Sussex County
Division of Engineering
Sight Distance Standards

Developed August 29, 2005
Last Revised March 12, 2009

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Revisions:

March 19, 2008:

1.) **Replaced detail sheets SC-01 and SC-02 to agree versions contained within Sussex County Standard Design and Construction Details.**
2.) **Removed notation "Appendix B" from header of sheets 18-28.**

May 22, 2008:

1.) **Updated Sight Distance Table for Posted Speed to agree with design speeds as established under Land Development Standards Section V.C.3.b.ii.**

March 12, 2009

1.) **Update "Posted Speed Table" 35 MPH Posted Speed now uses 40 MPH Design Speed.**

County of Sussex
SIGHT DISTANCE DATA
Using 85th Percentile Speed

Intersections - Left Turns In from Major Road

85th pctl speed (MPH)	DESIGN SPEED (MPH)	LEFT IN FROM STOP Eye height 3.5' Object height 3.5' Diagram Dist "B" *Left from Major Distance* *AASHTO* DESIGN VEHICLE (P)	(SU)	(WB)	LEFT IN ON APPROACH Eye height 3.5' Object height 3.5' Diagram Dist "TDSD" DESIGN VEHICLE (P)		
20	22	178	210	243	207		
25	27.5	222	263	303	258		
30	33	267	315	364	310		
35	38.5	311	368	424	361		
40	44	356	420	485	413		
45	49.5	400	473	546	465		
50	55	445	526	606	516		
55	60.5	489	578	667	568		
60	66	534	631	728	620		
65	71.5	578	683	788			
70	77	623	736	849			
		Stopping Sight Distance					
		Eye height 3.5' Object height 2.0' Diagram Dist "D"			See Tables Sight Distance Appendix B t=6.4s		

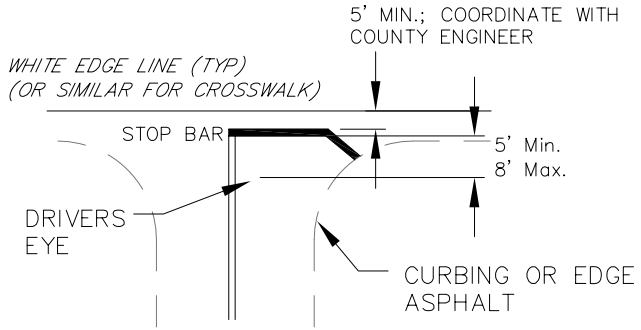
Intersections - Turns Out

85th pctl speed (MPH)	DESIGN SPEED (MPH)	Left Out Eye height 3.5' Object height 3.5' Diagram Dist "A" *Clear sight lines* *from stopped condition* DESIGN VEHICLE (P)	(SU)	(WB)	Right Out Eye height 3.5' Object height 3.5' Diagram Dist "E" *Clear sight lines* *from stopped condition* DESIGN VEHICLE (P)	(SU)	(WB)
20	22	243	307	372	210	275	340
25	27.5	303	384	465	263	344	424
30	33	364	461	558	315	412	509
35	38.5	424	538	651	368	481	594
40	44	485	614	744	420	550	679
45	49.5	546	691	837	473	619	764
50	55	606	768	930	526	687	849
55	60.5	667	845	1023	578	756	934
60	66	728	922	1116	631	825	1019
65	71.5	788	998	1209	683	893	1104
70	77	849	1075	1302	736	962	1188

County of Sussex
SIGHT DISTANCE DATA
Using Posted Speed

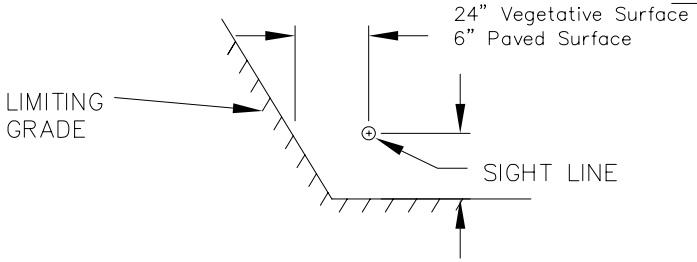
Posted speed (MPH)	DESIGN SPEED (MPH)	Intersections - Left Turns In from Major Road					
		LEFT IN FROM STOP			LEFT IN ON APPROACH		
		Eye height 3.5' Object height 3.5' Diagram Dist "B" *Left in From Major Road* *AASHTO*			Eye Height 3.5' Object Height 3.5' Diagram Dist "TDSD"		
		DESIGN VEHICLE			DESIGN VEHICLE		
		(P)	(SU)	(WB)	(P)		
20	20	162	191	221	188		
25	25	202	239	276	235		
30	30	243	287	331	282		
35	40	323	382	441	375		
40	45	364	430	496	422		
45	55	445	526	606	516		
50	60	485	573	662	563		
		Diagram Dist "DP"					
		123	123	123			
		Stopping Sight Distance					
		Eye height 3.5' Object height 2.0' Diagram Dist "D"			See Tables Sight Distance Appendix B t=6.4s		

Posted speed (MPH)	DESIGN SPEED (MPH)	Intersections - Turns Out					
		Left Out			Right Out		
		Eye height 3.5' Object height 3.5' Diagram Dist "A" *Clear sight lines* *from stopped condition*			Eye height 3.5' Object height 3.5' Diagram Dist "E" *Clear sight lines* *from stopped condition*		
		DESIGN VEHICLE			DESIGN VEHICLE		
		(P)	(SU)	(WB)	(P)	(SU)	(WB)
20	20	221	279	338	191	250	309
25	25	276	349	423	239	312	386
30	30	331	419	507	287	375	463
35	40	441	559	676	382	500	617
40	45	496	628	761	430	562	695
45	55	606	768	930	526	687	849
50	60	662	838	1014	573	750	926



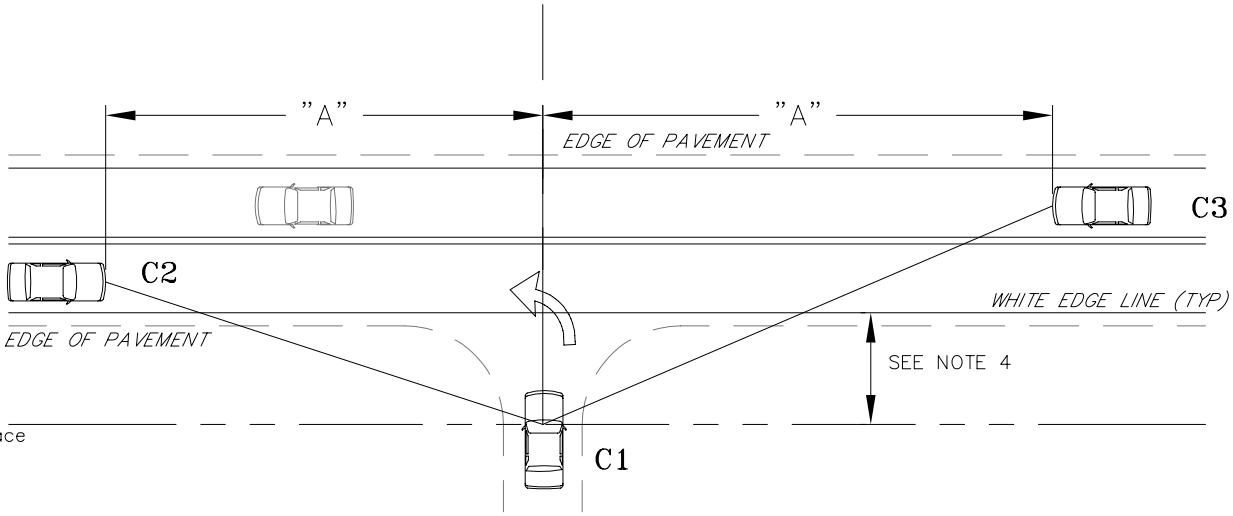
03 SC1 **Driver Eye Location**

(Coordinate with County Engineer)



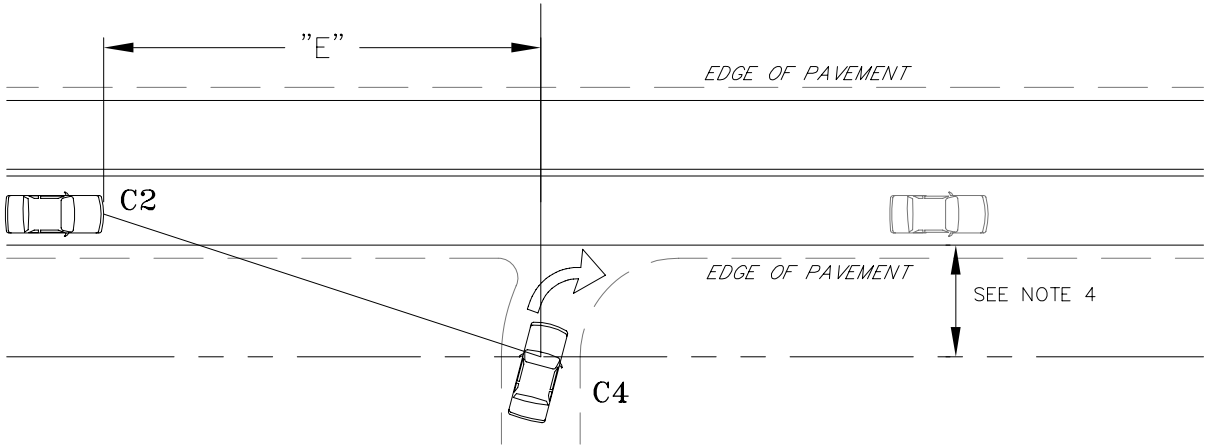
04 SC1 **Sight Line Buffer**

(Clear Area Between Obstruction and Sight Line)



02 SC1 **Intersection Allowing Left Turns Out**

(Typically Will Control for turns out)



01 SC1 **Intersection – Right Turn Out**

(Right Turn Out Only)

Legend:

- DS: Design Speed:
  (85th Speed plus 10%) or when not available
  (Posted Speed Modified per LDS V.C.3.b.ii)
- C1: Exiting vehicle
- C2: Left–hand approaching vehicle traveling at DS
- C3: Right–hand approaching vehicle traveling at DS
- C4: Right turn only exit vehicle
- Distance A: Intersection Sight Distance
  Left Turning vehicle
- Distance E: Intersection Sight Distance
  Right Turning Vehicle

Design Notes:

1. Diagram used in conjunction with sight distance tables.
2. Car C4 exiting to the right.
3. Eye and Object height per AASHTO standards.
4. Sight distance is measured as follows:

Access without Stop Bars: within the range of 5 to 10 feet behind the white line (white line is the edge of traveled way)

Access with Stop Bar: within a range of 5 to 8 feet behind Stop Bar, this point is typically located between 12 and 15 feet from the edge of traveled way. Coordinate with County Engineer.

Comments: Sight distance shall be measured nearest to location a driver will actually stop.
Sight distance shall be measured at the most restrictive location within the above range.

SHEET DATE: 11/29/05

No.	REVISIONS	DATE	REV. BY
1	Revised Sight Distance	4/4/06	WJK
	Measurement Offset		
2	Revise Detail 03/SC1	5/9/06	WJK
3	Add Detail 04/SC1	4/26/06	WJK
4	Mod. Note 4, Dtl 3, and Speed Std.	1/31/08	WJK

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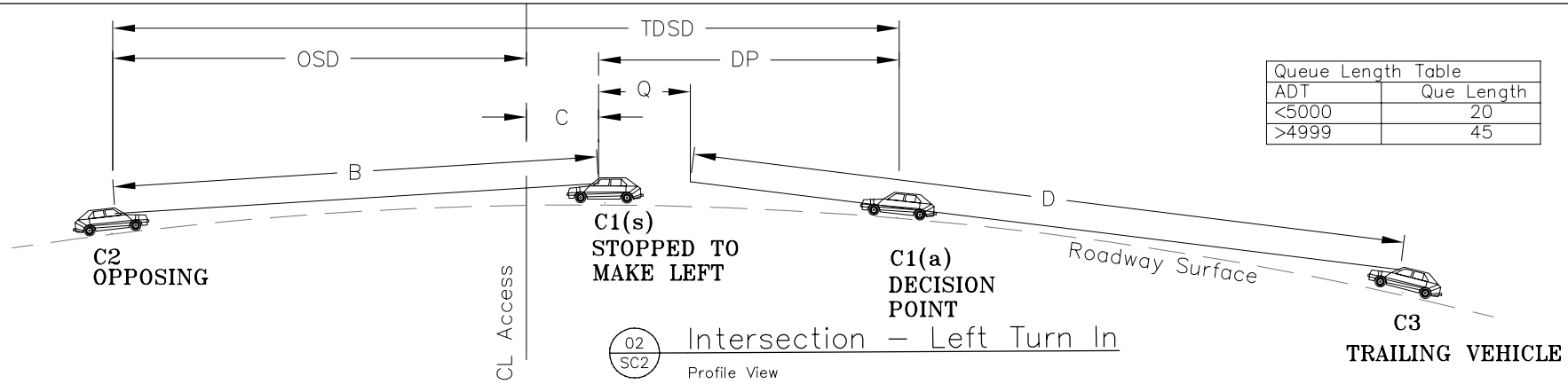
COUNTY OF SUSSEX
DEPARTMENT OF ENGINEERING AND PLANNING
STANDARD DETAILS

INTERSECTION ACCESS
SIGHT DISTANCE OUT

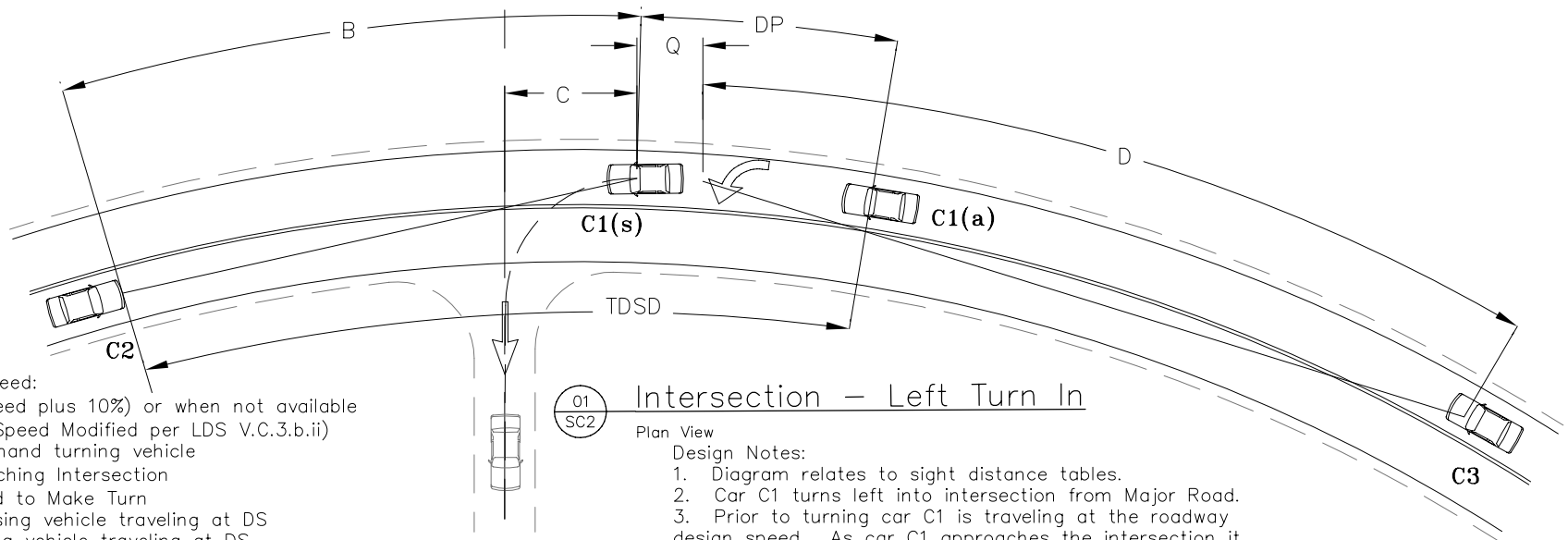
DETAIL SC-1



Queue Length Table	
ADT	Que Length
<5000	20
>4999	45

02 SC2 Intersection – Left Turn In

Profile View



01 SC2 Intersection – Left Turn In

Plan View

Legend:
DS: Design Speed:
(85th speed plus 10%) or when not available
(Posted Speed Modified per LDS V.C.3.b.ii)
Car C1: Left–hand turning vehicle
C1(a): Approaching Intersection
C1(s): Stopped to Make Turn
Car C2: Opposing vehicle traveling at DS
Car C3: Trailing vehicle traveling at DS
Distance C: Stop to Turn Location – 22' Access ingress
CL plus 5' to Driver Eye
Analysis 1 (C1(s) Stopped to Make Left):
Distance B: AASHTO Left Turn from Major Road Car C1 or
Stopping Sight Distance Car C2
Distance D: Stopping Sight Distance Car C3 at DS.
Distance Q: Queue Length: See Table "Queue Length"
Analysis 2: (C1(a) Advancing to make Turn):
Distance DP: Critical Decision Point
(See COS Sight Distance Standards)
Distance TDSD: Turn Decision Sight Distance (see
COS Sight Distance Standards).
Distance OSD: Stopping sight distance for Car C3.

Design Notes:
1. Diagram relates to sight distance tables.
2. Car C1 turns left into intersection from Major Road.
3. Prior to turning car C1 is traveling at the roadway design speed. As car C1 approaches the intersection it decelerates to make the left–hand turn. See COS Sight Distance Manual for more data.
4. Car C3 requires Stopping Sight Distance from the last car in a left turn queue.
5. Car C2, traveling toward car C1 in the opposing lane requires ample stopping sight distance to avoid car C1 should car C1 turn unsafely.
6. Driver Eye and Object Height per AASHTO standards.
7. Car C1 requires ample Turn Decision Sight Distance over which it must see car C2 to evaluate the safety of executing the turn movement. See COS Sight Distance Manual.
8. Stopping Sight Distance is required continuously within the intersection area of influence for all commercial and street access points.
8. Distance "C" is the centerline intersection offset to where Car 1 will stop to make the left hand turn. Distance "C" will be 16 feet plus one–half the entry way lane width.

SHEET DATE: 11/29/05

No.	REVISIONS	DATE	REV. BY
1	LEFT TURN IN FROM MAJOR ROAD	10/27/06	Div Eng
	CRITERIA CONFORMANCE CHECK/UPDATE		
	AGAINST AASHTO STANDARDS		
2	Mod. P. Speed Note to Land Dev. Std.	1/28/08	WJK

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COUNTY OF SUSSEX
DEPARTMENT OF ENGINEERING AND PLANNING
STANDARD DETAILS

INTERSECTION ACCESS
SIGHT DISTANCE IN

DETAIL
SC-2

COUNTY OF SUSSEX
Department of Engineering and Planning
Division of Engineering
Sight Distance Observations
Field Data Record

Date: _____ CR: _____ MM: _____

Municipality: _____

Block: _____ Lot: _____

SCPB No.: _____ Applicant: _____

85th Percentile Speed: _____ Design Speed: _____

Posted Speed: _____

Location: _____ feet from _____

	Field Measured	Require by Design		Eye Height	Object Height
A			Turn Out Looking Left	3.5'	3.5'
A			Turn Out Looking Right	3.5'	3.5'
Left Turn In from Major			(Note: Profile may be needed to safely obtain distance)	3.5'	3.5'
B			Left Turn in Distance (AASHTO Case F)		
TDSD			Decision Sight Distance		
	Standard	Site			
DP	123 ft		Decision Point CL Offset Distance		
D			Tail light Sight Distance	3.5'	2.0'
E			Right Turn Out	3.5'	3.5'

Comments:

Discussion on Left Turn from Major Roadway

The Division of Engineering has reviewed the issue of determining a reasonable and logical approach to providing adequate sight distances as needed for a driver to safely complete a left turn movement from the major roadway. Our evaluation and consideration of this subject has included reviewing numerous sources of information related to intersection sight distances. Although most available sources provided the sight distance criteria for a vehicle from the stopped position it is apparent that a driver approaching the intersection will require adequate sight distance to evaluate opposing traffic's impact on the desired turn movement. The turning driver must determine if the movement can be completed without conflict from opposing traffic. The materials reviewed all sited inadequate sight distances as the primary contributing factor to increased intersection accident rates. Studies have related inadequate intersection sight distances to significantly increased accident rates.

It should be noted that AASHTO recommends all intersections be designed to provide stopping sight distances continuously along the length of the major roadway thus allowing users adequate distance to stop. The following parameters do not by default provide stopping sight distances along the major roadway at the intersection. All proposed commercial driveways and street intersections must be located along sections of a County Routes that provide continuous stopping sight distance. The following parameters have been established for use in evaluating the suitability of existing and/or proposed intersections along Sussex County Roads and should only be used when superior locations are not available along the property frontage.

Additionally, the Division recommends that intersections at or near the crest of hills be avoided. A driver's comfort level is compromised when the driver is not provided adequate sight distance to observe potentially opposing vehicles that could present a conflict to the desired turn movement. Designs which fail to provide adequate sight distance for advancing left turn drivers such that a driver is only provided a marginal comfort level thus resulting in an extremely decreased approach speed and/or even requiring a left turning vehicle driver to stop in the traveled-way of any road has served to unnecessarily introduce a hazard for the traveling public.

Our analysis has identified the following minimum components required for a vehicle to safely complete a Left Turn from the Major roadway while minimally jeopardizing the safety of our traveling public.

A. Let us presume that the left turning vehicle has been provided sufficient sight distance ahead to identify an oncoming conflicting vehicle thus necessitating a stop prior to execution of the left turn. This condition is represented in Sussex County Standard Detail SC-2. Safeguarding the traveling public requires the following sight distances be provided when a vehicle is stopped in the thru-travel lane preparing for a left turn into a minor intersecting access:

1. Stopping Sight Distance must be provided for trailing vehicles, design parameters for this condition include:
    a. Optimal protection will be provided through utilization of an 85th percentile roadway operating speed applying a 10% adjustment such that a majority of roadway users are accounted for in the calculations. Posted or Statutory speed limits should only be used in the absence of data establishing operating speeds. A designer's primary objective should be that which provides a reasonably safe roadway corridor for the traveling public. The successful realization of this dictates the use of sound engineering judgment in applying standards. Based upon this objective a designer would be remiss in utilizing a posted or statutory speed when actual operating speeds are available.
    b. Reaction time should be 2.5 seconds as recommended by AASHTO and supported by various studies. A driver approaching from the rear of the stopped vehicle will not be alert nor anticipating the stopped vehicle. In consideration of this the Division believes the condition warrants conformance with established standards upon which recommendations have been developed providing a reasonable level of safety for most roadway users.
    c. The Left Turning vehicle will stop a distance of 22-feet from the centerline of the access ingress.
    d. A length of 20-feet will provide ample storage for the average automobile.
    e. Depending upon roadway ADT, there exists a reasonable probability that more than one car may queue behind the vehicle stopped awaiting an opportunity to execute the left turn movement. As such under higher ADT conditions additional vehicles should included in the design queue length.

    Using this information we can conclude the following:
    a. Stopping Sight distance must be provided for a trailing vehicle approaching the turning vehicle stopped within the travel way awaiting an opportunity to execute the desired left turn movement. The stopping sight distance will be computed using the roadways 85th percentile operating speed applying the 10% factor needed to encompass a majority of roadway users.
    b. Stopping Sight Distance must be measured from a point behind the stopped vehicle. Based upon the determination a vehicle stops 22-feet from the access ingress and the average vehicle have a length of 20-feet we compute the point to be 42-feet from the access ingress centerline. Higher roadway ADT will warrant an increased centerline offset distance thus accounting for additional vehicles likely to be in the queue length. The increase reflects that required to stack vehicles in the queue, the recommended incremental increase would be 25-feet per queued vehicle.

2. The Left Turning vehicle must be provide adequate sight distance to safely make the left turn from a stopped condition. This corresponds to the AASHTO Case F intersection sight distance criteria. The distance must be provided 22-feet from access ingress centerline location, this being the location a vehicle would

stop while waiting to complete the left turn movement. To this we will add 5-feet adjusting to the reasonable location of the driver's eye. In consideration of this, the AASHTO Case F distance must be provided for a vehicle stopped 27-feet from the access ingress centerline.

B. Let us now investigate the distance required by a driver advancing toward a Left Turn movement from the Major Roadway. As noted previously, the advancing driver must be provided adequate sight distance such that they can determine if the turn movement can be safely executed or if they will have to yield to conflicting opposing traffic. This distance must be provided to the advancing driver in advance of the intersection thus allowing sufficient opportunity for the driver to detect, react and execute the required action. A review of this condition identifies the following parameters for consideration:

1. Vehicle Operating Conditions:
    a. The Advancing vehicle will be decelerating as it approaches the intersection. Available information indicates that average drivers will slow to around one-half of their operating speed regardless of the detection of conflicting vehicles.
    b. A review of available information identifies that the typical driver will slow to 15 MPH when executing the turn without stopping.
    c. The Left Turning driver, in anticipation of the forthcoming turn maneuver, is alert. The Left Turning driver must evaluate both the approaching intersection and conflicting traffic. If we categorize the reaction time for detection of these events as expected we can use AASHTO tabular data to determine the 85^{th} percentile driver reaction time required for a one component event will be 1.7 seconds. This is slightly less than AASHTO findings indicating increased deceleration will occur about 2.5 seconds after a conflicting vehicle comes into view.
    d. Deceleration Rates vary depending upon the situation, ideally sight distances to a new access should be designed to allow a comfortable deceleration rate and not require the driver to react to an unexpected condition. AASHTO concludes the comfortable deceleration rate to be 11.2 ft/s^2. Additionally, AASHTO finds that drivers confronted with the need to stop will typically decelerate at 14.8 ft/s^2.
    e. Grade can play an important part in computation of the stopping sight distance and may be considered in computing the stopping sight distance.
    f. If the driver identifies conflicting opposing traffic which requires a stop prior to execution of the left turn the vehicle will stop 22-feet from the access ingress centerline.
    g. Opposing conflicting vehicles will travel at the roadway 85^{th} percentile operating speed. Determination of the appropriate roadway operating speed should be consistent with that outlined in 1.a above.
2. Computation Critical Locations: See Diagram 3.
    a. Decision Point "DP": the physical location along the intersection approach at which the advancing driver must have the minimum adequate sight

distance needed to provide for a safe driver perception, reaction and maneuver.

b. Stopping Point "SP": the physical location along the approach the driver will have to begin executing a stop maneuver to stop the vehicle at the turning stop point.
c. Turning Stop Point "TSP": The location along the intersection approach that the driver will stop the vehicle prior to executing the turn maneuver.

Using these conditions we can conclude:

a. The left turning advancing vehicle will require stopping sight distance should the driver identify the presence of a conflicting opposing vehicles such that they preventing the safe execution of a left turn. The stopping sight distance computation can reasonably be based upon the speed a driver will have decelerated to when they are required to detect, evaluate and react to the conflicting opposing vehicle. Determination will be predicated upon the following presumptions:
    i. The vehicle will execute the turn at 15 MPH.
    ii. The driver is decelerating at a rate of 11.2 ft/s^2.
    iii. We will use a reaction time of 2.2 seconds, a conservative median between the 1.7 and 2.5 seconds found in AASHTO.

    Using this information we can calculate the maximum speed at which the vehicle should be traveling when the driver reaches the point necessitating a decision to be 32 MPH.
b. We can now use this in conjunction with the other information to determine the distance from the intersection a driver will be when they reach the final decision point. Calculation of this will incorporate the following:
    i. The braking distance a vehicle traveling 15 MPH must be provided to stop. $d = 1.075\frac{(15MPH)^2}{11.2} = 22\ feet$
    ii. The distance a vehicle will travel in 2.2 seconds while decelerating from 32 MPH to 15 MPH
    $d = (46\ fps)(2.2s) + 1/2(-11.2)(2.2s)^2 = 74\ feet$
    iii. The location of the driver's eye will be 5-feet behind the front of vehicle.
    iv. 22-feet from access ingress centerline stopping location.

    Using these parameters we find the critical Decision Point to be a distance of 123 feet from the access ingress centerline.
c. Now we must determine what sight distance the Advancing vehicle will require from the "Decision Point" such that the advancing driver is provided adequate time to evaluate and decide if a turn can safely be completed. To complete this we consider the following:
    i. The advancing vehicle will be decelerating over the 101-foot decision distance prior to either stopping or executing the turn movement.

ii. The turning vehicle will travel approximately 47-feet once committed to the turn before the vehicle crosses the opposing lane and clears the roadway. See attached Diagram 2.
iii. The turning vehicle will complete the maneuver at no more than 10 MPH, we will assume the vehicle began the turn at 15 MPH and decelerated to complete the turn at 5 MPH.
iv. The opposing vehicle is traveling at the roadway 85th percentile operating speed.

d. Applying the above we can determine the distance an approaching opposing vehicle must be from the Advancing vehicle "Decision Point" such that the advancing driver is provided ample opportunity to adequately evaluate the safety of a potential left turn movement. Identification of this distance can be premised on the distance traveled by the opposing vehicle traveling at the 85th percentile operating design speed during the time required by the advancing left turn vehicle for detection, evaluation and completion of the turn. The factors used to compute this distance include the following two components:
    v. The time required for the advancing vehicle to traverse 101-foot distance between the "DP" and the Turning Stop Point "TSP": As determined previously, the vehicle speed at "DP" will be 32 MPH Calculation of this includes the following three components:
        1. First Segment: find the time required to travel from the decision point "DP" to the Stop Point "SP" we must use the Vehicle Speed at "DP" and the deceleration rate. We found that the vehicle traveled 74-feet between the "DP" and "SP". We also know the vehicle decelerated from 32 MPH to 15 MPH. Using a deceleration rate of 11.2 ft/s^2 we find 2.2 seconds.
        2. The second segment is between "SP" and "TSP". Assuming the driver has clear distance and determines it adequately safe to execute the turn the vehicle will travel this distance at 15 MPH. We can compute the time to travel the 22-foot distance to be 1 second.
        3. The total time required to travel from the "DP" to the "TP" is found to be 1s + 2.2s = 3.2 seconds.
    vi. Time required for turning vehicle to execute turn and clear roadway, assuming an average turn speed of 10 MPH we find it will require 3.2 seconds for the vehicle to travel the 47-foot distance of the turn.
    vii. We now determine the distance an opposing vehicle will travel in the 6.4 seconds while the turning vehicle evaluates the maneuver. This distance will be required by the Advancing driver to safely complete the maneuver. The distance will be applied to the Advancing Driver "Decision Point". Refer to Sussex County Standard Detail Sheet SC-2.

D. Finally, an opposing vehicle should be provided stopping sight distance prior to the intersection. This will provide the opposing vehicle ample opportunity to stop should the left turning vehicle unsafely execute the turn movement. Provided the previous sight distances are provided the stopping sight distance required for the opposing vehicle should be achieved.

Example Access Assessment:
Distances reference refer to Sussex County Standard Detail Sheet SC-2

Determine Minimum acceptable sight distances assuming an Observed 85th percentile speed of 50 MPH and a 7.7% incline grade.

- Condition A and D: Stopping Sight Distance for Following and Opposing Vehicle, Detail SC-2 dimension "D" and "OSD":

V= Velocity = 50 MPH plus 10% = 55 MPH
a = Rate of Deceleration = 11.2 ft/s^2
t = Reaction Time = 2.5 seconds
G = Percent Grade/100 = 7.7%/100

Component	Formula	Completed Equation
AASHTO Reaction Distance	$D_R = 1.47Vt$	$D_R = 1.47(55MPH)(2.5s) = 202\,ft$
AASHTO Braking Distance	$D_T = 1.075\frac{V^2}{a}$	$D_T = 1.075(\frac{(55MPH)^2}{11.2\frac{ft}{s^2}}) = 290\,ft$
AASHTO Braking Distance with Grade	$D_G = \frac{V^2}{30((\frac{a}{32.2}) \pm G)}$	$D_G = \frac{(55MPH)^2}{30((\frac{11.2}{32.2}) + 0.077)} = 237\,ft$

Find a SSD distance D = D_R+D_T >> 202 ft + 290 ft = 492 ft along tangent sections or D=D_R+D_G >> 202 ft + 237 ft = 449 ft on a 7.7% Grade

- Condition B: Left Turn from major road: Detail SC-2 dimension “B”

t = time gap = 5.5 passenger and 6.5 single unit

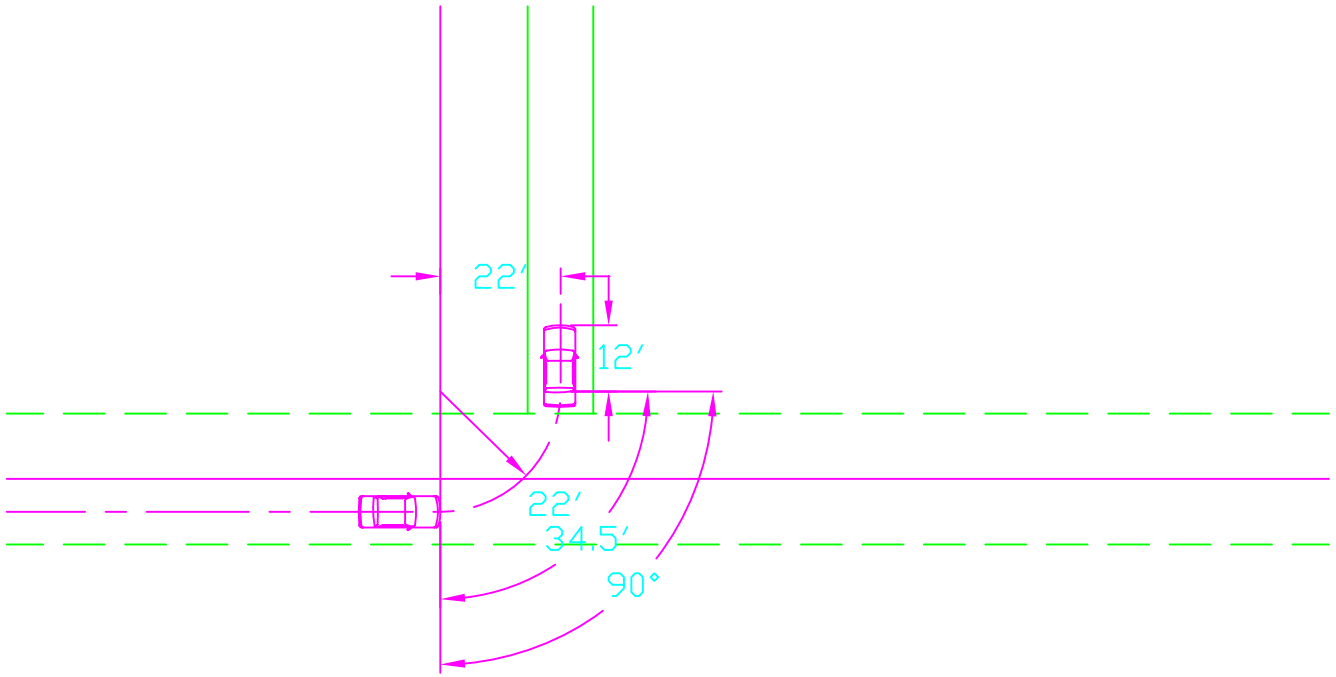
Component	Formula	Completed Equation
AASHTO Case F Formula	$D = 1.47Vt$	$D = 1.47(55MPH)(5.5s) = 445\,ft$

Find a Case F sight distance = 445 ft

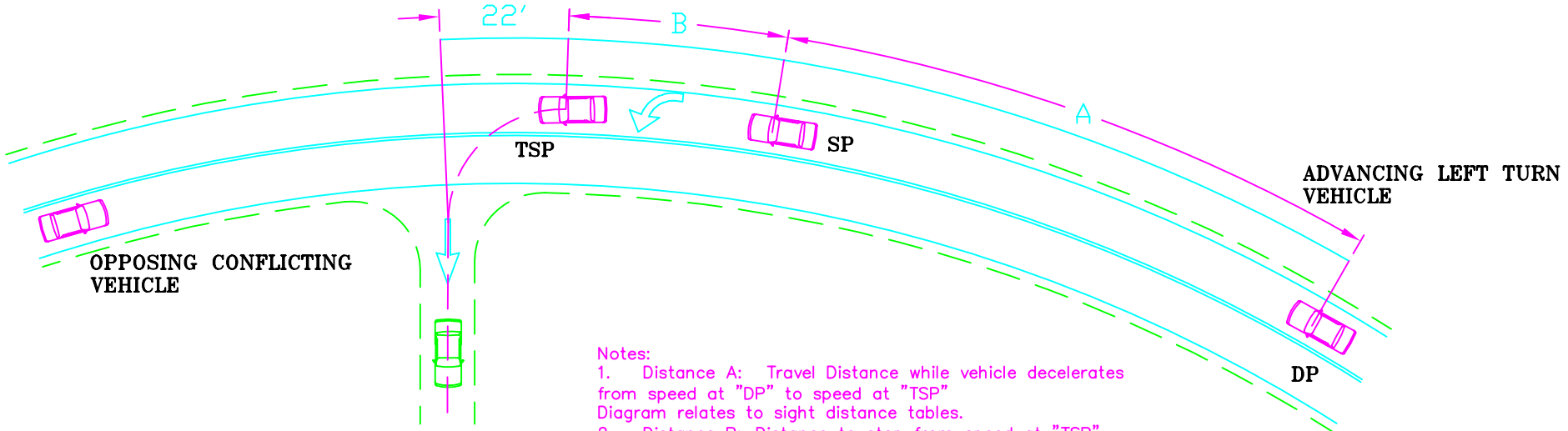
- Condition C: Turn Decision Sight Distance: Detail SC-2 dimension “TDSD”

Component	Formula	Completed Equation
Determine time for C1 to travel between “SP” and “TSP”	$t = \frac{2s}{V_o + V_f}$	$t = \frac{2(22\,ft)}{(22\,fps) + (22\,fps)} = 1.0s$
Determine Vehicle Speed at “DP”	$V_0 = \sqrt{V_f{}^2 + 2Da}$	$V_o = \sqrt{(15MPH \times 1.467)^2 + 2 \times 74\,ft \times 11.2\frac{ft}{s^2}}$ $V_o = 46\,fps(32MPH)$
Determine time for C1 to travel from “DP” to “SP”	$t = \frac{\sqrt{2as + V_o{}^2} + V_o}{a}$	$t = \frac{\sqrt{2(-11.2)(74\,ft) + (46\,fps)^2} - 46\,fps}{-11.2\frac{ft}{s^2}} = 2.2s$
Determine time for C1 to complete turn and clear roadway	$t = \frac{2s}{V_o + V_f}$	$t = \frac{2(47\,ft)}{22\,fps + 7.3\,fps} = 3.5s$
Determine time C2 travels during C1 turn	$t = 3.2s + 3.2s + t_{FS}$	$t = 3.2s + 3.2s = 6.4s$
Determine distance traveled by C2 during the above time	$D = 0.5t(V_o + V_f)$	$D = 0.5(6.4s(88\,fps + 88\,fps) = 516\,ft$

Find a Turn Decision Sight Distance “TDSD” of 516 feet.



Sight Distance DIAGRAM 2



Notes:
1. Distance A: Travel Distance while vehicle decelerates from speed at "DP" to speed at "TSP" Diagram relates to sight distance tables.
2. Distance B: Distance to stop from speed at "TSP"
3. TSP: Turn Stop Point – location vehicle will stop to make turn if opposing conflicting vehicle warrants.
4. DP: Decision Point – location turning vehicle will be from access when driver must decide on appropriate action, i.e turn of stop.
5. "SP" – Stopping Point – location vehicle will be when braking must be initiated to stop at "TSP".

Sight Distance DIAGRAM 3

STOPPING SIGHT DISTANCE 'D'

Sheet 1 of 11

85 th PERCENTILE SPEED	20
DESIGN SPEED	22
FRICTION FACTOR	0.4
REACTION DISTANCE	81

Vd;	f	Vd;	f
20;	0.40	50;	0.30
25;	0.38	55;	0.30
30;	0.35	60;	0.29
35;	0.34	65;	0.29
40;	0.32	70;	0.28
45;	0.32		

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	41	122
-0.5	42	123
-1	42	123
-1.5	43	124
-2	44	124
-2.5	44	125
-3	45	126
-3.5	45	126
-4	46	127
-4.5	47	128
-5	47	128
-5.5	48	129
-6	49	130
-6.5	50	130
-7	50	131
-7.5	51	132
-8	52	133
-8.5	53	134
-9	54	135
-9.5	55	136
-10	56	136
-10.5	57	137
-11	58	138
-11.5	59	140
-12	60	141
-12.5	61	142
-13	62	143
-13.5	63	144
-14	65	145
-14.5	66	147
-15	67	148
-15.5	69	150
-16	70	151
-16.5	72	153
-17	73	154
-17.5	75	156
-18	77	158
-18.5	79	160
-19	81	162
-19.5	83	164
-20	85	166

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	41	122
0.5	41	122
1	40	121
1.5	40	121
2	39	120
2.5	39	120
3	38	119
3.5	38	119
4	38	118
4.5	37	118
5	37	118
5.5	36	117
6	36	117
6.5	35	116
7	35	116
7.5	35	116
8	34	115
8.5	34	115
9	34	114
9.5	33	114
10	33	114
10.5	33	113
11	32	113
11.5	32	113
12	32	112
12.5	31	112
13	31	112
13.5	31	112
14	30	111
14.5	30	111
15	30	111
15.5	30	110
16	29	110
16.5	29	110
17	29	110
17.5	29	109
18	28	109
18.5	28	109
19	28	109
19.5	28	108
20	27	108

STOPPING SIGHT DISTANCE 'D'

85 th PERCENTILE SPEED	25
DESIGN SPEED	27.5
FRICTION FACTOR	0.36
REACTION DISTANCE	101

Vd;	f	Vd;	f
20;	0.40	50;	0.30
25;	0.38	55;	0.30
30;	0.35	60;	0.29
35;	0.34	65;	0.29
40;	0.32	70;	0.28
45;	0.32		

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	70	171
-0.5	71	172
-1	72	173
-1.5	73	174
-2	74	175
-2.5	75	176
-3	76	177
-3.5	78	179
-4	79	180
-4.5	80	181
-5	81	182
-5.5	83	184
-6	84	185
-6.5	85	187
-7	87	188
-7.5	88	190
-8	90	191
-8.5	92	193
-9	93	194
-9.5	95	196
-10	97	198
-10.5	99	200
-11	101	202
-11.5	103	204
-12	105	206
-12.5	107	208
-13	110	211
-13.5	112	213
-14	115	216
-14.5	117	218
-15	120	221
-15.5	123	224
-16	126	227
-16.5	129	230
-17	133	234
-17.5	136	237
-18	140	241
-18.5	144	245
-19	148	249
-19.5	153	254
-20	158	259

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	70	171
0.5	69	170
1	68	169
1.5	67	168
2	66	167
2.5	65	167
3	65	166
3.5	64	165
4	63	164
4.5	62	163
5	61	163
5.5	61	162
6	60	161
6.5	59	160
7	59	160
7.5	58	159
8	57	158
8.5	57	158
9	56	157
9.5	55	156
10	55	156
10.5	54	155
11	54	155
11.5	53	154
12	53	154
12.5	52	153
13	51	153
13.5	51	152
14	50	151
14.5	50	151
15	49	150
15.5	49	150
16	48	150
16.5	48	149
17	48	149
17.5	47	148
18	47	148
18.5	46	147
19	46	147
19.5	45	146
20	45	146

STOPPING SIGHT DISTANCE 'D'

85 th PERCENTILE SPEED	30
DESIGN SPEED	33
FRICTION FACTOR	0.3
REACTION DISTANCE	121

Vd;	f	Vd;	f
20;	0.40	50;	0.30
25;	0.38	55;	0.30
30;	0.35	60;	0.29
35;	0.34	65;	0.29
40;	0.32	70;	0.28
45;	0.32		

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	107	228
-0.5	108	230
-1	110	231
-1.5	112	233
-2	113	235
-2.5	115	237
-3	117	238
-3.5	119	240
-4	121	242
-4.5	123	244
-5	125	246
-5.5	127	249
-6	130	251
-6.5	132	253
-7	134	256
-7.5	137	258
-8	140	261
-8.5	142	264
-9	145	266
-9.5	148	269
-10	151	273
-10.5	154	276
-11	158	279
-11.5	161	283
-12	165	286
-12.5	169	290
-13	173	294
-13.5	177	298
-14	182	303
-14.5	186	307
-15	191	312
-15.5	196	317
-16	202	323
-16.5	207	329
-17	214	335
-17.5	220	341
-18	227	348
-18.5	234	355
-19	242	363
-19.5	250	372
-20	259	381

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	107	228
0.5	105	226
1	104	225
1.5	102	224
2	101	222
2.5	99	221
3	98	219
3.5	97	218
4	96	217
4.5	94	216
5	93	214
5.5	92	213
6	91	212
6.5	90	211
7	89	210
7.5	87	209
8	86	208
8.5	85	207
9	84	206
9.5	83	205
10	83	204
10.5	82	203
11	81	202
11.5	80	201
12	79	200
12.5	78	199
13	77	199
13.5	76	198
14	76	197
14.5	75	196
15	74	195
15.5	73	195
16	73	194
16.5	72	193
17	71	192
17.5	70	192
18	70	191
18.5	69	190
19	68	190
19.5	68	189
20	67	188

STOPPING SIGHT DISTANCE 'D'

85 th PERCENTILE SPEED	35
DESIGN SPEED	38.5
FRICTION FACTOR	0.32
REACTION DISTANCE	141

Vd;	f	Vd;	f
20;	0.40	50;	0.30
25;	0.38	55;	0.30
30;	0.35	60;	0.29
35;	0.34	65;	0.29
40;	0.32	70;	0.28
45;	0.32		

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	154	296
-0.5	157	298
-1	159	301
-1.5	162	303
-2	165	306
-2.5	167	309
-3	170	312
-3.5	173	315
-4	176	318
-4.5	180	321
-5	183	324
-5.5	186	328
-6	190	332
-6.5	194	335
-7	198	339
-7.5	202	343
-8	206	347
-8.5	210	352
-9	215	356
-9.5	220	361
-10	225	366
-10.5	230	371
-11	235	377
-11.5	241	383
-12	247	389
-12.5	253	395
-13	260	402
-13.5	267	409
-14	274	416
-14.5	282	424
-15	291	432
-15.5	299	441
-16	309	450
-16.5	319	460
-17	329	471
-17.5	341	482
-18	353	494
-18.5	366	507
-19	380	522
-19.5	395	537
-20	412	553

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	154	296
0.5	152	294
1	150	291
1.5	147	289
2	145	287
2.5	143	285
3	141	283
3.5	139	281
4	137	279
4.5	135	277
5	134	275
5.5	132	273
6	130	272
6.5	128	270
7	127	268
7.5	125	267
8	124	265
8.5	122	263
9	121	262
9.5	119	261
10	118	259
10.5	116	258
11	115	256
11.5	114	255
12	112	254
12.5	111	253
13	110	251
13.5	109	250
14	107	249
14.5	106	248
15	105	247
15.5	104	246
16	103	244
16.5	102	243
17	101	242
17.5	100	241
18	99	240
18.5	98	239
19	97	238
19.5	96	237
20	95	237

STOPPING SIGHT DISTANCE 'D'

85 th PERCENTILE SPEED	40
DESIGN SPEED	44
FRICTION FACTOR	0.32
REACTION DISTANCE	162

Vd;	f	Vd;	f
20;	0.40	50;	0.30
25;	0.38	55;	0.30
30;	0.35	60;	0.29
35;	0.34	65;	0.29
40;	0.32	70;	0.28
45;	0.32		

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	208	370
-0.5	212	373
-1	215	377
-1.5	219	380
-2	223	384
-2.5	226	388
-3	230	392
-3.5	235	396
-4	239	401
-4.5	244	405
-5	248	410
-5.5	253	415
-6	258	420
-6.5	263	425
-7	269	431
-7.5	275	436
-8	281	442
-8.5	287	449
-9	293	455
-9.5	300	462
-10	307	469
-10.5	315	476
-11	323	484
-11.5	331	493
-12	340	501
-12.5	349	511
-13	359	520
-13.5	369	530
-14	380	541
-14.5	391	553
-15	403	565
-15.5	416	578
-16	430	592
-16.5	445	607
-17	461	623
-17.5	478	640
-18	496	658
-18.5	516	678
-19	538	699
-19.5	561	723
-20	587	748

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	208	370
0.5	205	367
1	202	363
1.5	199	360
2	196	357
2.5	193	354
3	190	352
3.5	187	349
4	184	346
4.5	182	343
5	179	341
5.5	177	339
6	174	336
6.5	172	334
7	170	332
7.5	168	329
8	165	327
8.5	163	325
9	161	323
9.5	159	321
10	157	319
10.5	156	317
11	154	315
11.5	152	314
12	150	312
12.5	148	310
13	147	308
13.5	145	307
14	143	305
14.5	142	304
15	140	302
15.5	139	300
16	137	299
16.5	136	298
17	134	296
17.5	133	295
18	132	293
18.5	130	292
19	129	291
19.5	128	289
20	127	288

STOPPING SIGHT DISTANCE 'D'
Sheet 6 of 11

85 th PERCENTILE SPEED	45
DESIGN SPEED	49.5
FRICTION FACTOR	0.3
REACTION DISTANCE	182

Vd;	f	Vd;	f
20;	0.40	50;	0.30
25;	0.38	55;	0.30
30;	0.35	60;	0.29
35;	0.34	65;	0.29
40;	0.32	70;	0.28
45;	0.32		

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	272	454
-0.5	277	459
-1	282	464
-1.5	287	468
-2	292	474
-2.5	297	479
-3	303	484
-3.5	308	490
-4	314	496
-4.5	320	502
-5	327	509
-5.5	333	515
-6	340	522
-6.5	348	529
-7	355	537
-7.5	363	545
-8	371	553
-8.5	380	562
-9	389	571
-9.5	398	580
-10	408	590
-10.5	419	601
-11	430	612
-11.5	441	623
-12	454	636
-12.5	467	649
-13	480	662
-13.5	495	677
-14	510	692
-14.5	527	709
-15	545	726
-15.5	563	745
-16	583	765
-16.5	605	787
-17	628	810
-17.5	653	835
-18	681	863
-18.5	710	892
-19	743	924
-19.5	778	960
-20	817	999

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	272	454
0.5	268	450
1	263	445
1.5	259	441
2	255	437
2.5	251	433
3	248	429
3.5	244	426
4	240	422
4.5	237	419
5	233	415
5.5	230	412
6	227	409
6.5	224	406
7	221	403
7.5	218	400
8	215	397
8.5	212	394
9	209	391
9.5	207	389
10	204	386
10.5	202	384
11	199	381
11.5	197	379
12	194	376
12.5	192	374
13	190	372
13.5	188	370
14	186	368
14.5	184	365
15	182	363
15.5	180	361
16	178	359
16.5	176	358
17	174	356
17.5	172	354
18	170	352
18.5	168	350
19	167	349
19.5	165	347
20	163	345

STOPPING SIGHT DISTANCE 'D'

85 th PERCENTILE SPEED	50
DESIGN SPEED	55
FRICTION FACTOR	0.3
REACTION DISTANCE	202

Vd;	f	Vd;	f
20;	0.40	50;	0.30
25;	0.38	55;	0.30
30;	0.35	60;	0.29
35;	0.34	65;	0.29
40;	0.32	70;	0.28
45;	0.32		

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	336	538
-0.5	342	544
-1	348	550
-1.5	354	556
-2	360	562
-2.5	367	569
-3	373	576
-3.5	381	583
-4	388	590
-4.5	395	598
-5	403	605
-5.5	412	614
-6	420	622
-6.5	429	631
-7	438	641
-7.5	448	650
-8	458	660
-8.5	469	671
-9	480	682
-9.5	492	694
-10	504	706
-10.5	517	719
-11	531	733
-11.5	545	747
-12	560	762
-12.5	576	778
-13	593	795
-13.5	611	813
-14	630	832
-14.5	651	853
-15	672	874
-15.5	695	898
-16	720	922
-16.5	747	949
-17	776	978
-17.5	807	1009
-18	840	1042
-18.5	877	1079
-19	917	1119
-19.5	960	1162
-20	1008	1210

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	336	538
0.5	331	533
1	325	527
1.5	320	522
2	315	517
2.5	310	512
3	306	508
3.5	301	503
4	297	499
4.5	292	494
5	288	490
5.5	284	486
6	280	482
6.5	276	478
7	273	475
7.5	269	471
8	265	467
8.5	262	464
9	259	461
9.5	255	457
10	252	454
10.5	249	451
11	246	448
11.5	243	445
12	240	442
12.5	237	439
13	234	437
13.5	232	434
14	229	431
14.5	227	429
15	224	426
15.5	222	424
16	219	421
16.5	217	419
17	215	417
17.5	212	414
18	210	412
18.5	208	410
19	206	408
19.5	204	406
20	202	404

STOPPING SIGHT DISTANCE 'D'

85 th PERCENTILE SPEED	55
DESIGN SPEED	60.5
FRICTION FACTOR	0.29
REACTION DISTANCE	222

Vd;	f	Vd;	f
20;	0.40	50;	0.30
25;	0.38	55;	0.30
30;	0.35	60;	0.29
35;	0.34	65;	0.29
40;	0.32	70;	0.28
45;	0.32		

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	421	643
-0.5	428	650
-1	436	658
-1.5	444	666
-2	452	674
-2.5	460	683
-3	469	692
-3.5	478	701
-4	488	710
-4.5	498	720
-5	508	731
-5.5	519	742
-6	530	753
-6.5	542	765
-7	555	777
-7.5	567	790
-8	581	803
-8.5	595	818
-9	610	832
-9.5	626	848
-10	642	864
-10.5	660	882
-11	678	900
-11.5	697	920
-12	718	940
-12.5	739	962
-13	763	985
-13.5	787	1009
-14	813	1036
-14.5	841	1064
-15	871	1094
-15.5	904	1126
-16	939	1161
-16.5	976	1198
-17	1017	1239
-17.5	1061	1283
-18	1109	1332
-18.5	1162	1384
-19	1220	1442
-19.5	1284	1507
-20	1356	1578

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	421	643
0.5	414	636
1	407	629
1.5	400	622
2	394	616
2.5	387	610
3	381	604
3.5	375	598
4	370	592
4.5	364	587
5	359	581
5.5	354	576
6	349	571
6.5	344	566
7	339	561
7.5	334	557
8	330	552
8.5	325	548
9	321	543
9.5	317	539
10	313	535
10.5	309	531
11	305	527
11.5	301	524
12	298	520
12.5	294	516
13	290	513
13.5	287	509
14	284	506
14.5	280	503
15	277	500
15.5	274	497
16	271	493
16.5	268	490
17	265	488
17.5	262	485
18	260	482
18.5	257	479
19	254	477
19.5	252	474
20	249	471

STOPPING SIGHT DISTANCE 'D'

85 th PERCENTILE SPEED	60
DESIGN SPEED	66
FRICTION FACTOR	0.29
REACTION DISTANCE	243

Vd;	f	Vd;	f
20;	0.40	50;	0.30
25;	0.38	55;	0.30
30;	0.35	60;	0.29
35;	0.34	65;	0.29
40;	0.32	70;	0.28
45;	0.32		

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	501	743
-0.5	509	752
-1	519	761
-1.5	528	771
-2	538	780
-2.5	548	790
-3	558	801
-3.5	569	812
-4	581	823
-4.5	593	835
-5	605	848
-5.5	618	860
-6	631	874
-6.5	645	888
-7	660	903
-7.5	675	918
-8	691	934
-8.5	708	951
-9	726	969
-9.5	745	987
-10	764	1007
-10.5	785	1027
-11	807	1049
-11.5	830	1072
-12	854	1097
-12.5	880	1123
-13	908	1150
-13.5	937	1179
-14	968	1211
-14.5	1001	1244
-15	1037	1280
-15.5	1076	1318
-16	1117	1359
-16.5	1162	1404
-17	1210	1453
-17.5	1263	1505
-18	1320	1563
-18.5	1383	1625
-19	1452	1695
-19.5	1528	1771
-20	1613	1856

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	501	743
0.5	492	735
1	484	727
1.5	476	719
2	468	711
2.5	461	704
3	454	696
3.5	447	689
4	440	683
4.5	433	676
5	427	670
5.5	421	663
6	415	657
6.5	409	652
7	403	646
7.5	398	640
8	392	635
8.5	387	630
9	382	625
9.5	377	620
10	372	615
10.5	368	610
11	363	606
11.5	359	601
12	354	597
12.5	350	592
13	346	588
13.5	342	584
14	338	580
14.5	334	576
15	330	573
15.5	326	569
16	323	565
16.5	319	562
17	316	558
17.5	312	555
18	309	551
18.5	306	548
19	303	545
19.5	299	542
20	296	539

STOPPING SIGHT DISTANCE 'D'

85 th PERCENTILE SPEED	65
DESIGN SPEED	71.5
FRICTION FACTOR	0.28
REACTION DISTANCE	263

Vd;	f	Vd;	f
20;	0.40	50;	0.30
25;	0.38	55;	0.30
30;	0.35	60;	0.29
35;	0.34	65;	0.29
40;	0.32	70;	0.28
45;	0.32		

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	609	871
-0.5	620	882
-1	631	894
-1.5	643	906
-2	655	918
-2.5	668	931
-3	682	944
-3.5	696	958
-4	710	973
-4.5	725	988
-5	741	1004
-5.5	757	1020
-6	775	1037
-6.5	793	1055
-7	811	1074
-7.5	831	1094
-8	852	1115
-8.5	874	1137
-9	897	1160
-9.5	921	1184
-10	947	1209
-10.5	974	1237
-11	1002	1265
-11.5	1033	1296
-12	1065	1328
-12.5	1099	1362
-13	1136	1399
-13.5	1175	1438
-14	1217	1480
-14.5	1262	1525
-15	1311	1574
-15.5	1363	1626
-16	1420	1683
-16.5	1482	1745
-17	1549	1812
-17.5	1623	1886
-18	1704	1967
-18.5	1794	2057
-19	1893	2156
-19.5	2005	2268
-20	2130	2393

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	609	871
0.5	598	861
1	588	850
1.5	578	840
2	568	831
2.5	559	821
3	550	812
3.5	541	804
4	533	795
4.5	524	787
5	516	779
5.5	509	771
6	501	764
6.5	494	757
7	487	750
7.5	480	743
8	473	736
8.5	467	730
9	461	723
9.5	454	717
10	448	711
10.5	443	705
11	437	700
11.5	431	694
12	426	689
12.5	421	684
13	416	678
13.5	411	673
14	406	668
14.5	401	664
15	396	659
15.5	392	655
16	387	650
16.5	383	646
17	379	641
17.5	375	637
18	370	633
18.5	366	629
19	363	625
19.5	359	622
20	355	618

STOPPING SIGHT DISTANCE 'D'

85 th PERCENTILE SPEED	70
DESIGN SPEED	77
FRICTION FACTOR	0.28
REACTION DISTANCE	283

Vd;	f	Vd;	f
20;	0.40	50;	0.30
25;	0.38	55;	0.30
30;	0.35	60;	0.29
35;	0.34	65;	0.29
40;	0.32	70;	0.28
45;	0.32		

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	706	989
-0.5	719	1002
-1	732	1015
-1.5	746	1029
-2	760	1043
-2.5	775	1058
-3	791	1074
-3.5	807	1090
-4	823	1106
-4.5	841	1124
-5	859	1142
-5.5	878	1161
-6	898	1181
-6.5	919	1202
-7	941	1224
-7.5	964	1247
-8	988	1271
-8.5	1014	1296
-9	1040	1323
-9.5	1068	1351
-10	1098	1381
-10.5	1129	1412
-11	1163	1446
-11.5	1198	1481
-12	1235	1518
-12.5	1275	1558
-13	1318	1601
-13.5	1363	1646
-14	1412	1695
-14.5	1464	1747
-15	1520	1803
-15.5	1581	1864
-16	1647	1930
-16.5	1719	2002
-17	1797	2080
-17.5	1882	2165
-18	1976	2259
-18.5	2080	2363
-19	2196	2479
-19.5	2325	2608
-20	2470	2753

SLOPE TOWARD DESIGN POINT

PCT	BRAKING DISTANCE	TOTAL SSD
0	706	989
0.5	693	976
1	681	964
1.5	670	953
2	659	942
2.5	648	931
3	638	921
3.5	627	910
4	618	901
4.5	608	891
5	599	882
5.5	590	873
6	581	864
6.5	573	856
7	565	848
7.5	557	840
8	549	832
8.5	541	824
9	534	817
9.5	527	810
10	520	803
10.5	513	796
11	507	790
11.5	500	783
12	494	777
12.5	488	771
13	482	765
13.5	476	759
14	471	754
14.5	465	748
15	460	743
15.5	454	737
16	449	732
16.5	444	727
17	439	722
17.5	434	717
18	430	713
18.5	425	708
19	420	703
19.5	416	699
20	412	695