School Bus Stop

Traffic and Safety Manual
Chapter 7
Traffic Engineering Studies
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General Guidelines

Requests for placement of School Bus Stop Ahead signs submitted by school or law enforcement officials should be evaluated as provided herein. Requests received from other sources should be reviewed with the appropriate school officials to verify bus travel patterns and operations, and recommendations.

The MUTCD states in Section 7B.13 that "the School Bus Stop Ahead (S3-1) sign (see Figure 7B-1) should be installed in advance of locations where a school bus, when stopped to pick up or discharge passengers, is not visible to road users for an adequate distance and where there is no opportunity to relocate the school bus stop to provide adequate sight distance." It is not to be used at all locations, but only where terrain and vertical or horizontal sight geometry of the roadway limit approach sight distance and there is no opportunity to relocate the stop to a point where visibility is adequate.

A procedure has been developed to compute the stopping sight distance for each location under study and compare it with available sight distance. If the stopping sight distance exceeds the available sight distance, a School Bus Stop Ahead sign is justified. If the stopping sight distance is less than the available sight distance, a sign is not to be installed.

Procedures

Determine the Available Sight Distance

The available sight distance (SD) is determined by making observations at each site under study. Assumptions and criteria used for this part of the study are as follows:

1. The driver's eye height is 3.50 feet.
2. The height of the target used at the driveway where passengers are picked up or discharged is 4.0 feet. This is approximately ½ the height of a school bus and would include the flashing lights and a substantial portion of the bus itself.
3. The observation point is positioned on the roadway at approximately the same lateral location as the driver's eye.

By using the above assumptions and criteria, the available sight distance is determined.

Determine the Average Grade

The equation used to calculate stopping sight distance includes the grade through the section of highway where deceleration takes place because deceleration rate is affected by gradient. For instance, the stopping sight distance for 60 MPH varies from 686 feet on a downgrade of 9% to 495 feet on an upgrade of 9%. The average grade can be obtained from the plan and profile for the highway section being studied or can be checked in the field.

Determine the Stopping Sight Distance

The method of computing stopping sight distance is taken from the 2011 edition of *A Policy on Geometric Design of Highways and Streets* published by the American Association of State Highway and Transportation Officials (AASHTO). Stopping sight distance is the sum of two distances: (1) the distance traversed by the vehicle from the instant the driver sights an object necessitating a stop to the instant the brakes are applied; and (2) the distance needed to stop the vehicle from the instant brake application begins. These are referred to as brake reaction distance and braking distance, respectively. The approximate stopping sight distance may be determined from the following equation:

$$SSD = V(1.47)(t) + \frac{V^2}{(30)(0.348 \pm G)}$$

Where:

SSD = stopping sight distance, ft

V = speed, MPH

t = brake reaction time, 2.5 s

11.2 = deceleration rate, ft/s^2

G = percent grade divided by 100%, percent/percent

0.348 = deceleration rate divided by 32.2 ft/s^2

Assumptions made in computing the stopping sight distance are:

1. The initial speed (*V*) is 60 MPH for a location with a posted speed limit of 55 MPH or 70 MPH for a location with a posted speed limit of 65 MPH. If the location is in a speed zone of less than 55 MPH, the actual posted speed limit is used.
2. The brake reaction time (*t*) equals 2.5 seconds.
3. The deceleration rate is 11.2 feet/second^2.
4. The grade (*G*) used is the actual percent divided by 100 or the average grade if the approach is on a vertical curve.

Example Computation

V = 60 MPH

G = minus 0.045

$$SSD = 60(1.47)(2.5) + \frac{60^2}{(30)(0.348 - 0.0456)}$$

$$SSD = 221 + \frac{3600}{9.09}$$

SSD = 221 + 396

SSD = 617

SSD = 620, rounded

Alternate Method

An acceptable method of determining the stopping sight distance is to refer to Table 1 or Table 2 below and read the stopping sight distance directly for the speed and average grade for the location under

study. If the average grade is not a whole number it would be appropriate to round up to the nearest whole number grade for downgrades and down to the nearest whole number grade for upgrades.

Table 1

Stopping Sight Distance on Downgrades

Speed	Stopping sight distance on downgrades									
Mph	0%	1%	2%	3%	4%	5%	6%	7%	8%	9%
30	197	200	202	205	208	211	215	219	223	227
35	246	250	254	256	262	266	271	276	281	287
40	301	305	310	315	321	326	333	339	347	354
45	360	366	372	378	385	392	400	409	418	428
50	424	431	438	446	455	464	474	484	495	507
55	492	501	510	520	530	541	553	565	579	593
60	566	576	587	598	611	624	638	653	669	686
65	644	656	669	682	697	712	728	746	765	785
70	727	741	756	771	788	806	825	845	867	891

Table 2

Stopping Sight Distance on Upgrades

Speed	Stopping sight distance on Upgrades									
Mph	0%	1%	2%	3%	4%	5%	6%	7%	8%	9%
30	197	195	192	190	188	186	184	183	181	179
35	246	243	240	237	234	232	229	227	225	222
40	301	296	292	289	285	282	278	275	272	269
45	360	354	349	344	340	335	331	327	324	320
50	424	417	411	405	399	394	388	384	379	375
55	492	484	477	469	463	456	450	444	438	433
60	566	556	547	538	530	523	515	508	501	495
65	644	633	622	612	602	593	585	576	568	561
70	727	714	702	690	679	668	658	648	639	631

Determination of Signing Need

The available sight distance (SD) needs to be compared with the needed stopping sight distance (*SSD*) to determine if a School Bus Stop Ahead sign is needed.

When the situation involves approaching the front of a stopped school bus, 10 feet should be added for a passenger crosswalk and 25 feet for a clear zone. The analysis would be as follows:

- If SD is greater than *SSD* + 10 + 25 a School Bus Stop Ahead sign is not justified.
- If SD is equal to or less than *SSD* + 10 + 25 a School Bus Stop Ahead sign is justified.

When the situation involves approaching the rear of a stopped school bus, 35 feet should be added for the bus and 25 feet for a clear zone. The analysis is as follows:

- If SD is greater than *SSD* + 35 + 25 a School Bus Stop Ahead sign is not justified.
- If SD is equal to or less than *SSD* + 35 + 25, a School Bus Stop Ahead sign is justified.

Sign Installation

If a School Bus Stop Ahead sign is justified, it should be installed approximately 500 feet in advance of the point where one-half of the school bus is visible, i.e., SD + 500 feet. Two signs are required on a divided highway (median and right shoulder).

Documentation

For many studies, the findings, conclusions and recommendations must be clearly conveyed to those who are responsible for acting on the results. This is done through the use of a memo, letter or more formal report. Some study presentations include the use of forms, tables or graphs depicting the data collected. The documentation for a school bus stop sight distance study should include when, where and by whom the study was conducted, and that it was done in conformance with established guidelines. The calculation of needed sight distance should be shown and compared to the measured available sight distance to show why the sign is or is not being recommended.