_L}{mg}} \quad (8)$$

where: h_3 = height of vehicle headlights above roadway surface (m)
ψ = upper divergence angle of headlight beam (most countries use 1°; some use 0°)

The curvature of crest and sag vertical curves is often characterized by the K-factor, which is defined as the length of the vertical curve divided by its algebraic difference in grade, shown in Equation 7.

$$K = \frac{L}{A} \quad (7)$$

where: g = accelerationof gravity (9.81 m/sec^2)
V = speed at any point in the deceleration maneuver (km/h)
$F_T(V)$ = speed dependent longitudinal friction factor
F_L = aerodynamic draf force (N)
m = mass of vehicle (kg)

The aerodynamic drag force is determined as:

$$F_L = 0.5\ \gamma\ C_w\ A\ (0.278V)^2 \quad (9)$$

where: γ = density of air (1.15kg/m^3)
C_w = aerodynamic drag coefficient
A = projected frontal area (m^2)

The term $f_T(V)$ represents the variation of the braking friction coefficient as a function of speed. This concept was originally developed by Lamm.(*1*) The equations used for $f_T(V)$ in Austria, Germany, and Greece are given below in the discussion of each country's SSD design policy.

Parameters Used in Stopping Sight Distance Models

The variation in SSD design policies between the various countries are reviewed below, with emphasis on the parameter values assumed in the SSD models.

Australia

The National Association of Australian State Road Authorities (NAASRA) defines sight distance as the distance a vehicle will travel before coming to rest under hard braking after first seeing a hazard in the roadway. It is calculated using a reaction time of 2.5 sec, longitudinal friction factor of 0.5, and an approximate operating speed (km/h). A reaction time of 2.0 sec is used for roads with speeds less than 100 km/h and a reaction time of 1.5 sec may be used in restricted situations and difficult terrain. NAASRA uses speed prediction procedures to estimate the actual operating speed which is then used in determining the SSD. Australian research has found that, on lower-speed facilities, operating speeds are normally higher than the specified design speeds used in the United States and, at speeds greater than 100 km/h, the two methods produce essentially the same results. Since the SSD equation is more sensitive to changes in the design speed than other factors, NAASRA introduces a larger factor of safety by designing for faster drivers.(*2*)

The design of crest vertical curves is controlled by the required SSD. The curve lengths are specified in terms of a Kvalue, which is the length of curve that produces a 1 percent change in grade. The minimum Kvalues are found with an eye height of 1.15 m and an object height of 0.2 m. Where normal stopping sight distance is difficult or costly to achieve, equivalent maneuver times and distances are used to determine minimum stopping sight distances.

Australia has a visual capability guideline that affects SSD, requiring a driver to be able to recognize a hazard once it is seen. A human observer, such as a driver, can resolve spatial detail to1' of arc which is the angle subtended by the height of the object at the eye. An angle of 5', however, is more typical of the contrast and lighting conditions found on roadways. By translating this requirement into the height of the object which must be visible to be seen by the driver, 100 and 200 mm of the object must be above the line of sight for distances of 65 and 130 m, respectively. The object probably will not be seen at distances greater than 130 m even with sufficient sight distance. Using distances from the SSD formula, speeds greater than 90 km/h in daylight and 70 km/h at night are beyond the visual capability of the driver.

Austria

Sight distance design policy in Austria is based on an operating speed, known as the project speed, which represents the maximum theoretical speed at a particular location on the road. The maximum project speed corresponds to 100 km/h for two-lane rural roads and ranges from 100 to 140 km/h for multilane roads.(*3*)

The brake reaction time used in Austria is 2.0 sec. Equation 10 is used in Austria to represent the braking coefficient at any speed in the deceleration maneuver.

Britain

The responsibilities for highway design in Britain lie with the Department of Transport for national highways and with the County Councils for local roads. Most County Councils, however, adopt Department of Transport standards and specifications. SSD is defined in Britain using essentially the same model given in Equation (1). The roadway design speed is based on geometric constraints and the observed speed of adjoining roadway sections, rather than considering a general roadway classification. The total perception and reaction time used is 2.0 sec. The braking distance is based on a coefficient of braking friction intended to

$$f_T(V) = 0.214 \left(\frac{V}{100}\right)^2 - 0.640 \left(\frac{V}{100}\right) + 0.615 \qquad (10)$$

The following assumptions are made in Austria in determining aerodynamic drag using Equation (9):

Drag coefficient (C_w) = 0.46
Projected vehicle frontal area (A) = 2.21 m^2 for a passenger car
Vehicle mass (m) = 1.175 kg

avoid excessive discomfort to the driver. A braking coefficient of 0.375 can be achieved in wet conditions on normally textured surface without loss of control; however, the maximum comfortable deceleration rate used in design is based on a braking coefficient of 0.25.(*4*)

The driver eye height used to determine vertical curve lengths in Britain ranges from 1.05 to 2.00 m. The object height ranges from the height of a rear tail light, 0.25 m, to 2.0 m.

Canada

The Canadian SSD policy is similar to the U.S. policy discussed later except that it was converted to metric units at an earlier time and the design values have been rounded differently. Current Canadian practice differs from U.S. practice in that an object height of 0.38 m, to represent vehicle tail light height, has been chosen.

France

The Ministry of Transportation, City Planning and Housing, Division of Roads, and Division of Safety and Road Traffic are responsible for development and promotion of design policies in France.(*6*) The standards are primarily applicable to national roads but they are generally adopted for city roads by the departmental engineers. Although it is not directly documented, the French do not believe SSD is very important when designing roads, because their accident studies suggest that accidents with fixed objects are not common. The most common object struck is a pedestrian, and this type of accident accounts for 5 percent of rural accidents and 8 percent of fatal accidents. These accidents typically occur at night when SSD is not the factor that limits visibility.(*6*)

Therefore, the new French guidelines use an object height of 0.35 m, which represents the tail light height of a vehicle. This height also is sufficient to cover a pedestrian, the most common cause of accidents. The French guidelines stat e that when SSD is difficult to provide and the roadway has a paved shoulder, then an acceptable alternative is to accommodate an evasive maneuver by providing sight distance equal to the lateral displacement for 3.5 sec at the 85th percentile speed of traffic. This sight distance is measured from the driver's eye height to the pavement surface. For existing roads, they consider the provision of intersection sight distance, visibility of curves, and the lateral displacement rule for SSD to be most important sight distance concerns.

Germany

Sight distance design policy in Germany uses a design speed based on the prevailing 85th percentile speed of traffic.(*7,8,9,10,11*) The brake reaction time used in Germany is 2.0 sec for rural roads and 1.5 sec for urban streets. Equation 11 is used in Germany to represent the braking coefficient at any speed in the deceleration maneuver.

$$f_T(V) = 0.241 \left(\frac{V}{100}\right)^2 - 0.721 \left(\frac{V}{100}\right) + 0.708 \qquad (11)$$

The following assumptions are made in Germany in determining the aerodynamic drag using Equation (9):

Drag coefficient (C_w) = 0.35,
Vehicle mass (m) = 1304 kg,
Projected vehicle frontal area
(A) = 2.08 m^2 for a passenger car.

The length of vertical curves is determined on the basis of an eye height of 1.0 m for passenger cars (or 2.50 m for trucks) and on an object height that varies from 0 to 0.45 m as a function of the 85th percentile speed.

Greece

Sight distance policy in Greece uses a design speed based on the 85th percentile speed of traffic.

The brake reaction time used in Greece is 2.0 sec for rural roads and 1.5 sec for urban streets. Equation 12 is used in Greece to represent the braking coefficient at any speed in the deceleration maneuver.

$$f_T(V) = 0.151 \left(\frac{V}{100}\right)^2 - 0.485 \left(\frac{V}{100}\right) + 0.59 \qquad (12)$$

The assumptions made in Greece in determining the aerodynamic drag using Equation (9) are the same as those made in Germany.(*12*)

South Africa

SSD design in South Africa is based on perception-reaction time of 2.5 sec. SSD criteria are based on an operating speed that, for speeds above 50 km/h is less than the design speed. For example, for a design speed of 120 km/h, SSD design is based on an assumed operating speed of 101 km/h

Sweden

The Swedish National Road Administration (SNRA) is responsible for all aspects of the Swedish State Road Network. Adherence to the design standards for rural roads is required; however, they are only recommended for urban highways.(*13*)

The equation for SSD considers design brake time and design brake friction. Additional variables needed for the equation include the vehicle height of 1.35 m, eye height of 1.10 m, object height of 0.20 m, and the minimum visibility angle of 1 min of arc. The visibility angle is the minimum optic angle an object must cover to allow the driver of a vehicle to distinguish it in daylight. The portion of the object that is required to be visible ranges from 0.01 m for a 0.2-m object at a distance of 50 m to 0.09 m at a distance of 300 m. The braking-reaction time of 2.0 sec is the time elapsed from the moment a driver has the physical capability of perceiving an obstruction on the road until the moment when a braking reaction begins between the tires and the road. A headlight height of 0.6 m is used for calculating SSD in the dark.

In Sweden, SSD generally is not an important parameter for design because it is difficult for them to quantify the benefits of varying sight distances within their benefit/cost framework; however, they determined, through a small-scale study, that accidents increased with an increase in the ratio of number of locations with less than 300 m sight distance to the total length of the road.

Switzerland

Only a few details on the determination of SSD in Switzerland are available, but it is known that sight distance design is based on a driver eye height of 1.0 m and an object height of 0.15 m.(*14*) Sight distance design in Switzerland is based on an operating speed concept similar to the project speed used in Austria.

United States

SSD design policies in the United States are based on the policies of the American Association of State Highway and Transportation Officials (AASHTO). Under AASHTO policies, design speeds are chosen primarily based on the functional classification of the roadway and are not as closely tied to operating speeds as in other countries.(*15*)

The brake reaction time assumed in the AASHTO SSD policy is 2.5 sec. The braking friction coefficients range from 0.40 for a design speed of 30 km/h to 0.28 for a design speed of 120 km/h.

The AASHTO policy for selecting lengths of vertical curves is based on the assumption of a driver eye height of 1.07 m and an object height of 0.15 m.

It should be noted that the U.S. SSD policy is currently under review in NCHRP Project 3-42 and changes to that policy may be forthcoming.

TABLE 1 Comparison of Minimum Required Stopping Sight Distance for Level Terrain Used in Selected Countries

		Design or operating speed (km/h)												
Country	t (sec)	20	30	40	50	60	70	80	90	100	110	120	130	140
		Stopping sight distance (m)												
Australia														
(Normal design)	2.5	--	--	--	--	--	--	115	140	170	210	250	300	--
(Normal design)	2.0	--	--	--	45	65	85	105	130	--	--	--	--	--
(Restricted situations)	1.5	--	--	--	40	55	70	--	--	--	--	--	--	--
Austria	2.0	--	--	35	50	70	90	120	--	185	--	275	--	380
Britain	2.0	--	--	--	70	90	120	--	--	215	--	295	--	--
Canada	2.5	--	--	45	65	85	110	140	170	200	220	240	--	--
France	2.0	15	25	35	50	65	85	105	130	160	--	--	--	--
Germany	2.0	--	--	--	--	65	85	110	140	170	210	255	--	--
Greece	2.0	--	--	--	--	65	85	110	140	170	205	245	--	--
South Africa	2.5	--	--	50	65	80	95	115	135	155	180	210	--	--
Sweden	2.0	--	35	--	70	--	165	--	--	--	195	--	--	--
Switzerland	2.0	--	--	35	50	70	95	120	150	195	230	280	--	--
United States	2.5	--	30	44	63	85	111	139	169	205	246	286	--	--

NOTE: Perception-reaction time (t) values are generally those used for rural roads; for more detail see the discussion in the accompanying text.

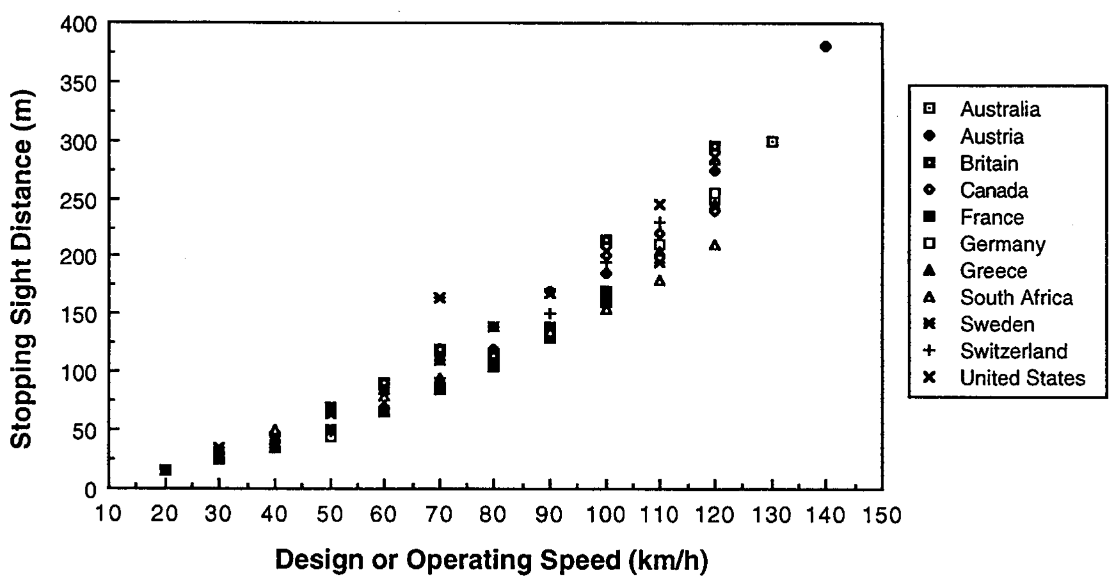

FIGURE 1 Comparison of Minimum Required Stopping Sight Distances for Level Terrain Used in Selected Countries

TABLE 2 Comparison of Criteria for Longitudinal Friction Coefficients Used in Stopping Sight Distance Design

Country	Design or operating speed (km/h)									
	30	40	50	60	70	80	90	100	110	120
	Stopping sight distance (m)									
Australia	--	--	0.52	0.48	0.45	0.43	0.41	0.39	0.37	0.35
Austria	0.44	0.39	0.35	0.31	0.27	0.24	0.21	0.19	0.17	0.16
France	--	0.37	--	0.37	--	0.33	--	0.30	--	0.27
Germany	0.51	0.46	0.41	0.36	0.32	0.29	0.25	0.23	0.21	0.19
Greece	0.46	0.42	0.39	0.35	0.32	0.30	0.28	0.26	0.24	0.23
South Africa										
(passenger cars)	0.42	0.38	0.35	0.32	--	0.30	--	0.29	--	0.28
(heavy vehicles)	0.28	0.25	0.23	0.21	--	--	--	--	--	--
Sweden	0.46	0.45	0.42	0.40	0.37	0.35	0.33	0.32	0.30	--
Switzerland	--	0.43	0.37	0.33	0.29	0.27	0.25	0.24	0.23	0.22
United States	0.40	0.38	0.35	0.33	0.31	0.30	0.30	0.29	0.28	0.28

NOTE: The longitudinal friction factors given for Austria, Germany, and Greece are assumed to increase with decreasing speed during the deceleration maneuver. The longitudinal friction factors for other countries represent a constant (i.e., average) rate over the entire maneuver.

TABLE 3 Comparison of Criteria for Driver Eye Height and Object Height Used in Vertical Curve Design

Country	Driver eye height (m)		Object height (m)
	Passenger car	Truck	
Australia	1.15	1.80	0.20
Austria	1.00	--	0.00-0.19
Britain	1.05	--	0.26
Canada	1.05	--	0.38
France	1.00	--	0.35
Germany	1.00	2.50	0.00-0.45
Greece	1.00	--	0.00-0.45
South Africa	1.05	1.80	0.15-0.60
Sweden	1.10	--	0.20
Switzerland	1.00	2.50	0.15
United States	1.07	--	0.15

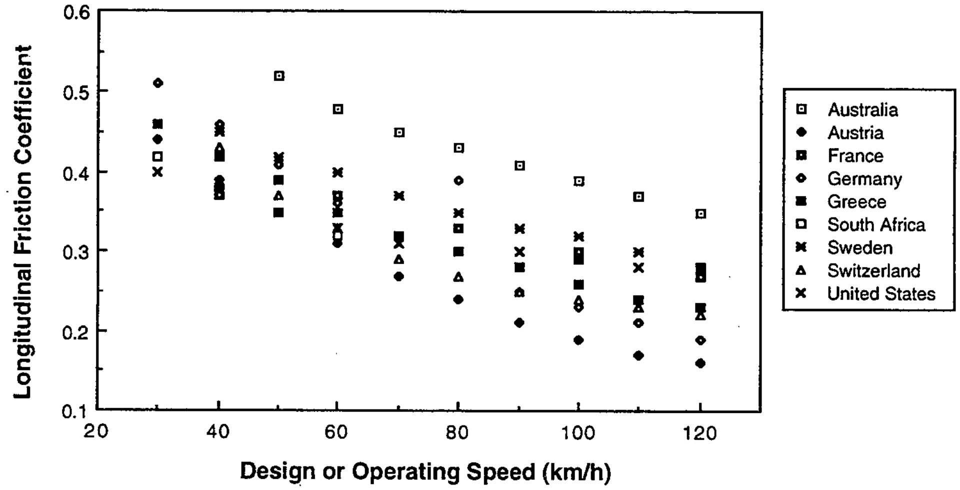

FIGURE 2 Comparison of Criteria for Longitudinal Friction Coefficients Used in Stopping Sight Distance Design

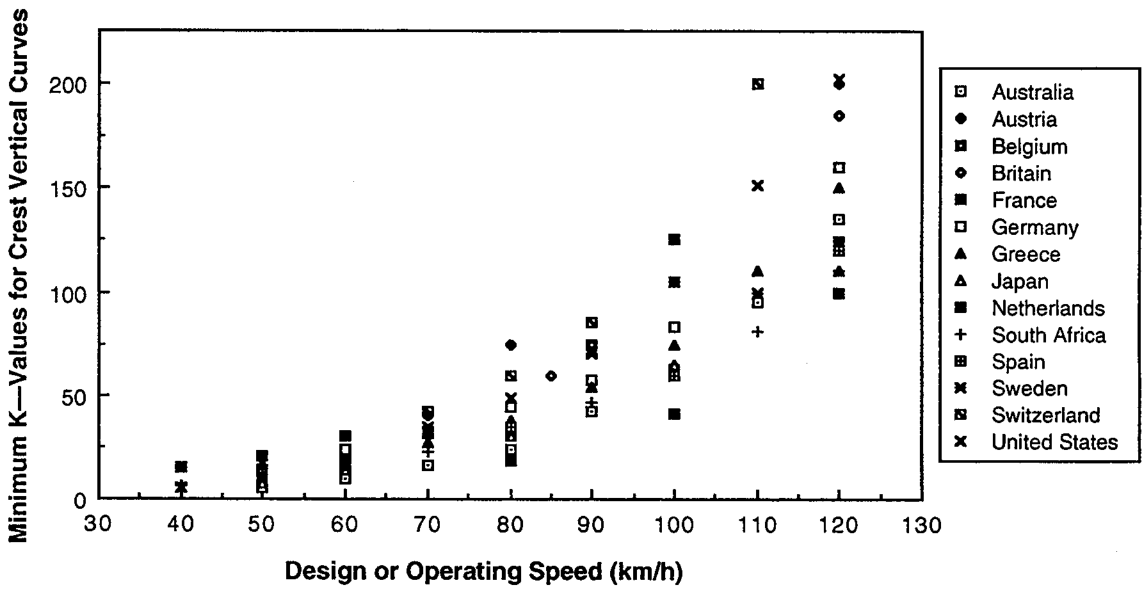

FIGURE 3 Comparison of Minimum K-Values for Crest Vertical Curves for Selected Countries

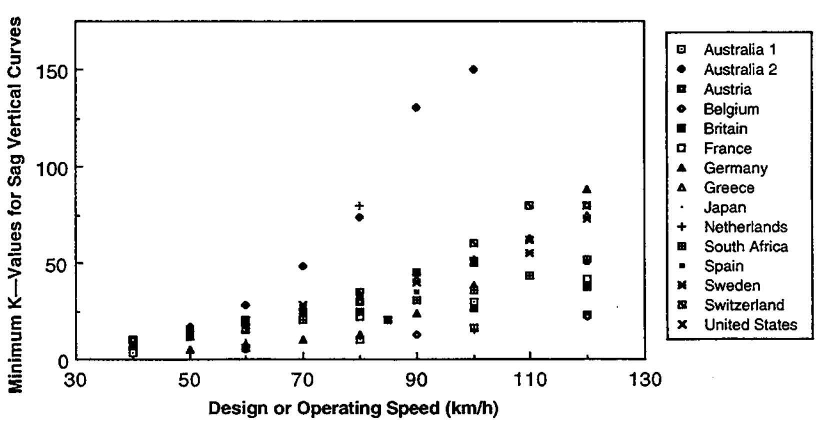

FIGURE 4 Comparison of Minimum K-Values for Sag Vertical Curves for Selected Countries

Comparison of Stopping Sight Distance Design Values

Table 1 and Figure 1 compare the minimum required SSD design values for the countries reviewed. As shown the U.S design values are near the upper end of the range and the Canadian values are near the lower end of the range.

The principal assumptions used in determining SSD values are the brake reaction time and the braking friction coefficient. All of the counties reviewed use brake reaction times of 2.0 sec for rural roads, except Australia (for higher speeds only), Canada, South Africa, and the United States, which all use 2.5 sec. Table 2 and Figure 2 compare the braking coefficients of friction assumed in determining SSD. In interpreting Table 2 and Figure 2, it should be kept in mind that most of the values given represent constant assumed values of braking coefficient over the entire speed range, while the Austrian, German, and Greek values vary with speed over the braking maneuver.

Table 3 summarizes the differences between countries in driver eye height and object height for determining vertical curve lengths. All of the assumed driver eye heights are in the range from 1.00 to 1.15 m for a passenger car driver. Object height assumptions are more varied. Australia, Britain, Sweden, Switzerland, and the United States each assume a small object with a height in the range from 0.15 to 0.26 m. Canada and France use an object height based on vehicle taillight height in the range from 0.35 to 0.38 m. Germany uses a value of object height that varies with design speed from 0 m at low speeds to 0.45 m at high speeds. A unique feature of the Swedish guidelines is that they specify a minimum portion of the object (1'of arc) that must be visible.

Figure 3 summarizes the guidelines of fourteen countries for determining crest vertical curve lengths. Data for countries in addition to those directly reviewed in this paper are based on the work of Krammes and Garnham.(*16*) The minimum K values are based on the required SSD, as well as eye and object heights.

Many countries specify paraboic vertical curves; most European countries specify circular vertical curves, but for convenience, lay them out in the field as parabolic curves. For a circular vertical curve, the K value represents the radius of the vertical curve. However, it should be recognized that, for a given K value, the alignment of parabolic and circular vertical curves differs by only a few centimeters.

Guidelines for sag vertical curves are compared in Figure 4. Some of the countries reviewed, including the United States, use sag vertical curve criteria based on headlight height; other countries consider sag vertical curves as less critical with respect to safety and base sag vertical curve design guidelines on comfort and appearance.

PASSING SIGHT DISTANCE

Passing sight distance is needed where passing is permitted on two-lane, two-way highways to ensure that passing drivers, who use the lane normally reserved for opposing traffic, have a sufficiently clear view ahead to minimize the possibility of collision with an opposing vehicle.

Two types of passing sight distance criteria are used by highway agencies in the countries included in this review: geometric criteria that are used in design and are intended to assure that the completed highway includes a sufficient length of zones for passing in the opposing lane so that the highway will operate efficiently; and marking criteria that are used to define the beginnings and ends of the no-passing barrier lines that are marked on the roadway. Australia, Britain, Canada, and the United States all have geometric and marking criteria for passing sight distance that differ from one another and are presented in separate design and traffic control policies. The following review of passing sight distance criteria in these countries is based primarily on the work of Proudlove,(*17*) although information on passing sight distance policies has been updated where more recent revisions have occurred. In addition, the review includes available information on passing sight distances used in Austria, Germany, Greece, and South Africa.

It should be noted that passing another vehicle by using the lane normally reserved for traffic in the opposing direction of travel on a two-lane highway is referred to as overtaking in English-speaking countries other than the United States.

Geometric Design Criteria for Passing Sight Distance

Passing sight distance (PSD) is considered in the geometric design of a highway to assure that the completed highway will operate efficiently. The quality of service on a two-lane highway is a function of the percentage of the length of the highway in which passing in the opposing lane is permitted; the percent of the roadway length in no-passing zones is an explicit factor in the operational analysis procedures in Chapter 8 of the *Highway Capacity Manual* (HCM)(*18*) and has an inverse effect on quality of service. The PSD criteria used in geometric design are typically substantially longer than the PSD criteria actually used in marking passing and no-passing zones on the highway. The reason for using longer PSD in geometric design is to assure the availability of passing zones with above-minimum PSD on the completed highway. Geometric design policies in many countries do not require any specified minimum percentage of highway length with adequate PSD for passing and typically do not call for a review of the extent of passing and no-passing zones that will be marked on the completed highway; the intent of such policies is to leave the decisions concerning the extent of passing opportunities that can be provided in different types of terrain to the discretion of the highway agency. However, Germany and Greece do have policies that require at least 25% of the highway length to have adequate PSD for passing.

The typical design situation for PSD is called a "delayed pass," in which the passing vehicle trails the passed vehicle as they enter a passing zone; in a delayed pass, the passing vehicle has found it necessary to slow to the speed of the passed vehicle before the passing maneuver begins. There is another possibility, known as a "flying pass," in which the passing vehicle comes up behind the passed vehicle at higher speed and initiates the passing maneuver without slowing to the speed of the passed vehicle. Flying passes typically require less sight distance than delayed passes and, therefore, represent a less critical design situation.

Figure 5 illustrates the various components of the passing maneuver for use in explaining and comparing the policies of various countries. The figure shows the position of the passing, passed and oncoming vehicles at various points in time. At Point A, the passing vehicle (Vehicle 1) starts from a position trailing the passed vehicle (Vehicle 2), as it would in making a delayed pass. The passing vehicle accelerates and, at Point B, begins to enter the opposing lane of traffic. At Point C, the passing vehicle reaches the "critical position" or "point of no return" at which the sight distance required to abort the pass is equal to the sight distance required to complete the pass. Beyond Point C, the driver of the passing vehicle is committed to complete the pass, because more sight distance would be required to abort the pass than to complete it. At Point D, the passing vehicle completes the passing maneuver and returns to its normal traffic lane.

It is assumed that the most critical opposing vehicle (Vehicle 3) that would still result in acceptable operations would move from Point H to Point G in time that the passing vehicle moves from Point A to Point B; then, the opposing vehicle would move from Point G to Point F in the time the passing vehicle moves from Point B to Point C, and the opposing vehicle moves from Point F to Point E in the time the passing vehicle moves from Point C to Point D. This results in the a clearance margin equal to the distance from Point D to Point E at the end of the passing maneuver.

The PSD criteria used in geometric design in different counties are based on varying assumptions about which of the distances shown in Figure 5 should be included in PSD and on varying assumptions about the speeds, accelerations, decelerations, and clearance margins that will be used by the passing, passed, and oncoming vehicles.

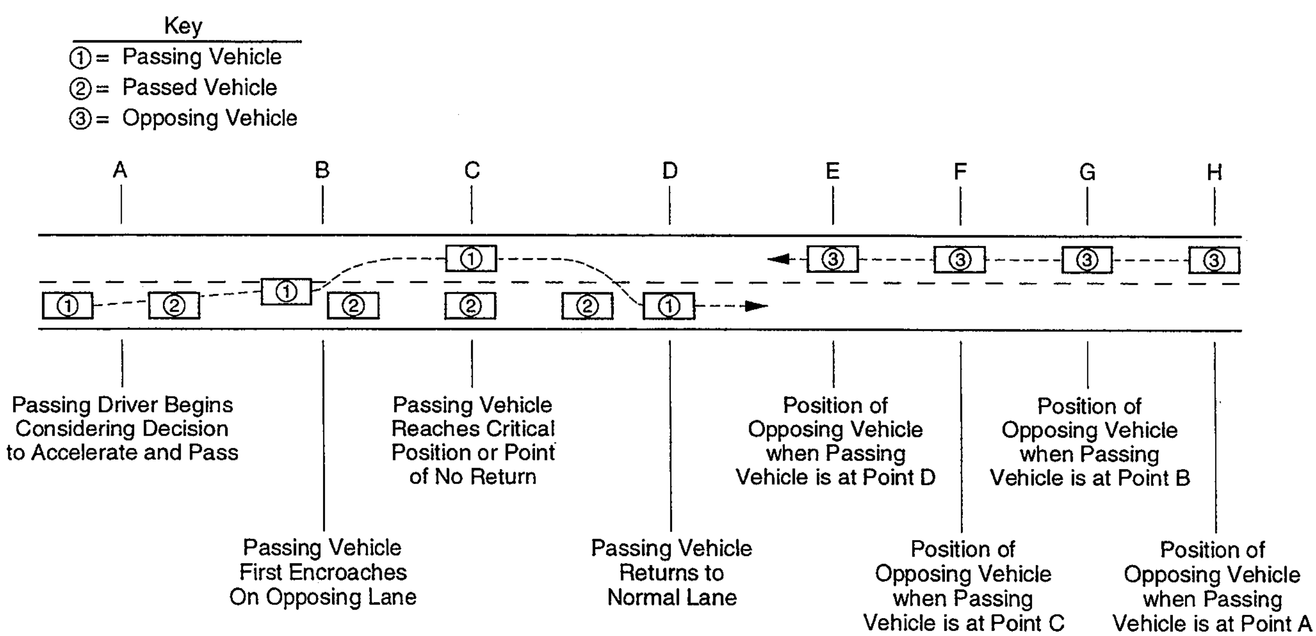

FIGURE 5 Components of the Passing Maneuver Used in Passing Sight Distance Criteria in Various Countries

TABLE 4 Passing Sight Distance Criteria Used in Geometric Design in Several Countries

Country	Design situation	Based on distance shown in Figure 5	Design or operating speed (km/h) 30	40	50	60	70	80	85	90	100	110	120	130
			Passing sight distance (m)											
Australia	ESD— beginning of PSD	AH	–	–	330	420	520	640	–	770	920	1100	1300	1500
	CSD— end of PSD	CF	–	–	165	205	245	300	–	360	430	500	600	700
Austria	beginning and end of PSD	BG	–	–	–	400	–	525	–	–	650	–	–	–
Britain	FOSD— beginning of PSD	BG	–	–	290	345	410	–	490	–	580	–	–	–
	ASD— end of PSD	1/2 BG	–	–	145	170	205	–	245	–	290	–	–	–
Canada	beginning and end of PSD	AF	–	–	340	420	480	560	–	620	680	740	800	–
Germany	beginning and end of PSD	BG	–	–	–	475	500	525	–	575	625	–	–	–
Greece	beginning and end of PSD	BG	–	–	–	475	500	525	–	575	625	–	–	–
South Africa	beginning and end of PSD	AF	–	–	340	420	490	560	–	620	680	740	800	–
United States	beginning and end of PSD	AF	217	285	345	407	482	541	–	605	670	728	792	–

NOTE: Australian CSD and British FOSD and ASD values (see test for explanation) represent the 85th percentile of the driver and vehicle population. Among the countries reviewed, only Britain uses 85 km/h as a standard design speed.

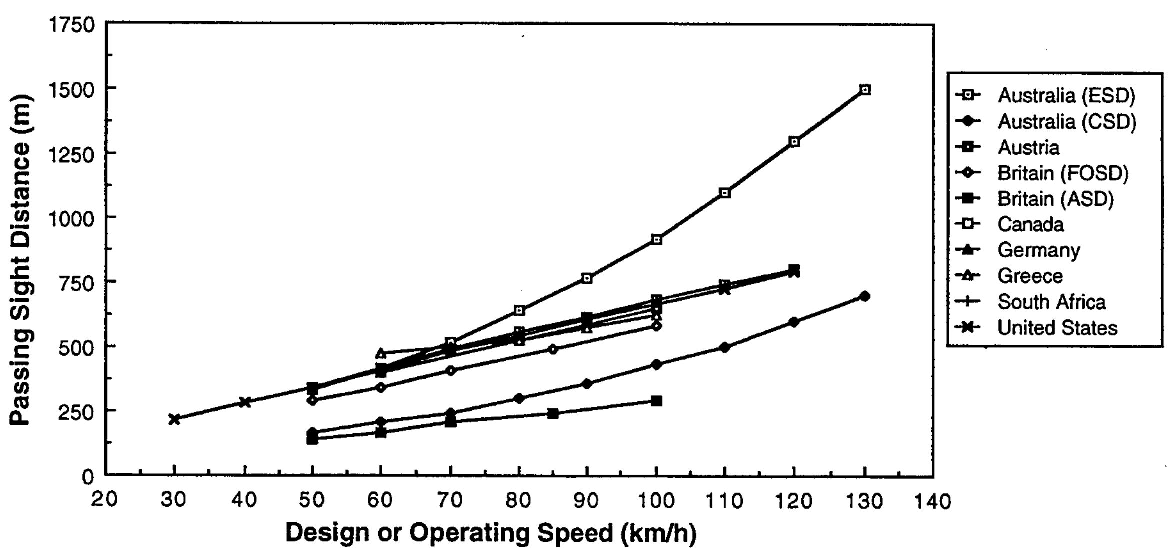

FIGURE 6 Passing Sight Distance Criteria Used in Geometric Design in Several Countries

United States

The policy for minimum PSD used for geometric design in the Unites States is that established by AASHTO.(*15*) The U.S. criteria for PSD are based on the distance AF, as shown in Figure 5. Distance FH is not included in the minimum PSD, because it is assumed implicitly that the driver of the passing vehicle could abort the pass if an opposing vehicle appears before the passing vehicle reaches Point C.

In computing PSD, the U.S. criteria assume that the passed vehicle travels at a uniform speed equal to the average running speed of the highway, which can be up to 29 km/h less than the design speed. The average speed of the passing vehicle while it occupies the opposing lane is assumed to be 15 km/h higher than the speed of the passed vehicle. The oncoming vehicle is assumed to travel at the same speed as the passing vehicle, which is less than the design speed of the highway for design speeds of 90 km/h or more.

The U.S. policy appears to assume implicitly that the critical position or point of no return occurs when the passing vehicle has completed 1/3 of its travel distance along the opposing lane (i.e., distance BC is assumed to be 1/3 of distance BD).

Table 4 presents the United States criteria for minimum passing sight distance in comparison to those of other countries. The comparison between these PSD criteria is also illustrated in Figure 6.

Canada

The criteria for passing sight distance used in Canada are essentially the same as the AASHTO criteria used in the U.S.(*5,19*) However, they differ slightly, as shown in Table 4, because they were converted into metric units at different times and in slightly different ways.

Britain

In Britain, two PSD values are used in geometric design.(*4*) The Full Overtaking Sight Distance (FOSD) is used to determine the point at which adequate PSD begins, and the Abort Sight Distance (ASD) is used to determine where adequate PSD ends. The FOSD used in Britain is based on an estimate of distance BG in Figure 5, which represents the full distance traveled by the passing vehicle in the opposing lane, a clearance margin, and the full distance traveled by the opposing vehicle while the passing vehicle occupies the opposing lane. Thus, the British criteria assume in geometric design that a region of adequate PSD begins only at a location from which the passing driver can see, when entering the opposing lane, any oncoming vehicle that could potentially conflict with the passing vehicle. In contrast, the British criteria assume that a region of adequate PSD extends past the point at which FOSD is lost, and continues throughout any downstream region in which ASD is available. ASD is assumed to be half of FOSD. No justification for this assumption is stated, but it is in good agreement with the corresponding assumption that the Australian equivalent of ASD is equal to an estimate of distance CF in Figure 5.

In Britain, the design speed is defined as the 85th percentile speed of traffic on the completed facility. The British criteria make explicit assumptions about the driver and vehicle population involved in passing maneuvers. PSD criteria are presented that are considered adequate for passing maneuvers by 50, 85, and 99 percent of the vehicle and driver population. Most PSD design is based on the 85th percentile vehicle and driver population, which was used to derive the PSD design values shown in Table 4.

Australia

The Australian PSD criteria used in geometric design are conceptually similar to those used in Britain, except that distance AB is included as part of the PSD needed to begin a region of adequate sight distance for passing and an explicit distance is specified for the PSD required to continue a passing zone.(*20*)

The Australian equivalent of the British FOSD is called the Establishment Sight Distance (ESD). This distance is an estimate of distance AH in Figure 5. Adequate sight distance to continue a passing maneuver is based on the Continuation Sight Distance (CSD), which is an estimate of Distance CF in Figure 5. The Australian terminology makes this concept of using two different PSD values very clear: the ESD represents the sight distance required for the passing driver's decision to start a passing maneuver; the CSD represents the sight distance necessary for the passing driver's decision to continue or abort the passing maneuver. Thus, the ESD values are used to define the beginning of a region of acceptable passing sight distance, and the CSD values are used to define the end of a region of acceptable passing sight distance.

Table 4 presents the ESD and CSD values used in geometric design in Australia.

Austria, Germany, and Greece

Austria, Germany, and Greece use a PSD concept that is similar to that used in the other countries discussed above.(*3,8,9,12*) The PSD criteria used in Germany and Greece are based on the prevailing 85th percentile speed of traffic, while those used in Austria are based on the project speed. During the passing maneuver, the passing vehicle

TABLE 5 Passing Sight Distance Criteria Used as Warrants for Marking No-Passing Zone Barrier Lines in Selected Countries

Country	Prevailing 85th percentile speed (km/h)							
	50	60	70	80	85	90	100	120
	Passing sight distance (m)							
Australia	150	180	210	240	--	270	300	--
Britain	90	105	125	--	155	--	185	--
Canada	160	200	240	275	--	330	400	--
South Africa	150	180	--	250	--	--	--	400
United States	155	175	210	240	--	280	315	--

NOTE: Australian and British values represent the 85th percentile of the driver and vehicle population. Among the countries reviewed, only Britain uses 85 km/h as a standard design speed.

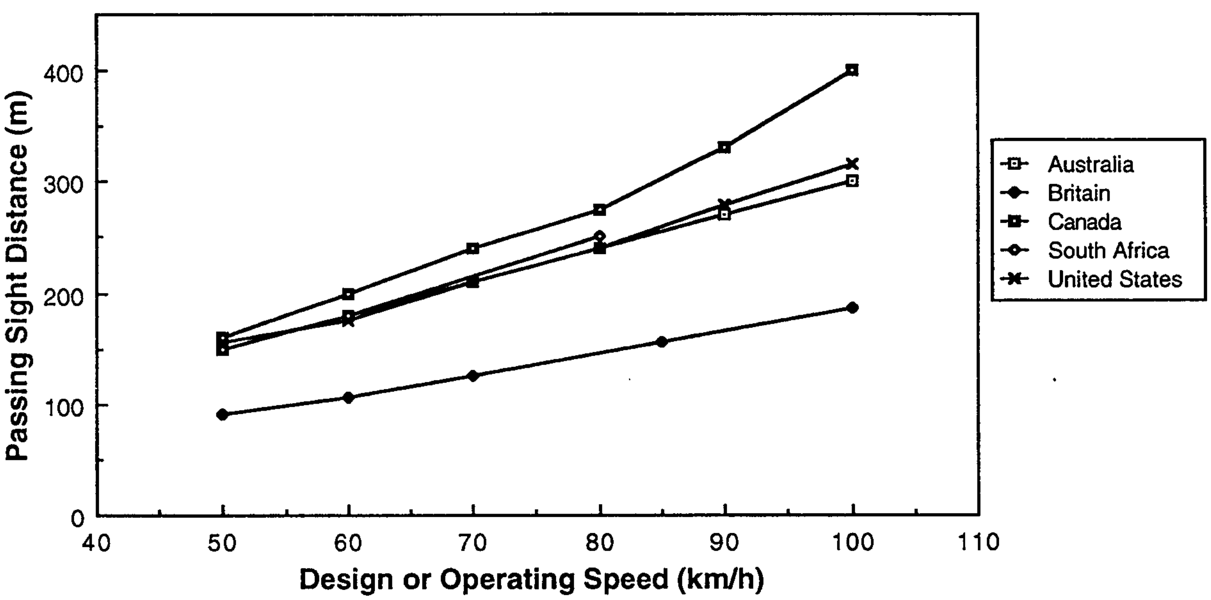

FIGURE 7 Passing Sight Distance Criteria Used as Warrants for Marking No-Passing Zone Barrier Lines in Selected Countries

is assumed to travel at 110 percent of the 85th percentile speed, the passed vehicle is assumed to travel at 85 percent of the 85th percentile speed, and the oncoming vehicle is assumed to travel at the 85th percentile speed of traffic. The design values for passing sight distance used in Austria, Germany, and Greece are presented in Table 4.

South Africa

Geometric design values for minimum PSD used in South Africa are presented in Table 4 and Figure 6.

Marking Criteria for Passing and No-Passing Zones

Each country reviewed uses criteria that differ from their geometric design criteria for actually marking passing and no-passing zones on the centerlines of two-lane highways.(*21,22,23,24*) Table 5 and Figure 7 compare the criteria for marking passing and no-passing zones in each country, as a function of 85th percentile speed. A comparison between Tables 4 and 5 shows that the marking criteria are slightly less than the geometric criteria used in Britain and Australia, and substantially less in the

TABLE 6 Australian Criteria for Minimum Lengths and Spacings Between No-passing Zone Barrier Lines

	Prevailing 85th percentile speed (km/h)					
	50	60	70	80	90	100
Minimum length (m) (see Note 1)	75	90	105	120	135	150
Minimum spacing (m) (see Note 2)	125	150	175	200	225	250

NOTE 1: Minimum length of barrier line. If this length is not reached, no barrier line is marked.
NOTE 2: Minimum distance between adjacent barrier lines. If this distance is not achieved, then the barrier line is made continuous. The comparable U.S. value is 120 m, independent of speed.

TABLE 7 Comparison of Criteria for Driver Eye Height and Object Height Used in Measuring Passing Sight Distance

Country	Driver eye height (m)	Object height (m)
Australia	1.15	1.15
Austria	1.00	1.00
Britain	1.05	--
Canada	1.05	--
Germany	1.00	1.00
Greece	1.00	1.00
South Africa	1.05	1.30
United States		
(geometric design criteria)	1.07	1.30
(marking of barrier lines)	1.07	1.07

NOTE: All values in the table are based on passenger cars; none of the countries reviewed are known to consider trucks in their PSD criteria.

United States, Canada, and South Africa.

Proudlove(*17*) also points out that countries differ in the location at which the beginning of a no-passing zone barrier line marking begins relative to the point at which the minimum PSD for marking of a passing zone is lost. Two concepts have been generally employed in marking and enforcement of passing and no-passing zones. Under the "short zone" concept, all passing maneuvers must be completed before the point at which the no-passing zone barrier line begins. The "long zone" concept allows drivers who begin a passing maneuver in a marked passing zone to complete that passing maneuver beyond the beginning of the barrier line marking. Australia, Britain, Canada, and the United States all generally use the "short zone" concept in laws concerning passing maneuvers on two-lane highways. However, Proudlove(*17*) notes that Britain, Canada, and the United States all mark passing and no-passing zones on their highways as if the "long zone" concept were in effect; i.e., the marked no-passing zone barrier line begins at the point at which the required PSD shown in Table 5 is lost. In contrast, Australia extends the marked passing zone a distance equal to half the CSD beyond the point at which the no-passing zone warrant is first met. This practice recognizes that substantial sight distance is still available at the point at which the

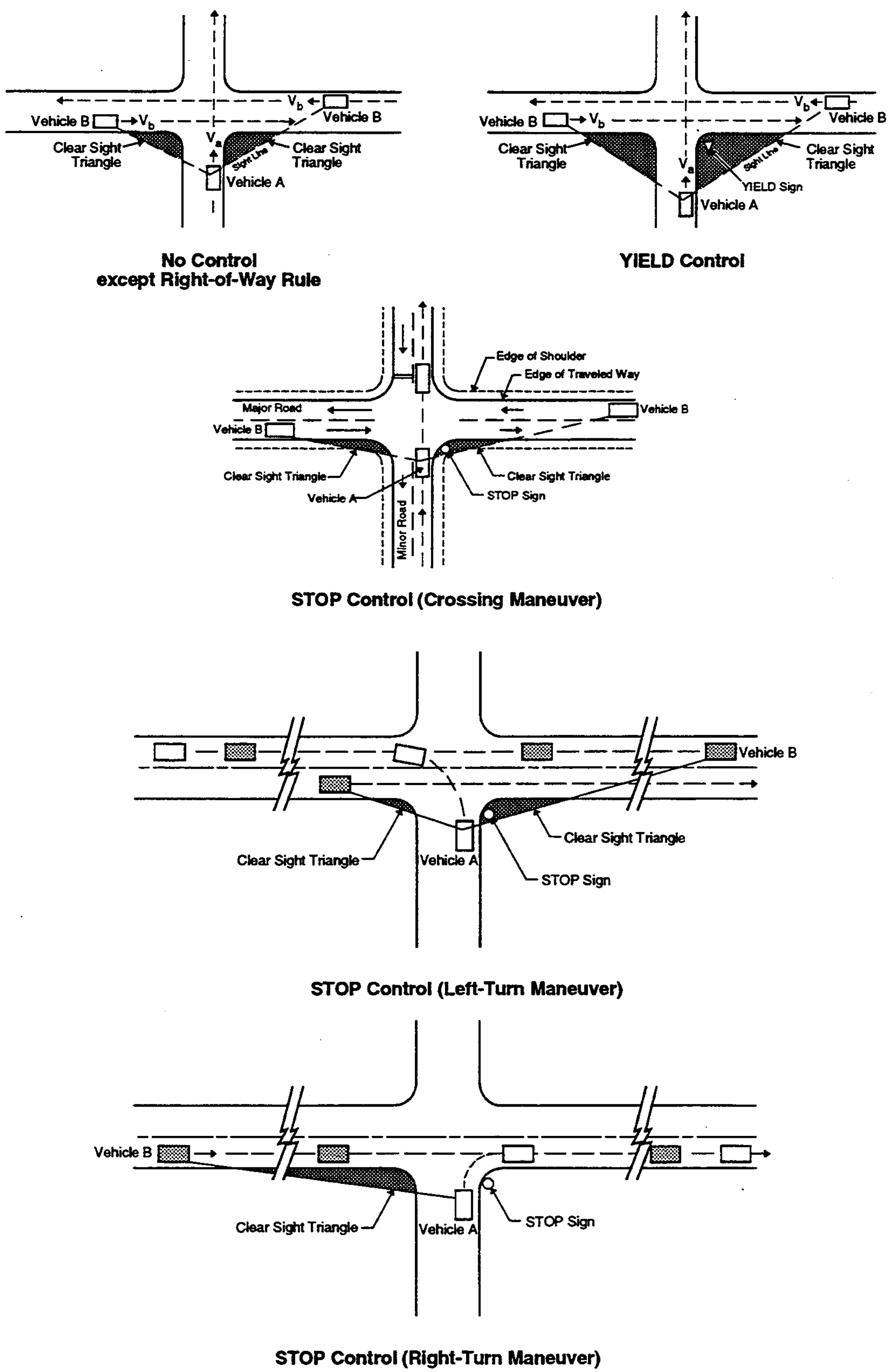

FIGURE 8 Typical Clear Sight Triangles Used in Intersection Sight Distance Design

no-passing zone warrant is first met. Moreover, since the Australian CSD is a geometric design concept rather than a marking concept, its use in determining the end of a passing zone makes the resulting passing zones marked on the highway more like those that would result if the geometric design criteria were applied directly.

Austria, Germany, Greece, and Switzerland use a concept known as opposing sight distance as the basis of marking criteria for passing zones.(*3,25*) The opposing sight distance is equal to the sum of the stopping sight distances of two opposing vehicles, or twice the SSD design values. Where opposing sight distance cannot be provided, for economic or environmental reasons, a no-passing zone barrier line is marked.

As in other countries, the South African PSD values used for marking no-passing barrier lines, as shown in Table 5, are generally less than half of the PSD values used in geometric design, as shown in Table 4. The barrier line PSD values are also used in South Africa.

Table 6 illustrates the criteria used in Australia for the minimum length of no-passing zone barrier line and the minimum spacing between adjacent barrier lines, as a function of prevailing 85th percentile speed. The United States has no policy comparable to the Australian policy for minimum length of barrier line. The United States requires a minimum spacing of 120 m between adjacent barrier line segments, independent of speed. Where this distance is not achieved, the barrier line is made continuous.

Passing Sight Distance Measurement Criteria

Table 7 summarizes the values of driver eye height and object height that are assumed in the geometric design and marking of two-lane highways.

INTERSECTION SIGHT DISTANCE

Intersection sight distance (ISD) is intended to provide drivers at or approaching an at-grade intersection with an unobstructed view of the entire intersection and sufficient lengths of the intersecting highways to permit the approaching drivers to anticipate and avoid potential collisions. This requires unobstructed sight distance along each approach on both intersecting roadways, as well as across their included corners. Figure 8 illustrates the concept of a clear sight triangle between two intersection roadways which is the basis for all ISD policies. The clear sight triangle is defined by specified sight distances along each leg of each intersection. ISD is provided by controls on the horizontal and vertical alignments of the intersecting roadways and by keeping the area within the clear sight triangle free of sight obstructions.

Four different cases of ISD design policy are addressed in the following discussion:

- ISD for approaches to intersections with no control
- ISD for drivers on an intersection approach with YIELD control
- ISD for drivers crossing the major road from a STOP-controlled approach
- ISD for drivers turning left or right onto the major road from a STOP-controlled approach

Figure 8 illustrates the types of clear sight triangles that are provided for each ISD case. The required dimensions for each type of clear sight triangle illustrated in Figure 8 are typically a function of the speeds at which vehicles are expected to operate on specific intersection legs.

The following discussion summarizes the ISD design policies of nine countries: Australia, Canada, France, Germany, the Netherlands, South Africa, Sweden, Switzerland, and the United States. In addition to identifying the ISD cases considered by each country's ISD policy, and the dimensions that are used to define the clear sight triangle, the following discussion addresses the values assumed in different countries for the height of the driver's eye above the roadway surface and the assumed height of the target to be seen.

It should be noted that United States ISD policy discussed below is currently under review in NCHRP Project 15-14(1) and changes to that policy may be forthcoming.

Intersections with No Control

Some highway agencies operate low-volume intersections with no traffic control devices (STOP or YIELD signs) on any of the approaches. The right-of-way at such intersections is assigned by applicable law. For example, United States law assigns the right-of-way between potentially conflicting vehicles to the vehicle on the right. Australian law incorporates a "T-intersection rule" in which vehicles on the stem of a T-intersection must yield the right of way to vehicles from either direction on the through roadway.

Of the countries whose ISD design policies were reviewed, only the United States appears to have a policy for sight distance on approaches to intersections with no control other than the right-of-way rule.(*15*) The German policy states explicitly that intersections controlled by the right-of-way rule are not generally found on highways of the type addressed by the policy and, therefore, are not considered.(*26*)

The United States policy provides clear sight triangles sufficient to allow each vehicle 3 sec to adjust speeds if a vehicle appears on intersection approach. The policy states that this 3 sec period consists of 2 sec for perception and reaction plus an additional 1 sec to actuate braking or to accelerate to regulate speed. The resulting ISD values,

TABLE 8 Design Values for Sight Distance Along Each Leg of an Uncontrolled Intersection

Design speed (km/h)	20	30	40	50	60	70	80	90	100	110	120
	Sight distance (m)										
United States	20	30	35	45	50	60	65	75	85	90	100

TABLE 9 Design Values for Sight Distance Along the Major-Road Leg of a YIELD-Controlled Intersection

		Design or operating speed (km/h)									
Country	Design situation	30	40	50	60	70	80	90	100	110	120
		Sight distance (m)									
Germany	rural highways	--	--	70	85	110	135	170	200	--	--
	rural highways with high volumes of turning trucks	--	--	--	--	175	210	250	300	--	--
Sweden		--	--	--	--	195	--	275	--	355	--
South Africa	passenger car	30	62	--	92	--	124	--	155	--	188
	single-unit truck	38	75	--	112	--	150	--	190	--	228
	combination truck	45	90	--	136	--	184	--	232	--	278
United States	(see Note 1)	30	44	63	85	111	139	169	205	246	286

NOTE 1: Equivalent to United States SSD design policy. The values represent the higher end of the range of SSD values used for design.

TABLE 10 Design Values for Sight Distance Along the Minor-Road Leg of a YIELD-Controlled Intersection

	Design or operating speed (km/h)									
Country	30	40	50	60	70	80	90	100	110	120
	Sight distance (m)									
Germany (see Notes 1 and 2)	--	--	10	10	10	10	10	10	--	--
South Africa (see Note 2)	45	45	--	45	--	45	--	45	--	45
Sweden (see Note 2)	--	--	20	20	20	20	20	20	20	--
United States (see Note 3)	30	44	63	85	111	139	169	205	246	286

NOTE 1: In German policy, the design values are increased from 10 to 20 m for rural intersections with high volumes of turning trucks.
NOTE 2: In German, South African, and Swedish policies, the leg of the sight triangle along the minor road is independent of speed.
NOTE 3: Equivalent to United States SSD design policy. The values represent the higher end of the range of SSD values used for design.

TABLE 11 Sight Distance Design Values for Crossing the Major Road from a STOP-Controlled Approach

Country	Design situation	Design or operating speed (km/h)								
		40	50	60	70	80	90	100	110	120
		Sight distance (m)								
Canada	Passenger car/2-lane road	--	99	119	138	158	178	198	217	--
	Single unit truck/2-lane road	--	129	155	181	207	233	258	284	--
	Combination truck/2-lane road	--	172	206	241	275	309	344	378	--
United States	Passenger car/2-lane road	73	91	109	127	146	164	182	200	218
	Single unit truck/2-lane road	102	127	153	178	204	229	255	280	306
	Combination truck/2-lane road	140	175	210	245	280	315	350	385	420

NOTE: United States design values for sight distance along the minor road are the same as the United States values shown in Table 8. Both United States and Canadian values for a combination truck are based on the WB-15 design vehicle.

representing each leg of the clear sight triangle for each approach, are shown in Table 8. These values apply to each leg of each uncontrolled intersection.

Intersection Approaches with YIELD Control

Four of the countries whose ISD policies were reviewed have policies concerning ISD for vehicles on an intersection approach controlled by a YIELD sign. These countries are Germany, South Africa, Sweden, and the United States.

Tables 9 and 10 compare the dimensions of the required sight triangles at a YIELD-controlled intersection in these countries for the legs of the clear sight triangle along the major and minor roads, respectively.

In the German policy, the leg of the sight triangle along the minor road, measured from the edge of the major-road traveled way to the driver's eye, is extended from the 3 m length used for a STOP-controlled intersection to 10 m. In rural areas, it is recommended that the length of the sight triangle along the minor road be increased to 20 m for sites with high volumes of turning trucks. The leg of the sight triangle along the major road is the same in the German policy for YIELD controlled intersections as that discussed below for STOP-controlled intersections.(*26*)

In the South Africa policy for YIELD-controlled intersections, the leg of the clear sight triangle along the major road varies as a function of speed and vehicle type, as shown in Table 9. The leg of the clear sight triangle along the minor road is set at 45 m, independent of speed, as shown in Table 10.

The Swedish policy specifies a sight triangle whose legs along both the major and minor roads are longer for YIELD-controlled approaches than for STOP-controlled approaches.(*27*)

The U.S. policy for YIELD-controlled intersections specifies that each leg of the sight triangle used for ISD on a YIELD-controlled approach should be equal in length to the design values used for SSD. SSD is represented in U.S. policy by a range of values, based on assumptions as to whether vehicles travel at or slightly below the design speed of the roadway.(*15*)

Crossing the Major Road from a STOP-Controlled Approach

Of the countries whose ISD policies were reviewed, only Canada, South Africa, and the United States explicitly address the sight distance requirements for crossing the major road from a STOP-controlled approach. The sight distance values for the crossing maneuver used in United States

TABLE 12 Design Values for Sight Distance Along the Major-Road Leg for Turning Left or Right onto the Major Road from a STOP-Controlled Approach

Country	Design situation	Major-road design or operating speed (km/h)									Remarks
		40	50	60	70	80	90	100	110	120	
		Sight distance (m)									
Australia	minimum ISD - urban	60	80	105	130	165	--	--	--	--	known as Safe Intersection Sight Distance (SISD)
	minimum ISD - rural	70	90	115	140	175	210	250	290	330	known as Safe Intersection Sight Distance (SISD)
	desirable ISD	100	125	160	220	305	400	500	500	500	known as Entering Sight Distance (ESD)
Canada	left and right turns - passenger cars	--	125	165	215	265	320	380	435	--	
France	desirable - 3-lane or 2-lane divided road	100	125	150	175	200	225	250	275	300	based on travel time of 9 sec at 85th %ile speed
	desirable - 2-lane road	89	111	133	156	178	200	222	244	267	based on travel time of 8 sec at 85th %ile speed
	minimum - 3-lane or 2-lane divided road	78	97	117	136	156	175	194	214	233	based on travel time of 7 sec at 85th %ile speed
	minimum - 2-lane road	67	83	100	117	133	150	167	183	200	based on travel time of 6 sec at 85th %ile speed
Germany	rural hwys w/o access control - passenger cars	--	70	85	110	135	170	200	--	--	
	rural hwys w/o access control - trucks	--	--	--	175	210	250	300	--	--	
	urban and suburban, partial access control	--	70	85	110	--	--	--	--	--	
	urban arterials and collectors	50	70	--	--	--	--	--	--	--	
Netherlands	left and right turns - passenger cars	--	--	100	--	150	--	250	--	--	
Sweden	normal design	--	110	--	170	--	240	--	320	--	provides acceptable gaps for 85% of drivers
	extreme design	--	80	--	130	--	190	--	260	--	provides acceptable gaps for 50% of drivers
Switzerland	left turns - passenger cars	60	80	115	140	170	210	240	--	--	
	right turns - passenger cars	55	70	105	125	155	195	230	--	--	
	left & right turns - trucks	125	155	180	220	245	--	--	--	--	
United States	left & right turns - passenger cars	86	118	156	199	250	308	375	452	544	

TABLE 13 Design Values for Sight Distance Along the Minor-Road Leg for Turning Left or Right onto the Major Road from a STOP-Controlled Approach

Country	Distance from edge of major road to driver's eye (m)
Australia	7.00 - desirable
	5.00 - minimum
France	3.00
Germany	3.00 (see Note 1)
Netherlands	5.00
Sweden	5.00 - desirable
	3.00 - minimum
Switzerland	2.50
United States	6.10

NOTE 1: The German design value is increased to 4.50 to 5.00 m if there is a bicycle path along the major road.

TABLE 14 Design Values for Height of Driver's Eye and Height of Object To Be Seen Used in Intersection Sight Distance Design

	Height of driver's eye (m)		Height of object to be seen (passenger car) (m)
Country	Passenger car	Truck	
Australia	1.15	1.80	1.15
France	1.00	--	1.00
Germany	1.00	2.50	1.00
South Africa	1.05	1.80	1.30
United States	1.07	--	1.30

policy is presented in Table 11; the Canadian values are essentially the same. The time required to cross the major road, and thus the sight distance required, are a function of the acceleration capability and length of the crossing vehicle and thus the vehicle type. Table 11 shows the ISD values used for passenger cars, single-unit trucks, and articulated or combination trucks.*(5,15)* In addition to the values shown in the table, the United States also has a policy on the sight distance required for left-turn maneuvers from the major road to a minor road; the logic used to determine these sight distance values is similar to the sight distance policy for the crossing maneuver, except that fewer lanes may need to be crossed.

The recommended South Africa ISD values for the crossing maneuver at a STOP-controlled intersection are about 7 percent higher than the United States values shown in Table 11.

Turning Left or Right onto the Major Road from a STOP-Controlled Approach

Every country reviewed has a policy for the sight distance requirements for left and right turns from a STOP-controlled approach. The required sight distance for the legs of the clear sight triangle along the major and minor roads for each country are shown in Tables 12 and 13, respectively. The ISD policies of Australia, Canada, Sweden, and the United States are based on design speed.*(5,15,20,27)* The policies of France, Germany, and the Netherlands are based on the prevailing 85th percentile speed.*(6,26,28,29)*

Most of the design policies reviewed say very little about how the sight distance values used in design were derived. However, the Australian ISD policy is based on an enhanced SSD model, the French policy is based on gap acceptance, and the Canadian and U.S. policies are based on specific assumptions concerning the acceleration behavior of the minor-road vehicle as it turns onto the major road and the deceleration behavior of a following major-road vehicle that is forced to slow by the appearance of the turning vehicle. All of the policies make the assumption, whose validity can be readily demonstrated, that the sight distance requirements of left- and right-turning vehicles are so nearly equivalent that they can be treated as identical. The Australian design policy for the length of the leg of the clear distance triangle along the major road is based on two distinct sets of ISD criteria. The Safe Intersection Sight Distance (SISD) represents the minimum sight distance to be provided for a STOP-controlled intersection approach, and has distinct values for urban and rural intersections, with the rural values being 10 m longer than the urban values up to the maximum design speed of 80 km/h for urban facilities. There is also a policy for Entering Sight Distance (ESD), which is substantially longer than the SISD values and represents desirable sight distance values for design. An interesting feature of the Australian policy is the specified maximum sight distance of 500 m. The ESD policy assumes that drivers are unlikely to seek gaps over 500 m in length, and therefore the sight distance requirements are reduced to 500 m for speeds of 100 km/h or more, even when the ESD model indicates a higher values.*(20)*

The French ISD criteria are based on a gap acceptance approach that results in sight distance values for the major road leg of the sight distance triangle equivalent to 6 to 9 sec travel time at the prevailing 85th percentile speed of the major road. The critical gap varies in the range of 6 to 9 sec based on the roadway type and the designer's choice of minimum or desirable criteria (see Table 12).*(6)*

The United States policy assumes that the sight distance along the major road must be sufficient for a vehicle turning left or right from the minor road to complete its turn by accelerating from a stop to 85% of the major-road design speed without being overtaken by a major road vehicle which reduces speed from the design speed of the major road to 85% of the design speed. The key assumptions in determining ISD by this method are that the perception-reaction time of the minor-road driver is 2.0 sec, the acceleration behavior of the minor-road vehicle is that assumed in Table IX-8 of the 1994 Green Book and the gap between the minor- and major-road vehicles at the end of the maneuver is 2.0 sec.*(15)*.

Table 14 compares the other ISD measurement criteria used by the countries whose policies were reviewed, including policies concerning the distance from the edge of the major road to the driver's eye (i.e., the length of the leg of the clear sight triangle along the minor road); the height of the driver's eye; and the height of the object to be seen, which in all cases is assumed to be a passenger car.

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