COMMONWEALTH of VIRGINIA

DEPARTMENT OF TRANSPORTATION
1401 EAST BROAD STREET
RICHMOND, VIRGINIA 23219-2000

David S. Ekern, P.E.
COMMISSIONER

January 30, 2007

MEMORANDUM

To: All Holders of the Virginia Department of Transportation's 2001 Road and Bridge Standards

The current design standards for Transition Curves (TC-5.01 and TC-5.04) have been revised and the attached revision documents are to be added to your copy of the VDOT 2001 Road and Bridge Standards. The revision updates specific terminology in the TC-5.01 Standards to conform to the terminology used in the AASHTO 2004 A Policy on Geometric Design of Highways and Streets ("Green Book"). These changes include:

- The "Crown Runoff" (CR) has been changed to "Tangent Run out" (Lt). This term denotes the transition distance from normal crown to the 0% grade on the high side of the superelevation.
- The "Length of Spiral" (LS) has been changed to "Super Runoff" (Lr). This term denotes the transition distance from 0% grade on the high side of the superelevation to full superelevation.

In addition to these changes, all references to Appendix A of the VDOT Road Design Manual have been revised to reference Chapter 3 of the AASHTO Green Book. An insertable sheet will not be required in plan assemblies for this revision. To avoid confusion, the old TC-5 Standard has also been revised to reflect the AASHTO Green Book terminology.

If you have any questions or comments regarding the listed revisions to this publication, please contact Steve Van Cleef of the Standards and Special Design Section at (804) 786-2532.

Sincerely,

Mohammad Mirshahi, P.E.
State Location and Design Engineer

STANDARD SYMBOLS

LOCATION ℄.....ALIGNMENT ON WHICH THE PROPOSED RIGHT-OF-WAY AND CONSTRUCTION IS BASED.
STANDARD PAVEMENT.....THE TYPICAL PAVEMENT SECTION TO BE SHOWN ON THE ROAD PLANS.
P.C. .....POINT OF BEGINNING OF BASELINE CIRCULAR CURVE.
P.T. .....POINT OF ENDING OF BASELINE CIRCULAR CURVE.
P.C.C. .....POINT OF BASELINE COMPOUND CURVATURE.
P.R.C.....POINT OF BASELINE REVERSE CURVE.
T.S. .....POINT OF CHANGE FROM TANGENT TO TRANSITION CURVE. (TANGENT TO SPIRAL)
S.C. .....POINT OF CHANGE FROM TRANSITION CURVE TO CIRCULAR CURVE. (SPIRAL TO CIRCULAR)
C.S. .....POINT OF CHANGE FROM CIRCULAR CURVE TO TRANSITION CURVE. (CIRCULAR TO SPIRAL)
S.T. .....POINT OF CHANGE FROM TRANSITION CURVE TO TANGENT. (SPIRAL TO TANGENT)
RADIUS .....RADIUS OF BASELINE CIRCULAR CURVE.
DV .....APPROXIMATE MAXIMUM SAFE SPEED IN MILES PER HOUR USING STANDARD RATE OF SUPER-ELEVATION.
NC .....APPROXIMATE MAXIMUM SAFE SPEED IN MILES PER HOUR WITH NO SUPERELEVATION. FACTORS APPLY ONLY TO URBAN LOW SPEED CONDITIONS.
Lr .....LENGTH OF TRANSITION CURVE MEASURED ALONG BASELINE. WHERE NO TRANSITION CURVE IS APPLIED Lr IS LENGTH OF SUPERELEVATION RUNOFF SECTION.
W OR PW .....WIDTH OF STANDARD PAVEMENT.
ZT .....DISTANCE FROM TRANSITIONED BASELINE TO EDGES OF TRANSITIONED PAVEMENT $(\frac{W}{2}+\frac{w}{2})$
w .....MAXIMUM TOTAL PAVEMENT WIDENING.
E .....RATE OF SUPERELEVATION.
F .....SAFE SIDE FRICTION FACTOR.
S .....AMOUNT OF SUPERELEVATION TO BE APPLIED TO THE BASELINE GRADE TO OBTAIN THE ELEVATIONS OF THE EDGES OF TRANSITIONED PAVEMENT.
C .....DIFFERENCE IN ELEVATION BETWEEN BASELINE (CENTER) AND EDGE OF PAVEMENT FOR STANDARD PAVEMENT CROWN.
Lt .....STANDARD PAVEMENT CROWN TRANSITION OR TANGENT RUNOUT SECTION.
CP .....CHORD POINT (1/10 INCREMENTS OF TRANSITION CURVE).
NPC.....NORMAL PAVEMENT CROWN.

ALL DISTANCES (HORIZONTAL AND VERTICAL) ARE MEASURED IN FEET.

URBAN CONDITION

URBAN CONDITIONS APPLY TO URBAN STREET SYSTEMS AND ANY OTHER ROAD WITH PRESENT OR FUTURE URBAN STREET OPERATING CONDITIONS.

THESE TABLES CONTAIN SUPERELEVATION RATES AND TRANSITION LENGTHS FOR STANDARD URBAN PAVEMENT WIDTHS THOUGH A RANGE OF CURVES AND DESIGN VELOCITIES CONSIDERED MOST LIKELY TO BE USED IN URBAN ROAD DESIGN.

DEFINITIONS FOR THE STANDARD SYMBOLS USED THROUGHOUT THESE TABLES ARE FOUND ON SHEET 801.01.

A TABLE FOR "LOW SPEED URBAN" DESIGNS IS ON SHEET 801.20 WITH A RANGE OF STANDARD PAVEMENT WIDTHS (W), TRANSITION LENGTHS (Lr), AND RADII OF CURVE WHEN SUPERELEVATED BY AN AMOUNT EQUAL TO THE NORMAL CROWN AND THE APPROXIMATE MAXIMUM SAFE SPEEDS (DV) AFFORDED THEREBY. VALUES IN THIS TABLE CAN BE USED ON STREETS WITH OPERATING SPEEDS LESS THAN OR EQUAL TO 45 MPH. ALSO SHOWN ARE THE APPROXIMATE MAXIMUM SAFE SPEEDS (NC) WITH NO SUPERELEVATION. VALUES FOR (NC) CAN BE USED ON URBAN ARTERIAL, COLLECTOR, AND LOCAL STREETS.

FOR MINIMUM DESIGN FACTORS FOR VARIOUS DESIGN SPEEDS FOR URBAN CONDITIONS SEE SHEETS 801.21 THRU 801.29

WHEN URBAN CONDITIONS APPLY THERE WILL BE NO BASELINE TRANSITION OR PAVEMENT WIDENING. THE LENGTH OF SUPERELEVATION RUNOFF (Lr) DETERMINES THE LENGTH OF SUPERELEVATION TRANSITION THROUGH WHICH THE OUTER EDGE OF PAVEMENT IS RAISED ABOVE THE BASELINE GRADE TO A MAXIMUM OF E ($\frac{W}{2}$). SEE SHEET 801.06 FOR A GRAPHICAL ILLUSTRATION OF THE APPLICATION OF THIS CORRECTION.

FOR CURVE RADII NOT LISTED IN TABLES REFER TO SHEET 801.18 TO CALCULATE TRANSITION LENGTHS (Lr).

Lr SHOULD BE SHOWN ON THE PLANS FOR ALL CURVES.

E SHOULD BE SHOWN ON THE PLANS FOR ALL CURVES WITH URBAN STREET CONDITIONS.

FOR GRAPHICAL ILLUSTRATION OF DESIGN SUPERELEVATION RATES FOR URBAN CONDITIONS SEE SHEET 801.15.

FOR ADDITIONAL GENERAL INSTRUCTIONS (BOTH URBAN AND RURAL) SEE SHEET 801.04.

RURAL CONDITION

RURAL CONDITIONS APPLY TO INTERSTATE, ARTERIAL, PRIMARY AND SECONDARY SYSTEMS OR TO ANY OTHER ROAD WITH RURAL TYPE DESIGN AND OPERATING CONDITIONS.

THESE TABLES CONTAIN SUPERELEVATION AND WIDENING CORRECTIONS FOR STANDARD RURAL PAVEMENT WIDTHS THROUGH A RANGE OF RADII AND DESIGN VELOCITIES CONSIDERED MOST LIKELY TO BE USED IN RURAL HIGHWAY DESIGN.

DEFINITIONS FOR THE STANDARD SYMBOLS USED THROUGHOUT THESE TABLES ARE FOUND ON SHEET 801.01.

FOR MINIMUM DESIGN FACTORS FOR VARIOUS DESIGN SPEEDS FOR RURAL CONDITIONS SEE SHEETS 801.30 THRU 801.40.

ON CURVES WITH GREATER THAN 2865 FT RADIUS THERE WILL BE NO SPIRAL TRANSITION OR PAVEMENT WIDENING. PAVEMENT WILL BE SUPERELEVATED BY AN AMOUNT EQUAL TO THE RATE SHOWN IN THE TABLES. SEE SHEET 801.06 FOR A GRAPHICAL ILLUSTRATION OF THE APPLICATION OF THIS CORRECTION.

ON CURVES WITH PAVEMENT WIDTHS OF 24' OR WIDER AND A RADIUS OF 881 FT. OR GREATER, THERE WILL BE NO SPIRAL TRANSITION OR PAVEMENT WIDENING. PAVEMENT WILL BE SUPERELEVATED BY AN AMOUNT EQUAL TO THE RATE SHOWN IN THESE TABLES.

FOR CURVE RADII NOT LISTED IN TABLES REFER TO SHEET 801.18 TO CALCULATE SUPERELEVATION RUNOFF LENGTHS (Lr) AND PAVEMENT WIDENING (w).

Lr AND E SHOULD BE SHOWN ON THE PLANS FOR ALL CURVES..

FOR GRAPHICAL ILLUSTRATION OF DESIGN SUPERELEVATION RATES FOR RURAL CONDITIONS SEE SHEET 801.16.

FOR ADDITIONAL GENERAL INSTRUCTIONS (BOTH URBAN AND RURAL) SEE SHEET 801.04.

GENERAL CONDITION

ALL ORIGINAL CROSS SECTIONS SHALL BE TAKEN FROM THE BASELINE AT STATIONS, PLUS FIFTIES, AND UNUSUAL BREAKS IN THE GROUND AS ON TANGENT ALIGNMENT.

WHERE A PART OR ALL OF A SUPERELEVATION TRANSITION CURVE FALLS ON A VERTICAL CURVE, ELEVATIONS ON THE VERTICAL CURVE SHOULD BE COMPUTED FOR THE POSITIONS GIVEN ON SHEET 801.12 FOR CROWN TRANSITIONS, SHEET 801.13 FOR URBAN PROJECTS AND SHEET 801.14 FOR RURAL PROJECTS. THESE ELEVATIONS AND PLUSES SHOULD BE SHOWN ON THE PLANS FOR THE CONVENIENCE OF THE SURVEY PARTY IN STAKING OUT THE PROJECT. THROUGHOUT THESE SECTIONS OF THE GRADE, ELEVATIONS AT EVEN STATIONS AND PLUS FIFTIES SHOULD BE OMITTED.

SLOPE STAKES SHOULD BE SET AT THE POSITIONS ON THE TRANSITION GIVEN ON SHEETS 801.12, 801.13 AND 801.14 AND GROUND CROSS SECTIONS TAKEN AT THESE POSITIONS OMITTING THE STATIONS AND PLUS FIFTIES THROUGHOUT THE TRANSITION. IF UNUSUAL BREAKS IN THE GROUND OCCUR, ADDITIONAL SECTIONS SHOULD, OF COURSE, BE TAKEN. ADDITIONAL SECTIONS SHOULD ALSO BE TAKEN WHERE LOCATION IS THROUGH ROCK CUT IN ANTICIPATION OF UNUSUAL BREAKAGE WHICH MAY OCCUR DURING CONSTRUCTION.

AFTER ROUGH GRADING HAS BEEN DONE, FINE GRADING (BLUE TOP) AND FORM STAKES SHOULD BE SET AT THE POSITIONS GIVEN ON SHEET 801.12 FOR CROWN TRANSITIONS, SHEET 801.13 FOR URBAN PROJECTS OR AS GIVEN ON SHEET 801.14 FOR RURAL PROJECTS.

FINAL CROSS SECTIONS SHOULD, OF COURSE, BE TAKEN AT THOSE POSITIONS AT WHICH THE SLOPE STAKE SECTIONS WERE TAKEN. WHERE UNUSUAL BREAKAGE IN ROCK OCCURS AND THIS WAS NOT ANTICIPATED, ADDITIONAL FINAL SECTIONS SHOULD BE TAKEN AND ORIGINAL GROUND SECTIONS INTERPOLATED.

BASELINE STAKES SHOULD BE SET AT ALL P.C.'S, P.T.'S, T.S.'S, S.T.'S,S.C.'S, AND C.S.'S IN STAKING OUT ALIGNMENT, BUT SLOPE STAKES NEED NOT BE SET NOR CROSS SECTIONS TAKEN AT P.C.'S OR P.T.'S EXCEPT WHERE CALLED FOR IN THE ACCOMPANYING TABLES. THE TRANSITION WILL TAKE ITS FORM FROM THE POSITIONS GIVEN ON SHEETS 801.13 AND 801.14.

THE RIGHT OF WAY SHALL, IN ALL CASES, BE REFERENCED FROM THE BASELINE.

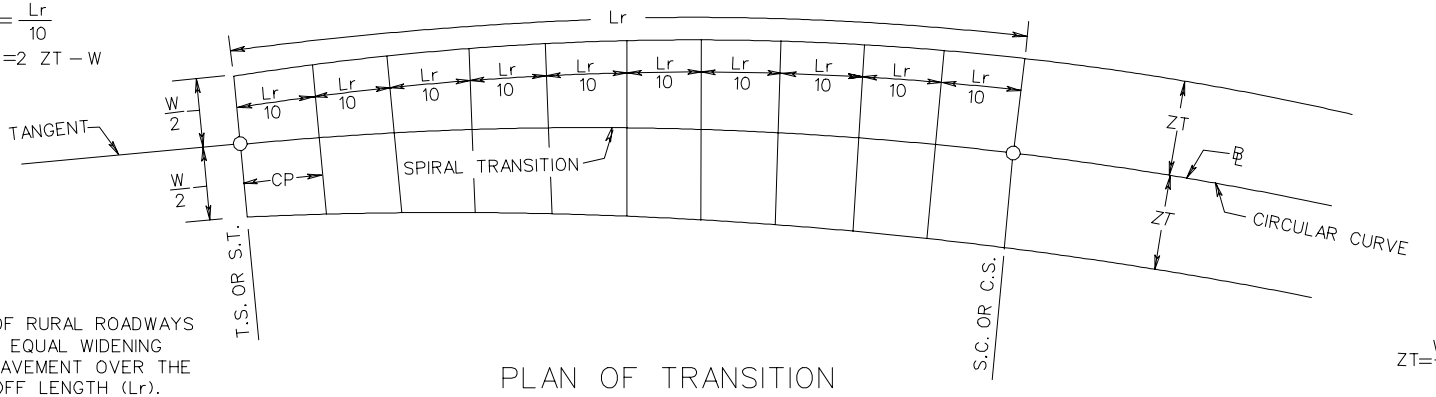
THE DESIGNER SHOULD AVOID SITUATIONS NECESSITATING REVERSE CURVES AND CURVES WITH OVERLAPPING TRANSITIONS WHERE POSSIBLE.

A DESIGN EXCEPTION IS NOT REQUIRED WHEN USING VALUES FROM SHEETS 801.21 THRU 801.40 SINCE THESE TABLES WERE DERIVED WITHIN AASHTO GUIDELINES.

ALL TANGENT RUNOUT SECTION VALUES LISTED IN THE TABLES HAVE BEEN ROUNDED UP TO THE NEAREST FOOT. ALL Lt VALUES ARE BASED ON A 2% CROWN.

CHORD POINTS (CP) = $\frac{Lr}{10}$

TOTAL WIDENING (W) = 2 ZT − W

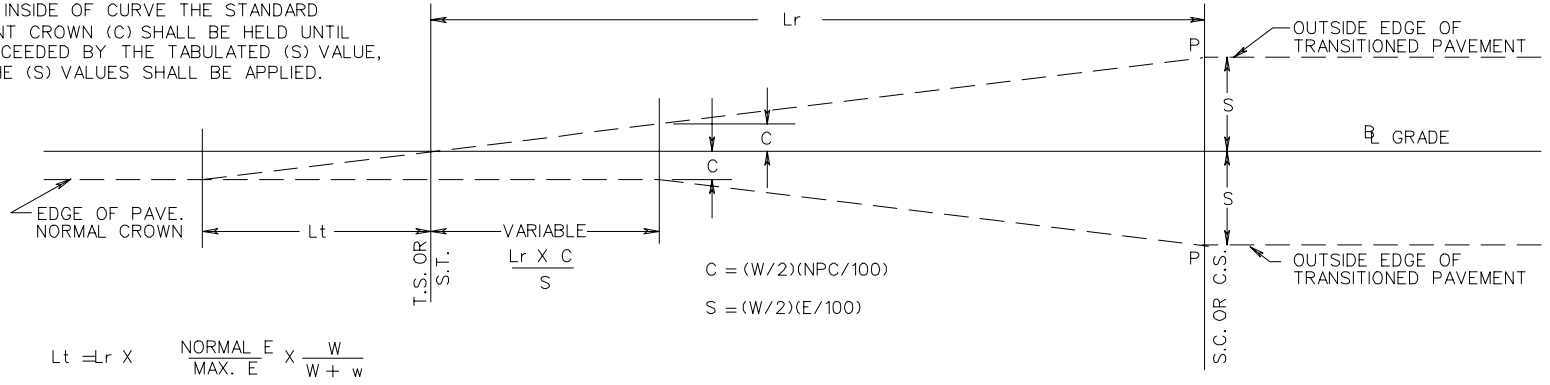


NOTE:
PAVEMENT WIDENING OF RURAL ROADWAYS WILL BE ACHIEVED BY EQUAL WIDENING OF BOTH EDGES OF PAVEMENT OVER THE SUPERELEVATION RUNOFF LENGTH (Lr).

PLAN OF TRANSITION

$ZT = \frac{W + w}{2}$

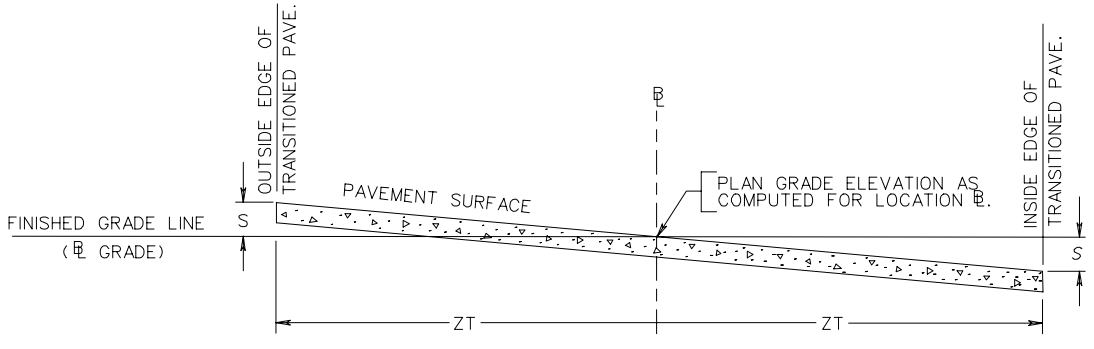
NOTE:
ON THE INSIDE OF CURVE THE STANDARD PAVEMENT CROWN (C) SHALL BE HELD UNTIL IT IS EXCEEDED BY THE TABULATED (S) VALUE, THEN THE (S) VALUES SHALL BE APPLIED.



$Lt = Lr \times \frac{\text{NORMAL E}}{\text{MAX. E}} \times \frac{W}{W + w}$

PROFILE OF TRANSITION

NOTE: SHORT VERTICAL CURVES SHOULD BE INSERTED BY EYE AT POINTS (P) IF CONSIDERED NECESSARY.



CROSS SECTION THRU TRANSITION

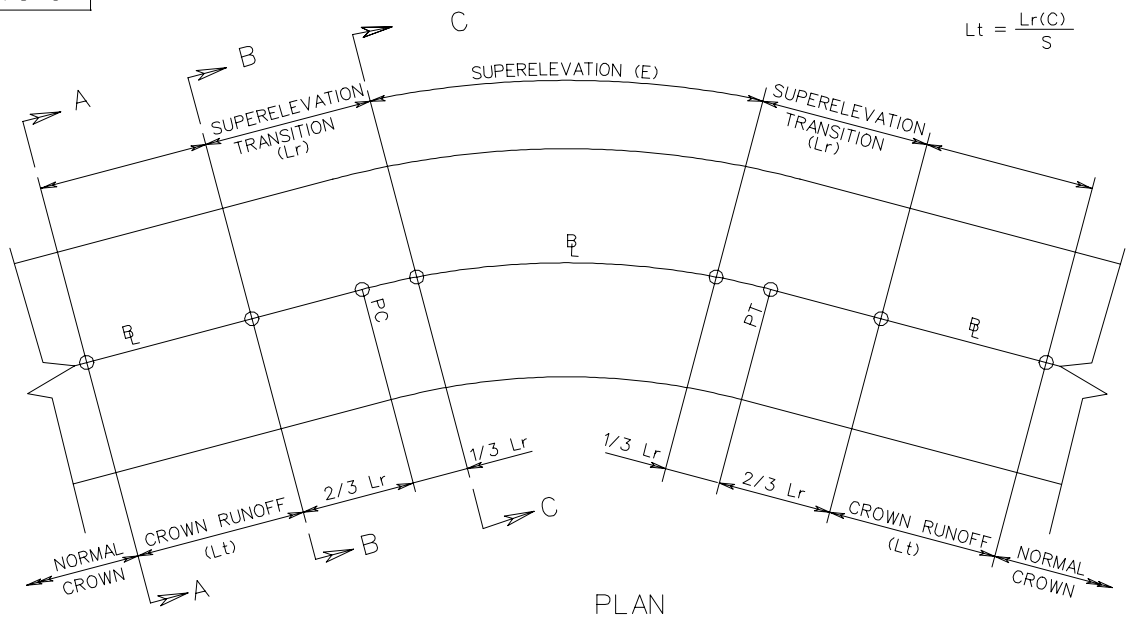
DETAILS FOR TRANSITIONED ℄ RURAL CONDITION WITH PAVEMENT WIDENING

VIRGINIA DEPARTMENT OF TRANSPORTATION

REV. 1/07

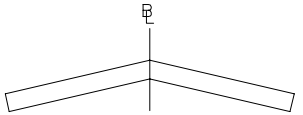
801.05

TC-5

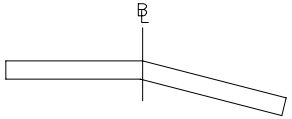


$$Lt = \frac{Lr(C)}{S}$$

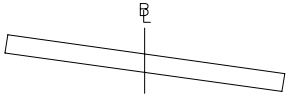
PLAN



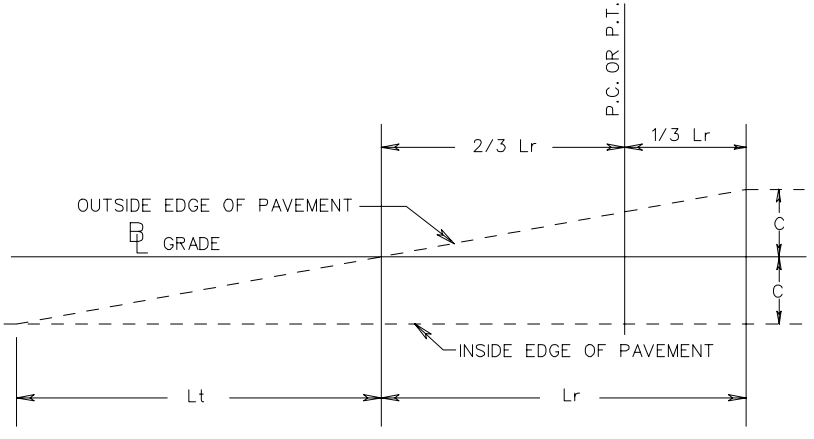
SECTION A-A
NORMAL CROWN



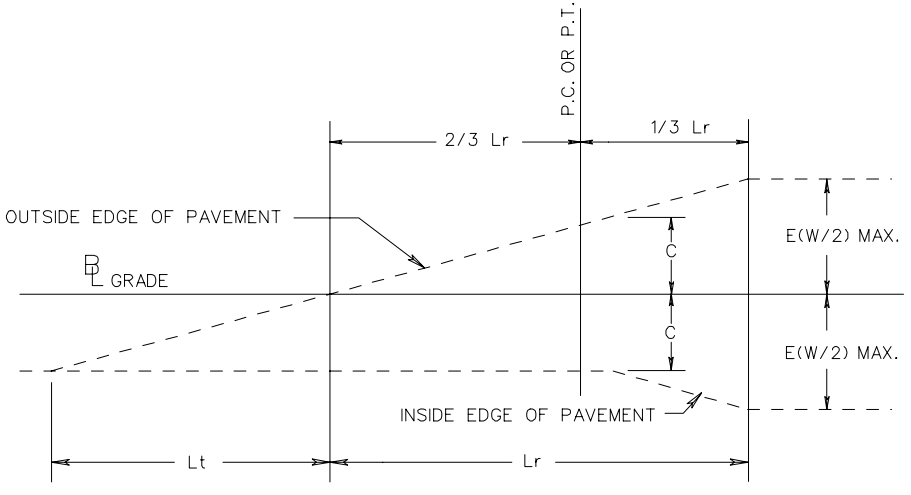
SECTION B-B
NORMAL CROWN
REMOVED (FLAT)



SECTION C-C
FULL SUPERELEVATION



SUPERELEVATED BY AN AMOUNT EQUAL TO THE STANDARD PAVEMENT CROWN



NOTE : ON THE INSIDE OF CURVE THE STANDARD PAVEMENT CROWN (C) SHALL BE HELD UNTIL IT IS EXCEEDED BY THE TABULATED RATE OF SUPERELEVATION (E).

SUPERELEVATED BY AN AMOUNT EXCEEDING THE STANDARD PAVEMENT CROWN

DETAILS FOR NON-TRANSITION ℄ URBAN CONDITIONS AND RURAL CONDITIONS WITHOUT PAVEMENT WIDENING

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801.06

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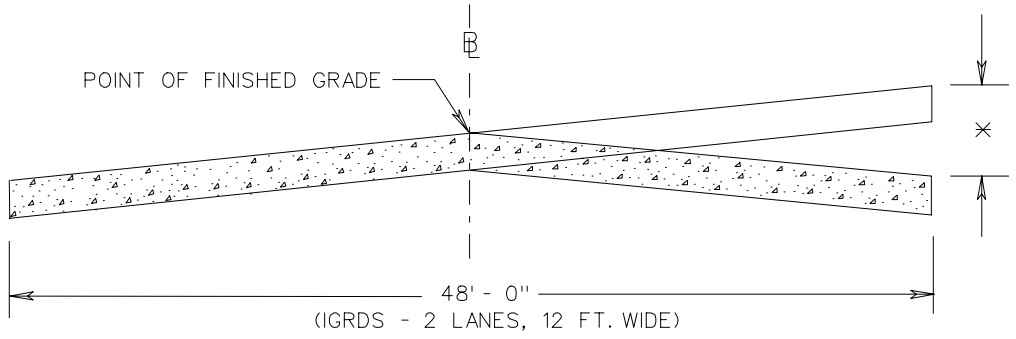
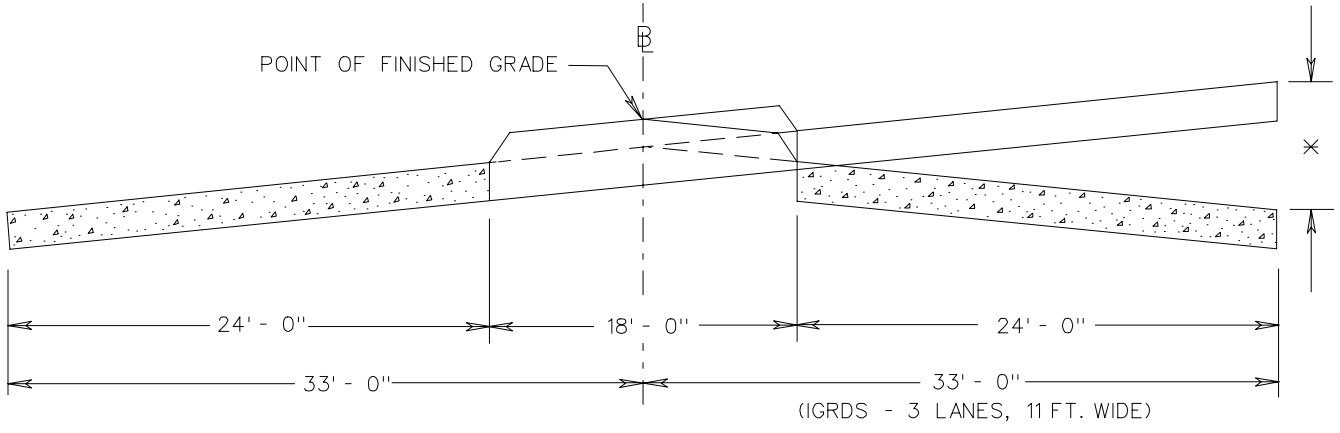




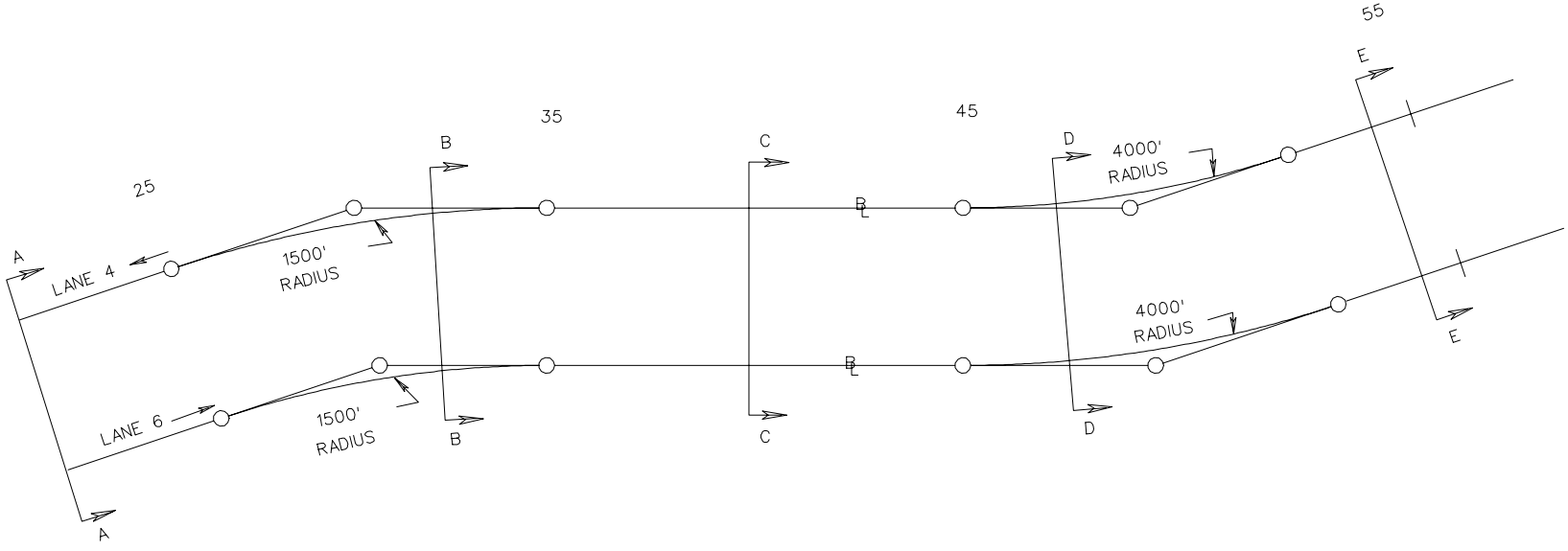
X THE ELEVATION DIFFERENTIAL BETWEEN NORMAL CROWN AND MAXIMUM SUPERELEVATION, RELATIVE TO THE BASELINE PROFILE.

ADDITIONAL INFORMATION MAY BE OBTAINED FROM A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS (AASHTO) BOOK, CHAPTER III - ELEMENTS OF DESIGN (SUPERELEVATION RUNOFF).

ON STANDARD TC-5ULS, TC-5U , AND TC-5R (WITHOUT PAVEMENT WIDENING) SUPERELEVATED CURVES, POSITION THE Lr TWO THIRDS (2/3) ON THE TANGENT AND ONE THIRD (1/3) INTO THE CURVE. STATIONS AND ELEVATIONS FOR THESE TRANSITIONS WILL NEED TO BE COMPUTED FOR ALL CHORD POINTS AND SHOWN ON THE PROFILES.

DETAILS OF SUPERELEVATION ABOUT BASELINE

VIRGINIA DEPARTMENT OF TRANSPORTATION



EXAMPLE FOR FOUR LANE ROADWAYS

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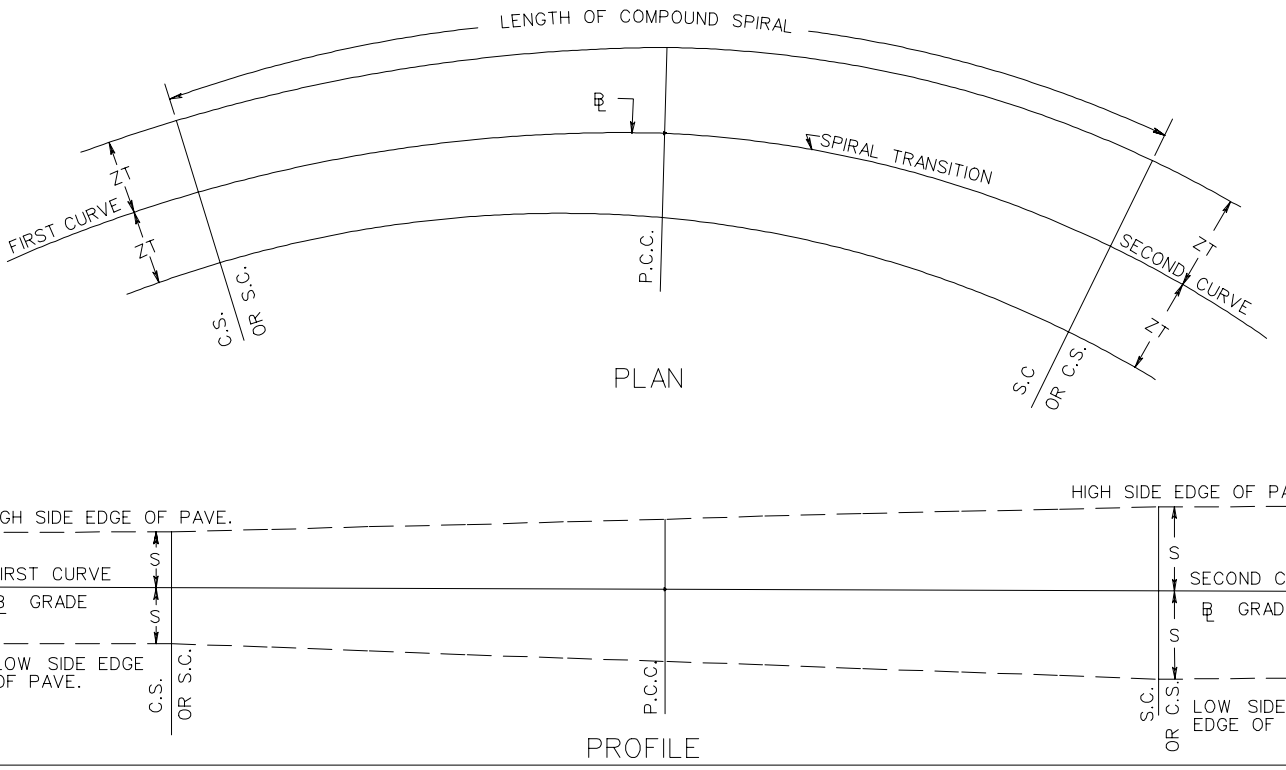
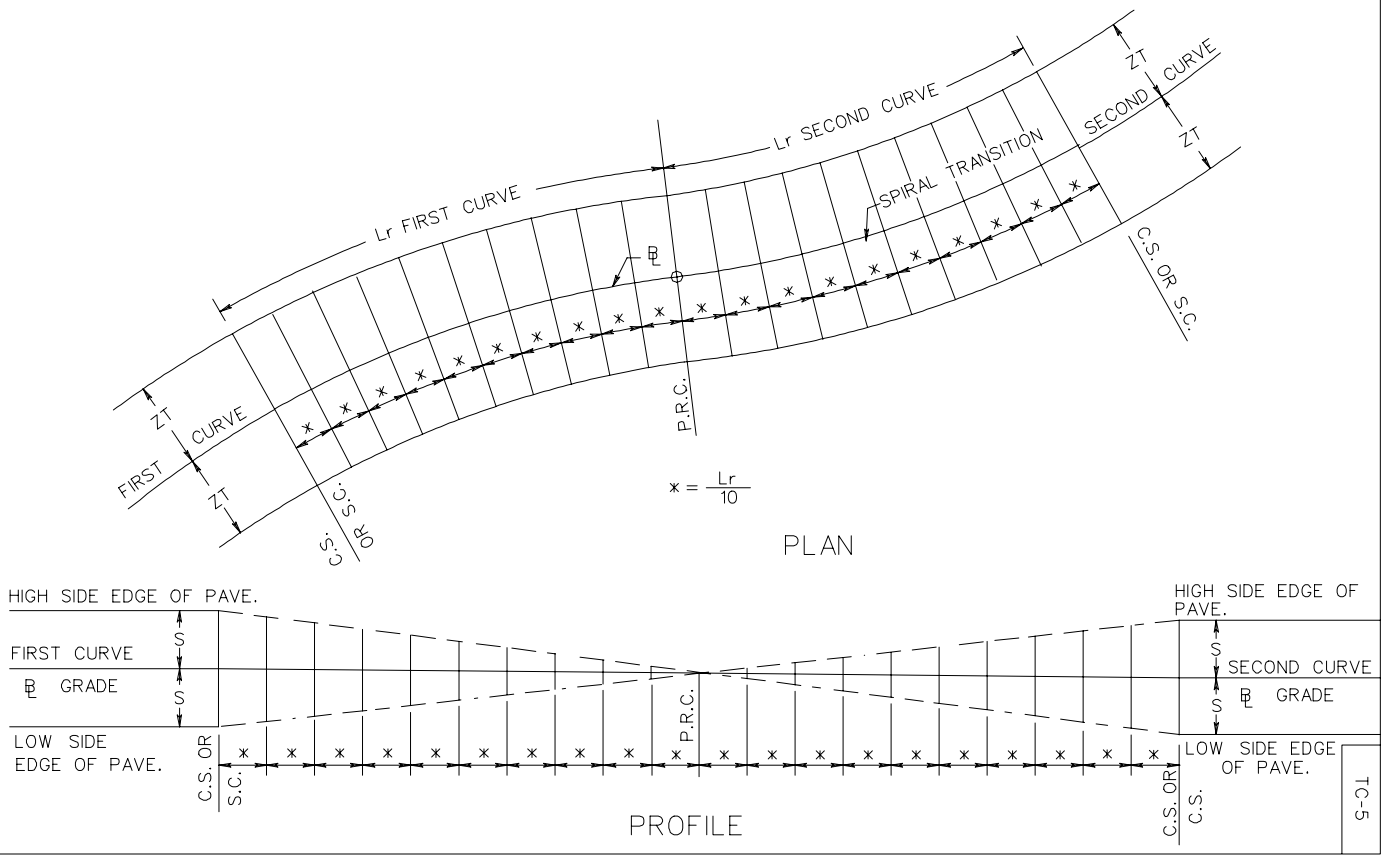
METHOD OF APPLYING TC-5 ON COMPOUND AND REVERSE CURVES
RURAL CONDITION ONLY WITH PAVEMENT WIDENING

VIRGINIA DEPARTMENT OF TRANSPORTATION



COMPUTE STRAIGHT LINE WIDENING AND SUPERELEVATION TRANSITION FROM MAXIMUM OF FIRST CURVE TO MAXIMUM OF SECOND CURVE.



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801.11

TC-5

TRANSITION TABLE

LENGTH OF TANGENT RUNOUT (Lt)	START/END OF SUPERELEVATION RUNOFF SECTION (Lr)	DISTANCE IN FEET FROM START/END OF SUPERELEVATION RUNOFF SECTION				NORMAL CROWN
		1	2	3	4	
220	0	44	88	132	176	220
200	0	40	80	120	140	200
180	0	36	72	108	144	180
160	0	32	64	96	128	160
140	0	28	56	84	112	140
120	0	24	48	72	96	120
100	0	20	40	60	80	100
90	0	18	36	54	72	90
80	0	16	32	48	64	80
60	0	15	30	45	———	60
40	0	20	———	———	———	40

NOTE:

TABLE LISTS POSTIONS ON TRANSITIONS AT WHICH SLOPE STAKES SHOULD BE SET, CONSTRUCTION AND FINAL CROSS-SECTIONS TAKEN, FINE GRADING STAKES (BLUE TOP) SET, AND FORM STAKES SET (CONCRETE PAVEMENT ONLY).

SUPERELEVATION RUNOFF (Lr) / TANGENT RUNOUT (Lt) TABLE

VIRGINIA DEPARTMENT OF TRANSPORTATION

URBAN CONDITIONS
RURAL CONDITIONS WITHOUT PAVEMENT WIDENING

FOR USE WITH FLEXIBLE AND CONCRETE PAVEMENT

(Lr POSITIONED 2/3 ±ON TANGENT, 1/3 ±ON CURVE)

LENGTH OF SUPERELEVATION RUNOFF SECTION (Lr)	END/ BEGIN TANGENT RUNOUT (Lt)	DISTANCE IN FEET FROM P.C. OR P.T. ON TANGENT						P.C. OR P.T.	DISTANCE IN FEET FROM P.C. OR P.T. ON CURVE			FULL SUPER ELEVATION (E)
		1	2	3	4	5	6		7	8	9	
480	320	272	224	176	128	80	32	STAKE	16	64	112	160
460	307	261	215	169	123	77	31	STAKE	15	61	107	153
440	293	249	205	161	117	73	29	STAKE	15	59	103	147
420	280	238	196	154	112	70	28	STAKE	14	56	98	140
400	267	227	187	147	107	67	27	STAKE	13	53	93	133
380	253	215	177	139	101	63	25	STAKE	13	51	89	127
360	240	204	168	132	96	60	24	STAKE	12	48	84	120
340	227	193	159	125	91	57	23	STAKE	11	45	79	113
320	213	181	149	117	85	53	21	STAKE	11	43	75	107
300	200	170	140	110	80	50	20	STAKE	10	40	70	100
280	187	159	131	103	75	47	19	STAKE	9	37	65	93
260	173	147 *	121	95 *	69	43 *	17	STAKE *	9	35 *	61	87
240	160	136 *	112	88 *	64	40 *	16	STAKE *	8	32 *	56	80
220	147	125 *	103	81 *	59	37 *	15	STAKE *	7	29 *	51	73
200	133	113 *	93	73 *	53	33 *	13	STAKE *	7	27 *	47	67
180	120	102 *	84	66 *	48	30 *	12	STAKE *	6	24 *	42	60
160	107	91 *	75	59 *	43	27 *	11	STAKE *	5	21 *	37	53

NOTE :

TABLE GIVING POSITIONS ON CURVES AT WHICH SLOPE STAKES SHOULD BE SET, CONSTRUCTION AND FINAL CROSS-SECTIONS TAKEN, FINE GRADING STAKES (BLUE TOP) SET, AND FORM STAKES SET (CONCRETE PAVEMENT ONLY).

* DENOTES ADDITIONAL STAKING POSITIONS FOR USE WITH CONCRETE PAVEMENT ONLY.

TABLE I

VIRGINIA DEPARTMENT OF TRANSPORTATION

RURAL CONDITIONS WITH PAVEMENT WIDENING

FOR USE WITH FLEXIBLE AND CONCRETE PAVEMENT

SUPERELEVATION RUNOFF SECTION (Lr)	T.S. OR S.T.	DISTANCE IN FEET FROM T.S. OR S.T. ALONG SPIRAL TRANSITION									S.C. OR C.S.
		1	2	3	4	5	6	7	8	9	
480	0	48	96	144	192	240	288	336	384	432	480
460	0	46	92	138	184	230	276	322	368	414	460
440	0	44	88	132	176	220	264	308	352	396	440
420	0	42	84	126	168	210	252	294	336	378	420
400	0	40	80	120	160	200	240	280	320	360	400
380	0	38	76	114	152	190	228	266	304	342	380
360	0	36	72	108	144	180	216	252	288	324	360
340	0	34	68	102	136	170	204	238	272	306	340
320	0	32	64	96	128	160	192	224	256	288	320
300	0	30	60	90	120	150	180	210	240	270	300
280	0	28	56	84	112	140	168	196	224	252	280
260	0	26 *	52	78 *	104	130 *	156	182 *	208	234 *	260
240	0	24 *	48	72 *	96	120 *	144	168 *	192	216 *	240
220	0	22 *	44	66 *	88	110 *	132	154 *	176	198 *	220
200	0	20 *	40	60 *	80	100 *	120	140 *	160	180 *	200
180	0	18 *	36	54 *	72	90 *	108	126 *	144	162 *	180
160	0	16 *	32	48 *	64	80 *	96	112 *	128	144 *	160

NOTE :

TABLE GIVING POSITIONS ON TRANSITION CURVES AT WHICH SLOPE STAKES SHOULD BE SET, CONSTRUCTION AND FINAL CROSS-SECTIONS TAKEN, FINE GRADING STAKES (BLUE TOP) SET, AND FORM STAKES SET (CONCRETE PAVEMENT ONLY).

* DENOTES ADDITIONAL STAKING POSITIONS FOR USE WITH CONCRETE PAVEMENT ONLY.

TABLE 2

VIRGINIA DEPARTMENT OF TRANSPORTATION

TC-5

CURVE WIDENING TABLES

SU DESIGN VEHICLE

COMPONENT	SIZE
OVERALL WIDTH (u)	8.5 ft
WHEELBASE (L)	20 ft
FRONT OVERHANG (A)	4 ft

LATERAL CLEARANCE

LANE WIDTH	CLEARANCE (C)
8 ft	1 ft
9 ft	1.5 ft
10 ft	2 ft
11 ft	2.5 ft
12 ft	3 ft
16 ft	5 ft

IGRDS HA.TBL TABLES

EFFECTIVE WIDTHS

NUMBER OF LANES	EFFECTIVE WIDTHS (W)						EFFECTIVE WIDTH FACTOR (f)
	8 ft LANES	9 ft LANES	10 ft LANES	11 ft LANES	12 ft LANES	16 ft LANES	
1	8.0	9.0	10.0	11.0	12.0	16.0	1
1.5	9.6	10.8	12.0	13.2	14.4	19.2	1.2
2	12.0	13.5	15.0	16.5	18.0	24.0	1.5
3	16.0	18.0	20.0	22.0	24.0	32.0	2
4	32.0	36.0	40.0	44.0	48.0	64.0	4
5	40.0	45.0	50.0	55.0	60.0	80.0	5
6	48.0	54.0	60.0	66.0	72.0	96.0	6
7	56.0	63.0	70.0	77.0	84.0	112.0	7
8	64.0	72.0	80.0	88.0	96.0	128.0	8

RELATIVE GRADIENTS

DESIGN SPEED V_D MPH	RELATIVE GRADIENT (rg)		MIN. TRANSITION LENGTH IN FEET 2 SECOND RULE	
	UP TO 3 LANES	4 OR MORE LANES	URBAN	RURAL
20	0.75	1.14	100	60
25	0.71	1.07	100	80
30	0.67	1.00	100	100
35	0.63	0.93	120	120
40	0.58	0.86	120	120
45	0.54	0.81	140	140
50	0.50	0.75	160	160
55	0.47	0.69	180	180
60	0.45	0.67	180	180
65	0.41	0.62	200	200
70	0.40	0.60	220	220

DEFINITIONS

A - FRONT OVERHANG OF DESIGN VEHICLE FROM APPROPRIATE TABLE.

C - LATERAL CLEARANCE OF DESIGN VEHICLE FROM APPROPRIATE TABLE.

E - SUPERELEVATION RATE IN DECIMAL FROM APPROPRIATE TABLE OR CALCULATED PER AASHTO METHOD 5.

F_A - CALCULATED WIDTH OF OVERHANG FOR DESIGN VEHICLE.

L - WHEELBASE OF DESIGN VEHICLE FROM APPROPRIATE TABLE.

U - CALCULATED TRACK WIDTH OF DESIGN VEHICLE.

Lr - LENGTH OF SPIRAL OR SUPERELEVATION RUNOFF SECTION.

Lt - LENGTH OF TANGENT RUNOUT SECTION.

M - MULTIPLE LANE (2 +) FACTOR.

N - NUMBER OF LANES.

Pw - PAVEMENT WIDTH.

R - RADIUS OF CURVE.

rg - RELATIVE GRADIENT FROM APPROPRIATE TABLE.

u - TRACK WIDTH OF DESIGN VEHICLE FROM APPROPRIATE TABLE.

V_D - DESIGN VELOCITY.

w - CALCULATED WIDENING.

W - EFFECTIVE WIDTH FROM APPROPRIATE TABLE.

W_C - CALCULATED TOTAL CURVE WIDTH.

W_n - WITDH OF LANE.

Z - CALCULATED EXTRA WIDTH ALLOWANCE.

GENERAL DESIGN CONSIDERATIONS

1. WHERE PAVEMENT WIDENING IS REQUIRED, THE APPROPRIATE WIDENING IS ADDED TO THE LANE WIDTH WHEN CALCULATING THE SUPERELEVATION RUNOFF SECTION (Lr).
2. THE COMPUTED TRANSITION LENGTH (Lr) IS ROUNDED UP TO THE NEAREST TWENTY FOOT INCREMENT. COMPUTED LENGTHS THAT FALL ON THE TWENTY FOOT INCREMENT ARE NOT ROUNDED.
3. WHEN THE SUPERELEVATION RUNOFF SECTION (Lr) IS CALCULATED, IT MUST BE COMPARED WITH THE MINIMUM VALUE LISTED IN THE APPROPRIATE COLUMN ON THE RELATIVE GRADIENT TABLE.
4. TANGENT RUNOUT SECTION (Lt) IS ALWAYS ACHIEVED OUTSIDE OF THE TRANSITION.
5. NO PAVEMENT WIDENING IS REQUIRED FOR URBAN ROADWAYS.
6. NO PAVEMENT WIDENING IS REQUIRED FOR RURAL ROADWAYS WITH A CURVE RADIUS GREATER THAN 2865 FEET.
7. NO PAVEMENT WIDENING IS REQUIRED FOR RURAL ROADWAYS WITH 12 FOOT WIDE LANES AND A CURVE RADIUS GREATER THAN 881 FEET.
8. PAVEMENT WIDENING IS APPLIED ONLY WHEN CALCULATED WIDENING (w) IS EQUAL TO OR GREATER THAN 2 FEET.
9. WHEN CALCULATING WIDENING (w) FOR MULTI-LANE RURAL ROADWAYS, WIDENING IS FIRST CALCULATED USING THE SINGLE LANE WIDTH FOR "W" AND THE ANSWER (w) IS THEN MUTIPLIED BY THE MULTIPLE LANE FACTOR (M). FOR FOUR LANE UNDIVIDED PAVEMENTS (48'), THE Lr IS 1.5 TIMES (M=1.5) THE CORRESPONDING LENGTH FOR TWO LANE HIGHWAYS; AND FOR SIX LANE UNDIVIDED PAVEMENTS (72'), THE Lr IS TWO TIMES (M=2) THE CORRESPONDING LENGTH FOR TWO LANE HIGHWAYS.
10. CALCULATED WIDENING IS ROUNDED UP TO THE NEAREST 0.1 FOOT.

FORMULAS USED TO CALCULATE TRANSITION LENGTH (Lr) AND WIDENING (W)

$Lr = (100WE)/rg$ (NO WIDENING REQUIRED)

$Lr = [100(W + w/2)E]/rg$ (WIDENING REQUIRED)

$Lr = M[100(Pw/N + w/N)E]/rg$ (MULTI-LANE WIDENING REQUIRED)

$$U = u + R - \sqrt{R^2 - L^2}$$

$$F = \sqrt{R^2 + A(2L + A)} - R$$

$$Z = (V_D/\sqrt{R})$$

$$W_C = N(U + C) + F + Z_A$$

$$w = W_C - 2W_n$$

FOR SOLVED PROBLEMS USING THIS METHODOLOGY, SEE THE EXAMPLES ON PAGE 801.19.

METHODOLOGIES FOR CALCULATING TC-5 VALUES

RURAL EXAMPLE

20 FT PAVEMENT WIDTH
(IGRDS - 1 LANE AT 10 FT)

$V_D = 50$ MPH R = 1000 FT
$W_n = 10$ FT rg = 0.50
E = 0.076 (7.6% CALCULATED PER AASHTO METHOD 5)

$$U = u + R - \sqrt{R^2 - L^2}$$
$$U = 8.5 + 1000 - \sqrt{(1000)^2 - (20)^2}$$
$$U = 8.70002$$

$$F_A = \sqrt{R^2 + A\,(2L + A)} - R$$
$$F_A = \sqrt{(1000)^2 + 4[\,2(20) + 4\,]} - 1000$$
$$F_A = .087996$$

$$Z = (V_D / \sqrt{R})$$
$$Z = (50 / \sqrt{1000})$$
$$Z = 1.58$$

$$W_C = 2\,(U + C) + F_A + Z$$
$$W_C = 2(8.70002 + 2) + 0.08996 + 1.58$$
$$W_C = 23.0692$$

$$w = W_C - 2W_n = 23.069 - 2(10) = 3.069$$

(R<2865 & w>2 THEREFORE WIDENING IS REQUIRED)
Lr = [100 (W +w/2) E] / rg
Lr = [100 (10 +3.068/2) .076] / 0.50
Lr = 175.56 (180 ROUNDED)

RURAL EXAMPLE

72 FT PAVEMENT WIDTH
(IGRDS - 3 LANES AT 12 FT)

$V_D = 40$ MPH R = 600 FT
$W_n = 24$ FT rg = 0.58
E = 0.077 (7.7% CALCULATED PER AASHTO METHOD 5)

COMPUTE FOR 24' PAVEMENT WIDTH (IGRDS 1 @ 12')

$$U = u + R - \sqrt{R^2 - L^2}$$
$$U = 8.5 + 600 - \sqrt{(600)^2 - (20)^2}$$
$$U = 8.8334$$

$$F_A = \sqrt{R^2 + A\,(2L + A)} - R$$
$$F_A = \sqrt{(600)^2 + 4[\,2(20) + 4\,]} - 600$$
$$F_A = .14665$$

$$Z = (V_D / \sqrt{R})$$
$$Z = (40 / \sqrt{600})$$
$$Z = 1.6329$$

$$W_C = 2\,(U + C) + F_A + Z$$
$$W_C = 2(8.8334 + 3.0) + .14665 + 1.632$$
$$W_C = 25.4464$$

$$w = W_C - 2W_n = 25.4455 - 2(12) = 1.4464(1.5)$$

FOR 72' PAVEMENT WIDTH
$w = 3(1.5) = 4.5$

(R<881 & w>2 THEREFORE WIDENING IS REQUIRED)
Lr = M[100(Pw/N +w/N) E]/rg
Lr = 2[100(72/6 +4.5/6) 0.077]/0.58
Lr = 2[100(12.75)0.77]/0.58
Lr = 2(98.175/0.58)
Lr = 2(169.2672414)
Lr = 338.5344828 (ROUNDED TO 340)

URBAN EXAMPLES

24 FT PAVEMENT WIDTH
(IGRDS - 1 LANE AT 12 FT)

$V_D = 40$ MPH R = 600 FT
$W_n = 12$ FT rg = 0.58
E = 0.04 (4% PER PAGE 801.25)

Lr = (100WE) / rg (NO WIDENING REQUIRED)
Lr = [100(12)(0.04)] / 0.58
Lr = 82.759 < 120 (MIN. LS) THEREFORE
Lr = 120

66 FT PAVEMENT WIDTH
(IGRDS - 3 LANES AT 11 FT)

$V_D = 40$ MPH R = 600 FT
$W_n = 22$ FT rg = 0.58
E = 0.04 (4% PER PAGE 801.25)

Lr = (100WE) / rg (NO WIDENING REQUIRED)
Lr = [100(22)(0.04)] / 0.58
Lr = 151.72 (ROUND TO 160) > 120 (MIN. LS)
Lr = 160

CALCULATED TC-5 EXAMPLES

VIRGINIA DEPARTMENT OF TRANSPORTATION

TC-5

RADIUS (FEET)	E (%)	F	DV (MPH)	NC (MPH)	PAVEMENT WIDTH	
					W ≤ 72 FT.	W > 72 FT
					Lr (FEET)	
≥ 975	2.1	.161	45	45	140	
750	2.1	.161	45	41	140	
700	2.1	.164	44	40	120	
550	2.1	.178	40	37	120	
475	2.1	.186	38	35	120	
375	2.1	.197	35	32	120	
300	2.1	.211	32	30	100	
250	2.1	.221	30	28	100	
200	2.1	.240	27	25	100	
175	2.1	.252	25	24	90	
100	2.1	.290	21	20	90	
90	2.1	.300	20	20	90	

NOTE:
FOR PAVEMENTS WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY IGRDS WITH AN ABSOLUTE MINIMUM Lr OF 90 FEET.

SUMMARY OF STD. TC-5ULS (URBAN-LOW SPEED) DESIGN FACTORS

REV. 1/07

801.20

VIRGINIA DEPARTMENT OF TRANSPORTATION

DESIGN FACTORS FOR A DESIGN SPEED OF 20 MPH (URBAN) USING E= 4% MAX.

RADIUS (FEET)	E (%)	PAVEMENT WIDTH											
		24 FT		36 FT		48 FT		60 FT		66 FT		72 FT	
		IGRDS EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)											
		1 @ 12'		1.5 @ 12'		2 @ 12'		3 @ 10'		3 @ 11'		3 @ 12'	
		Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr
20000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
15000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
10000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
7000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
5000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
4000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
3000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
2500	2.1	100	100	100	100	100	100	100	100	100	100	100	100
2250	2.1	100	100	100	100	100	100	100	100	100	100	100	100
2000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
1750	2.1	100	100	100	100	100	100	100	100	100	100	100	100
1500	2.1	100	100	100	100	100	100	100	100	100	100	100	100
1300	2.1	100	100	100	100	100	100	100	100	100	100	100	100
1150	2.1	100	100	100	100	100	100	100	100	100	100	100	100
1000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
900	2.1	100	100	100	100	100	100	100	100	100	100	100	100
800	2.3	92	100	92	100	92	100	92	100	92	100	92	100
750	2.3	92	100	92	100	92	100	92	100	92	100	92	100
700	2.4	88	100	88	100	88	100	88	100	88	100	88	100
650	2.5	84	100	84	100	84	100	84	100	84	100	84	100
600	2.5	84	100	84	100	84	100	84	100	84	100	84	100
550	2.6	81	100	81	100	81	100	81	100	81	100	81	100
500	2.7	78	100	78	100	78	100	78	100	78	100	78	100
475	2.7	78	100	78	100	78	100	78	100	78	100	78	100
450	2.8	75	100	75	100	75	100	75	100	75	100	75	100
425	2.8	75	100	75	100	75	100	75	100	75	100	75	100
400	2.9	73	100	73	100	73	100	73	100	73	100	73	100
375	3.0	70	100	70	100	70	100	70	100	70	100	70	100
350	3.1	68	100	68	100	68	100	68	100	68	100	68	100
325	3.1	68	100	68	100	68	100	68	100	68	100	68	100
300	3.2	66	100	66	100	66	100	66	100	66	100	79	120
280	3.3	64	100	64	100	64	100	64	100	64	100	77	120
265	3.4	62	100	62	100	62	100	62	100	62	100	75	120
250	3.5	60	100	60	100	60	100	60	100	72	120	72	120
235	3.5	60	100	60	100	60	100	60	100	72	120	72	120
220	3.6	59	100	59	100	59	100	59	100	70	120	70	120
205	3.7	57	100	57	100	57	100	57	100	69	120	69	120
190	3.8	56	100	56	100	56	100	67	120	67	120	78	140
175	3.9	54	100	54	100	54	100	65	120	65	120	76	140
160	3.9	54	100	54	100	54	100	65	120	65	120	76	140
145	4.0	53	100	53	100	53	100	63	120	63	120	74	140
130	4.0	53	100	53	100	53	100	63	120	63	120	74	140
⊛127	4.0	53	100	53	100	53	100	63	120	63	120	74	140

NOTE:

Lt AND Lr VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY IGRDS WITH AN ABSOLUTE MINIMUM Lr OF 100 FEET.

⊛ MINIMUM ALLOWABLE RADIUS

LEGEND

C- RATE OF CHANGE OF SIDE FRICTION (f) IN FT./SEC.^{3}

e- SUPERELEVATION RATE IN PERCENT.

f- FRICTION FACTOR.

Lr- LENGTH OF SUPERELEVATION RUNOFF SECTION.

Lt- LENGTH OF TANGENT RUNOUT SECTION

R- RADIUS OF CURVE.

DV- DESIGN VELOCITY UTILIZING SUPERELEVATION.

NC- MAXIMUM VELOCITY WITH NO SUPERELEVATION (NORMAL CROWN).

URBAN LOW SPEED DESIGN TABLE

DV/NC	MAX. f	C	Lr
45	0.161	2.75	140
40	0.178	3.00	120
35	0.197	3.25	120
30	0.221	3.50	100
25	0.252	3.75	90
20	0.300	4.00	90

FRICTION FACTORS (f) FOR ODD VELOCITIES NOT LISTED SHOULD BE DERIVED BY INTERPOLATION.

FOR Lr LENGTHS FOR INTERMEDIATE VELOCITIES NOT LISTED IN TABLE USE THE Lr FOR NEXT LOWER VELOCITY IN TABLE.

GENERAL DESIGN CONSIDERATIONS

1. WHEN "URBAN LOW SPEED" DESIGNS UTILIZE SUPERELEVATION, THEY WILL BE SUPERELEVATED BY AN AMOUNT EQUAL TO THE NORMAL CROWN (TYPICALLY 2%) AND THE APPROXIMATE MAXIMUM SAFE SPEED (DV) AFFORDED THEREBY.

2. WHEN "URBAN LOW SPEED DESIGN" WITH NO SUPERELEVATION, THE APPROXIMATE MAXIMUM SAFE SPEED (NC) IS CALCULATED USING A NEGATIVE NORMAL CROWN (TYPICALLY -2%).

3. WHEN THE CURVE IS SUPERELEVATED, THE Lr IS APPLIED IN THE SAME MANNER AS IN URBAN CONDITIONS WITH THE TANGENT RUNOUT SECTION (Lt) BEING EQUAL TO THE Lr VALUE. THE CROWN RUNOUT SECTION (Lt) IS ALWAYS ACHIEVED OUTSIDE OF THE TRANSITION (Lr).

4. PLEASE NOTE THAT THE RADIUS VALUES LISTED ON PAGE 801.20 HAVE BEEN ROUNDED UP TO THE NEAREST TWENTY FIVE FOOT INCREMENT.

EXAMPLES

DV = 21 mph

e = +2.1 %

f = 300-[1/5(0.300-0.252)]=0.2904 (ROUND TO 0.29)

Lr = 47.2 f DV/C=47.2(0.29)(21)/4=71.862 FT.

= 71.862 <90 THEREFORE Lr=90 FT.

Rmin. = $(21)^2$/15(0.021+0.29)=94.53376206 FT.

NC = 37 mph

e = −2.1 %

f = 0.197-[2/5(0.197-0.178)]=0.1894 (ROUND TO 0.189)

Rmin. = $(37)^2$ /15(-0.021+0.189)=543.2539683 FT.

METHODOLOGIES FOR CALCULATING TC-5 VALUES FOR URBAN LOW-SPEED STREETS

VIRGINIA DEPARTMENT OF TRANSPORTATION

TC-5

DESIGN FACTORS FOR A DESIGN SPEED OF 25 MPH (URBAN) USING E= 4% MAX.

RADIUS (FEET)	E (%)	PAVEMENT WIDTH											
		24 FT		36 FT		48 FT		60 FT		66 FT		72 FT	
		IGRDS EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)											
		1 @ 12'		1.5 @ 12'		2 @ 12'		3 @ 10'		3 @ 11'		3 @ 12'	
		Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr
20000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
15000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
10000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
7000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
5000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
4000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
3000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
2500	2.1	100	100	100	100	100	100	100	100	100	100	100	100
2250	2.1	100	100	100	100	100	100	100	100	100	100	100	100
2000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
1750	2.1	100	100	100	100	100	100	100	100	100	100	100	100
1500	2.1	100	100	100	100	100	100	100	100	100	100	100	100
1300	2.1	100	100	100	100	100	100	100	100	100	100	100	100
1150	2.3	92	100	92	100	92	100	92	100	92	100	92	100
1000	2.4	88	100	88	100	88	100	88	100	88	100	88	100
900	2.5	84	100	84	100	84	100	84	100	84	100	84	100
800	2.6	81	100	81	100	81	100	81	100	81	100	81	100
750	2.7	78	100	78	100	78	100	78	100	78	100	78	100
700	2.8	75	100	75	100	75	100	75	100	75	100	75	100
650	2.9	73	100	73	100	73	100	73	100	73	100	73	100
600	2.9	73	100	73	100	73	100	73	100	73	100	73	100
550	3.0	70	100	70	100	70	100	70	100	70	100	84	120
500	3.2	66	100	66	100	66	100	66	100	66	100	79	120
475	3.2	66	100	66	100	66	100	66	100	66	100	79	120
450	3.3	64	100	64	100	64	100	64	100	77	120	77	120
425	3.4	62	100	62	100	62	100	62	100	75	120	75	120
400	3.4	62	100	62	100	62	100	62	100	75	120	75	120
375	3.5	60	100	60	100	60	100	60	100	72	120	72	120
350	3.6	59	100	59	100	59	100	70	120	70	120	82	140
325	3.7	57	100	57	100	57	100	69	120	69	120	80	140
300	3.8	56	100	56	100	56	100	67	120	67	120	78	140
280	3.9	54	100	54	100	54	100	65	120	76	140	76	140
265	3.9	54	100	54	100	54	100	65	120	76	140	76	140
250	4.0	53	100	53	100	63	120	63	120	74	140	74	140
235	4.0	53	100	53	100	63	120	63	120	74	140	74	140
220	4.0	53	100	53	100	63	120	63	120	74	140	74	140
⊛204	4.0	53	100	53	100	63	120	63	120	74	140	74	140

NOTE:

Lt AND Lr VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY IGRDS WITH AN ABSOLUTE MINIMUM Lr OF 100 FEET.

⊛MINIMUM ALLOWABLE RADIUS

DESIGN FACTORS FOR A DESIGN SPEED OF 30 MPH (URBAN) USING E=4% MAX.

RADIUS (FEET)	E (%)	PAVEMENT WIDTH											
		24 FT		36 FT		48 FT		60 FT		66 FT		72 FT	
		IGRDS EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)											
		1 @ 12'		1.5 @ 12'		2 @ 12'		3 @ 10'		3 @ 11'		3 @ 12'	
		Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr
20000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
15300	2.1	100	100	100	100	100	100	100	100	100	100	100	100
10000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
7000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
5300	2.1	100	100	100	100	100	100	100	100	100	100	100	100
4000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
3000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
2530	2.1	100	100	100	100	100	100	100	100	100	100	100	100
2250	2.1	100	100	100	100	100	100	100	100	100	100	100	100
2000	2.1	100	100	100	100	100	100	100	100	100	100	100	100
1750	2.2	96	100	96	100	96	100	96	100	96	100	96	100
1500	2.4	88	100	88	100	88	100	88	100	88	100	88	100
1000	2.5	84	100	84	100	84	100	84	100	84	100	84	100
1150	2.6	81	100	81	100	81	100	81	100	81	100	81	100
1000	2.8	75	100	75	100	75	100	75	100	75	100	90	120
900	2.9	73	100	73	100	73	100	73	100	73	100	87	120
800	3.0	70	100	70	100	70	100	70	100	70	100	84	120
750	3.1	68	100	68	100	68	100	68	100	82	120	82	120
700	3.2	66	100	66	100	66	100	66	100	79	120	79	120
650	3.3	64	100	64	100	64	100	64	100	77	120	77	120
600	3.4	62	100	62	100	62	100	75	120	75	120	87	140
570	3.5	60	100	60	100	60	100	72	120	72	120	84	140
500	3.6	59	100	59	100	59	100	70	120	70	120	82	140
475	3.7	57	100	57	100	57	100	69	120	80	140	80	140
450	3.8	56	100	56	100	67	120	67	120	78	140	78	140
425	3.8	56	100	56	100	67	120	67	120	78	140	78	140
400	3.9	54	100	54	100	65	120	65	120	76	140	76	140
375	3.9	54	100	54	100	65	120	65	120	76	140	76	140
350	4.0	53	100	53	100	63	120	63	120	74	140	84	160
325	4.0	53	100	53	100	63	120	63	120	74	140	84	160
⊛300	4.0	53	100	53	100	63	120	63	120	74	140	84	160

NOTE:

Lt AND Lr VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY IGRDS WITH AN ABSOLUTE MINIMUM Lr OF 100 FEET.

⊛MINIMUM ALLOWABLE RADIUS

TC-5

DESIGN FACTORS FOR A DESIGN SPEED OF 35 MPH (URBAN) USING E= 4% MAX.

RADIUS (FEET)	E (%)	PAVEMENT WIDTH											
		24 FT		36 FT		48 FT		60 FT		66 FT		72 FT	
		IGRDS EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)											
		1 @ 12'		1.5 @ 12'		2 @ 12'		3 @ 10'		3 @ 11'		3 @ 12'	
		Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr
20000	2.1	120	120	120	120	120	120	120	120	120	120	120	120
15000	2.1	120	120	120	120	120	120	120	120	120	120	120	120
10000	2.1	120	120	120	120	120	120	120	120	120	120	120	120
7000	2.1	120	120	120	120	120	120	120	120	120	120	120	120
5000	2.1	120	120	120	120	120	120	120	120	120	120	120	120
4000	2.1	120	120	120	120	120	120	120	120	120	120	120	120
3000	2.1	120	120	120	120	120	120	120	120	120	120	120	120
2500	2.1	120	120	120	120	120	120	120	120	120	120	120	120
2250	2.2	115	120	115	120	115	120	115	120	115	120	115	120
2000	2.4	105	120	105	120	105	120	105	120	105	120	105	120
1750	2.5	101	120	101	120	101	120	101	120	101	120	101	120
1500	2.7	94	120	94	120	94	120	94	120	94	120	94	120
1300	2.8	90	120	90	120	90	120	90	120	90	120	90	120
1150	3.0	84	120	84	120	84	120	84	120	84	120	84	120
1000	3.2	79	120	79	120	79	120	79	120	79	120	92	140
900	3.3	77	120	77	120	77	120	77	120	77	120	90	140
800	3.5	72	120	72	120	72	120	72	120	84	140	84	140
750	3.5	72	120	72	120	72	120	72	120	84	140	84	140
700	3.6	70	120	70	120	70	120	70	120	82	140	82	140
650	3.7	69	120	69	120	69	120	69	120	80	140	91	160
600	3.8	67	120	67	120	67	120	78	140	78	140	89	160
550	3.9	65	120	65	120	65	120	76	140	76	140	87	160
500	4.0	63	120	63	120	63	120	74	140	74	140	84	160
475	4.0	63	120	63	120	63	120	74	140	74	140	84	160
450	4.0	63	120	63	120	63	120	74	140	74	140	84	160
425	4.0	63	120	63	120	63	120	74	140	74	140	84	160
⊛ 420	4.0	63	120	63	120	63	120	74	140	74	140	84	160

NOTE:

Lt AND Lr VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY IGRDS WITH AN ABSOLUTE MINIMUM Lr OF 120 FEET.

⊛ MINIMUM ALLOWABLE RADIUS

DESIGN FACTORS FOR A DESIGN SPEED OF 40 MPH (URBAN) USING E= 4 % MAX.

RADIUS (FEET)	E (%)	PAVEMENT WIDTH											
		24 FT		36 FT		48 FT		60 FT		66 FT		72 FT	
		IGRDS EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)											
		1 @ 12'		1.5 @ 12'		2 @ 12'		3 @ 10'		3 @ 11'		3 @ 12'	
		Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr
20000	2.1	120	120	120	120	120	120	120	120	120	120	120	120
15000	2.1	120	120	120	120	120	120	120	120	120	120	120	120
10000	2.1	120	120	120	120	120	120	120	120	120	120	120	120
7000	2.1	120	120	120	120	120	120	120	40	120	120	120	120
5000	2.1	120	120	120	120	120	120	120	120	120	120	120	120
4000	2.1	120	120	120	120	120	120	120	120	120	120	120	120
3000	2.2	115	120	115	120	115	120	115	120	115	120	115	120
2500	2.4	105	120	105	120	105	120	105	120	105	120	105	120
2250	2.5	101	120	101	120	101	120	101	120	101	120	101	120
2000	2.7	94	120	94	120	94	120	94	120	94	120	94	120
1750	2.8	90	120	90	120	90	120	90	120	90	120	90	120
1500	3.0	84	120	84	120	84	120	84	120	84	120	98	140
1300	3.2	79	120	79	120	79	120	79	120	92	140	92	140
1150	3.3	77	120	77	120	77	120	77	120	90	140	90	140
1000	3.5	72	120	72	120	72	120	84	140	84	140	96	160
900	3.7	69	120	69	120	69	120	80	140	91	160	91	160
800	3.8	67	120	67	120	67	120	78	140	89	160	89	160
750	3.9	65	120	65	120	76	140	76	140	87	160	97	180
700	3.9	65	120	65	120	76	140	76	140	87	160	97	180
650	4.0	63	120	63	120	74	140	74	140	84	160	95	180
600	4.0	63	120	63	120	74	140	74	140	84	160	95	180
⊛563	4.0	63	120	63	120	74	140	74	140	84	160	95	180

NOTE:

Lt AND Lr VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY IGRDS WITH AN ABSOLUTE MINIMUM Lr OF 120 FEET.

⊛ MINIMUM ALLOWABLE RADIUS

TC-5

DESIGN FACTORS FOR A DESIGN SPEED OF 45 MPH (URBAN) USING E= 4% MAX.

RADIUS (FEET)	E (%)	PAVEMENT WIDTH											
		24 FT		36 FT		48 FT		60 FT		66 FT		72 FT	
		IGRDS EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)											
		1 @ 12'		1.5 @ 12'		2 @ 12'		3 @ 10'		3 @ 11'		3 @ 12'	
		Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr
20000	2.1	140	140	140	140	140	140	140	140	140	140	140	140
15000	2.1	140	140	140	140	140	140	140	140	140	140	140	140
10000	2.1	140	140	140	140	140	140	140	140	140	140	140	140
7000	2.1	140	140	140	140	140	140	140	140	140	140	140	140
5000	2.1	140	140	140	140	140	140	140	140	140	140	140	140
4000	2.1	140	140	140	140	140	140	140	140	140	140	140	140
3000	2.5	118	140	118	140	118	140	118	140	118	140	118	140
2500	2.7	109	140	109	140	109	140	109	140	109	140	109	140
2250	2.8	105	140	105	140	105	140	105	140	105	140	105	140
2000	2.9	102	140	102	140	102	140	102	140	102	140	102	140
1750	3.1	95	140	95	140	95	140	95	140	95	140	95	140
1500	3.3	90	140	90	140	90	140	90	140	90	140	102	160
1300	3.5	84	140	84	140	84	140	84	140	96	160	96	160
1150	3.7	80	140	80	140	80	140	80	140	91	160	103	180
1000	3.9	76	140	76	140	76	140	87	160	87	160	97	180
900	4.0	74	140	74	140	74	140	84	160	95	160	95	180
800	4.0	74	140	74	140	74	140	84	160	95	180	95	180
750	4.0	74	140	74	140	74	140	84	160	95	180	95	180
⊛ 732	4.0	74	140	74	140	74	140	84	160	95	180	95	180

NOTE:

Lt AND Lr VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY IGRDS WITH AN ABSOLUTE MINIMUM Lr OF 140 FEET.

⊛ MINIMUM ALLOWABLE RADIUS

DESIGN FACTORS FOR A DESIGN SPEED OF 50 MPH (URBAN) USING E= 4 % MAX.

RADIUS (FEET)	E (%)	PAVEMENT WIDTH											
		24 FT		36 FT		48 FT		60 FT		66 FT		72 FT	
		IGRDS EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)											
		1 @ 12'		1.5 @ 12'		2 @ 12'		3 @ 10'		3 @ 11'		3 @ 12'	
		Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr
20000	2.1	160	160	160	160	160	160	160	160	160	160	160	160
15000	2.1	160	160	160	160	160	160	160	160	160	160	160	160
10000	2.1	160	160	160	160	160	160	160	160	160	160	160	160
7000	2.1	160	160	160	160	160	160	160	160	160	160	160	160
5000	2.1	160	160	160	160	160	160	160	160	160	160	160	160
4000	2.4	140	160	140	160	140	160	140	160	140	160	140	160
3000	2.7	125	160	125	160	125	160	125	160	125	160	125	160
2500	2.9	116	160	116	160	116	160	116	160	116	160	116	160
2250	3.1	109	160	109	160	109	160	109	160	109	160	109	160
2000	3.2	105	160	105	160	105	160	105	160	105	160	105	160
1750	3.4	99	160	99	160	99	160	99	160	99	160	112	180
1500	3.6	94	160	94	160	94	160	94	160	94	160	105	180
1300	3.8	89	160	89	160	89	160	89	160	100	180	111	200
1150	3.9	87	160	87	160	87	160	87	160	97	180	108	200
1000	4.0	84	160	84	160	84	160	84	160	95	180	105	200
929 ⊛	4.0	84	160	84	160	84	160	84	160	95	180	105	200

NOTE:

Lt AND Lr VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY IGRDS WITH AN ABSOLUTE MINIMUM Lr OF 160 FEET.

⊛ MINIMUM ALLOWABLE RADIUS

TC-5

DESIGN FACTORS FOR A DESIGN SPEED OF 55 MPH (URBAN) USING E= 4% MAX.

RADIUS (FEET)	E (%)	PAVEMENT WIDTH											
		24 FT		36 FT		48 FT		60 FT		66 FT		72 FT	
		IGRDS EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)											
		1 @ 12'		1.5 @ 12'		2 @ 12'		3 @ 10'		3 @ 11'		3 @ 12'	
		Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr
20000	2.1	180	180	180	180	180	180	180	180	180	180	180	180
15000	2.1	180	180	180	180	180	180	180	180	180	180	180	180
10000	2.1	180	180	180	180	180	180	180	180	180	180	180	180
7000	2.1	180	180	180	180	180	180	180	180	180	180	180	180
5000	2.3	165	180	165	180	165	180	165	180	165	180	165	180
4000	2.6	146	180	146	180	146	180	146	180	146	180	146	180
3000	3.0	126	180	126	180	126	180	126	180	126	180	126	180
2500	3.3	115	180	115	180	115	180	115	180	115	180	115	180
2250	3.4	112	180	112	180	112	180	112	180	112	180	112	180
2000	3.6	105	180	105	180	105	180	105	180	105	180	117	200
1750	3.8	100	180	100	180	100	180	100	180	100	180	111	200
1500	3.9	97	180	97	180	97	180	97	180	108	200	108	200
1300	4.0	95	180	95	180	95	180	95	180	105	200	116	220
⊛ 1190	4.0	95	180	95	180	95	180	95	180	105	200	116	220

NOTE:

Lt AND Lr VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY IGRDS WITH AN ABSOLUTE MINIMUM Lr OF 180 FEET.

⊛ MINIMUM ALLOWABLE RADIUS

DESIGN FACTORS FOR A DESIGN SPEED OF 60 MPH (URBAN) USING E= 4 % MAX.

RADIUS (FEET)	E (%)	PAVEMENT WIDTH											
		24 FT		36 FT		48 FT		60 FT		66 FT		72 FT	
		IGRDS EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)											
		1 @ 12'		1.5 @ 12'		2 @ 12'		3 @ 10'		3 @ 11'		3 @ 12'	
		Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr
20000	2.1	180	180	180	180	180	180	180	180	180	180	180	180
15000	2.1	180	180	180	180	180	180	180	180	180	180	180	180
10000	2.1	180	180	180	180	180	180	180	180	180	180	180	180
7000	2.1	180	180	180	180	180	180	180	180	180	180	180	180
5000	2.6	146	180	146	180	146	180	146	180	146	180	146	180
4000	2.9	131	180	131	180	131	180	131	180	131	180	131	180
3000	3.3	115	180	115	180	115	180	115	180	115	180	115	180
2500	3.6	105	180	105	180	105	180	105	180	105	180	117	200
2250	3.7	103	180	103	180	103	180	103	180	114	200	114	200
2000	3.9	97	180	97	180	97	180	97	180	108	200	119	220
1750	4.0	95	180	95	180	95	180	95	180	105	200	116	220
⊛1505	4.0	95	180	95	180	95	180	95	180	105	200	116	220

NOTE:

Lt AND Lr VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY IGRDS WITH AN ABSOLUTE MINIMUM Lr OF 180 FEET.

⊛ MINIMUM ALLOWABLE RADIUS

TC-5 DESIGN FACTORS FOR A DESIGN SPEED OF 20 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY=20		WIDTH=16 FT			WIDTH= 18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT		
		IGRDS EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)																	
		1 @ 8'			1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'		
RADIUS(FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w
20000	2.1	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0
15000	2.1	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0
10000	2.1	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0
7000	2.1	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0
5000	2.1	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0
4000	2.1	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0
3000	2.1	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0
2500	2.1	13	60	3.6	14	60	2.6	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0
2250	2.1	13	60	3.7	14	60	2.7	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0
2000	2.1	13	60	3.7	14	60	2.7	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0
1750	2.1	13	60	3.8	14	60	2.8	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0
1500	2.1	13	60	3.9	14	60	2.9	60	60	0.0	60	60	0.0	60	60	0.0	60	60	0.0
1300	2.1	13	60	4.0	14	60	3.0	15	60	2.0	60	60	0.0	60	60	0.0	60	60	0.0
1150	2.1	13	60	4.1	14	60	3.1	15	60	2.0	60	60	0.0	60	60	0.0	60	60	0.0
1000	2.4	13	60	4.2	14	60	3.2	15	60	2.2	53	60	0.0	53	60	0.0	53	60	0.0
900	2.6	13	60	4.3	14	60	3.3	15	60	2.3	49	60	0.0	49	60	0.0	65	80	0.0
800	2.9	13	60	4.4	14	60	3.4	15	60	2.4	44	60	0.0	44	60	0.0	58	80	0.0
750	3.1	13	60	4.4	14	60	3.4	15	60	2.4	41	60	0.0	41	60	0.0	55	80	0.0
700	3.3	13	60	4.5	14	60	3.5	14	60	2.5	39	60	0.0	39	60	0.0	51	80	0.0
650	3.4	13	60	4.6	14	60	3.6	14	60	2.6	38	60	0.0	38	60	0.0	62	100	0.0
600	3.7	13	60	4.7	14	60	3.7	14	60	2.7	35	60	0.0	35	60	0.0	57	100	0.0
550	3.9	13	60	4.8	14	60	3.8	14	60	2.8	33	60	0.0	44	80	0.0	54	100	0.0
500	4.2	13	60	4.9	18	80	3.9	19	80	2.9	40	80	0.0	40	80	0.0	60	120	0.0
475	4.3	16	80	5.0	18	80	4.0	19	80	3.0	20	80	2.0	40	80	0.0	31	120	2.0
450	4.5	16	80	5.1	18	80	4.1	19	80	3.1	20	80	2.0	38	80	0.0	31	120	2.2
425	4.7	16	80	5.2	18	80	4.2	19	80	3.2	20	80	2.2	36	80	0.0	30	120	2.4
400	4.8	16	80	5.3	17	80	4.3	19	80	3.3	20	80	2.3	35	80	0.0	35	140	2.6
375	5.0	16	80	5.4	17	80	4.4	18	80	3.4	24	100	2.4	34	80	0.0	35	140	2.8
350	5.2	16	80	5.5	17	80	4.5	23	100	3.5	24	100	2.5	41	100	0.0	35	140	3.0
325	5.4	16	80	5.7	21	100	4.7	23	100	3.7	24	100	2.7	39	100	0.0	35	140	3.4
300	5.6	20	100	5.8	21	100	4.8	23	100	3.8	24	100	2.8	38	100	0.0	40	160	3.6
280	5.8	20	100	6.0	21	100	5.0	22	100	4.0	24	100	3.0	30	120	2.0	39	160	4.0
265	6.0	20	100	6.1	21	100	5.1	22	100	4.1	28	120	3.1	29	120	2.0	39	160	4.2
250	6.1	19	100	6.3	21	100	5.3	22	100	4.3	28	120	3.3	29	120	2.3	44	180	4.6
235	6.3	19	100	6.4	21	100	5.4	26	120	4.4	28	120	3.4	29	120	2.4	43	180	4.8
220	6.5	19	100	6.6	25	120	5.6	26	120	4.6	28	120	3.6	29	120	2.6	43	180	5.2
205	6.7	23	120	6.8	24	120	5.8	26	120	4.8	27	120	3.8	29	120	2.8	43	180	5.6
190	6.9	22	120	7.1	24	120	6.1	26	120	5.1	31	140	4.1	33	140	3.1	47	200	6.2
175	7.2	22	120	7.4	24	120	6.4	29	120	5.4	31	140	4.4	33	140	3.4	46	200	6.8
160	7.4	22	120	7.7	27	140	6.7	29	140	5.7	31	140	4.7	32	140	3.7	51	220	7.4
145	7.6	25	140	8.1	27	140	7.1	29	140	6.1	30	140	5.1	36	160	4.1	50	220	8.2
130	7.9	24	140	8.6	26	140	7.6	32	160	6.6	34	160	5.6	36	160	4.6	53	240	9.2
115	8.0	24	140	9.2	26	140	8.2	31	160	7.2	33	160	6.2	35	160	5.2	52	240	10.4
107 ⊛	8.0	23	140	9.6	29	160	8.6	31	160	7.6	33	160	6.6	35	160	5.6	52	240	11.2

NOTE:

Lt, Lr & w VALUES IN FEET.

⊛ MINIMUM ALLOWABLE RADIUS

DESIGN FACTORS FOR A DESIGN SPEED OF 25 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY=25		WIDTH=16 FT			WIDTH=18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT		
		IGRDS EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)																	
		1 @ 8'			1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'		
RADIUS(FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w
20000	2.1	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0
15000	2.1	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0
10000	2.1	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0
7000	2.1	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0
5000	2.1	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0
4000	2.1	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0
3000	2.1	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0
2500	2.1	18	80	3.7	19	80	2.7	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0
2250	2.1	17	80	3.8	19	80	2.8	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0
2000	2.1	17	80	3.9	19	80	2.9	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0
1750	2.1	17	80	3.9	19	80	2.9	80	80	0.0	80	80	0.0	80	80	0.0	80	80	0.0
1500	2.4	17	80	4.0	18	80	3.0	20	80	2.0	70	80	0.0	70	80	0.0	70	80	0.0
1300	2.7	17	80	4.1	18	80	3.1	20	80	2.0	63	80	0.0	63	80	0.0	63	80	0.0
1150	2.9	17	80	4.2	18	80	3.2	19	80	2.2	58	80	0.0	58	80	0.0	58	80	0.0
1000	3.3	17	80	4.3	18	80	3.3	19	80	2.3	51	80	0.0	51	80	0.0	64	100	0.0
900	3.6	17	80	4.4	18	80	3.4	19	80	2.4	47	80	0.0	47	80	0.0	59	100	0.0
800	3.9	17	80	4.5	18	80	3.5	19	80	2.5	44	80	0.0	44	80	0.0	54	100	0.0
750	4.1	17	80	4.6	18	80	3.6	19	80	2.6	41	80	0.0	41	80	0.0	62	120	0.0
700	4.3	17	80	4.7	18	80	3.7	19	80	2.7	40	80	0.0	40	80	0.0	59	120	0.0
650	4.6	17	80	4.8	18	80	3.8	19	80	2.8	37	80	0.0	37	80	0.0	55	120	0.0
600	4.8	17	80	4.9	18	80	3.9	19	80	2.9	35	80	0.0	44	100	0.0	62	140	0.0
550	5.1	16	80	5.0	18	80	4.0	23	100	3.0	25	100	2.0	42	100	0.0	36	140	2.0
500	5.3	20	80	5.1	22	100	4.1	23	100	3.1	24	100	2.0	39	100	0.0	41	160	2.2
475	5.5	20	100	5.2	22	100	4.2	23	100	3.2	24	100	2.2	39	100	0.0	40	160	2.4
450	5.7	20	100	5.3	22	100	4.3	23	100	3.3	24	100	2.3	37	100	0.0	40	160	2.6
425	5.8	20	100	5.4	22	100	4.4	23	100	3.4	24	100	2.4	37	100	0.0	40	160	2.8
400	6.0	20	100	5.5	21	100	4.5	23	100	3.5	29	120	2.5	42	120	0.0	45	180	3.0
375	6.2	20	100	5.6	21	100	4.6	27	120	3.6	29	120	2.6	41	120	0.0	45	180	3.2
350	6.4	20	100	5.8	25	120	4.8	27	120	3.8	28	120	2.8	40	120	0.0	44	180	3.6
325	6.7	24	120	5.9	25	120	4.9	27	120	3.9	28	120	2.9	38	120	0.0	49	200	3.8
300	6.9	23	120	6.1	25	120	5.1	27	120	4.1	33	140	3.1	34	140	2.0	49	200	4.2
280	7.1	23	120	6.3	25	120	5.3	31	140	4.3	32	140	3.3	34	140	2.3	48	200	4.6
265	7.3	23	120	6.4	29	140	5.4	31	140	4.4	32	140	3.4	34	140	2.4	53	220	4.8
250	7.4	23	120	6.6	29	140	5.6	30	140	4.6	32	140	3.6	34	140	2.6	53	220	5.2
235	7.6	26	140	6.8	28	140	5.8	30	140	4.8	32	140	3.8	38	160	2.8	52	220	5.6
220	7.7	26	140	7.0	28	140	6.0	30	140	5.0	36	160	4.0	38	160	3.0	52	220	6.0
205	7.9	26	140	7.2	28	140	6.2	34	160	5.2	36	160	4.2	38	160	3.2	56	240	6.4
190	8.0	26	140	7.4	28	140	6.4	34	160	5.4	35	160	4.4	37	160	3.4	56	240	6.8
175	8.0	25	140	7.7	27	140	6.7	33	160	5.7	35	160	4.7	37	160	3.7	55	240	7.4
171 ⊛	8.0	25	140	7.8	27	140	6.8	33	160	5.8	35	160	4.8	37	160	3.8	55	240	7.6

NOTE:

Lt, Lr & w VALUES IN FEET.

⊛ MINIMUM ALLOWABLE RADIUS

TC-5

DESIGN FACTORS FOR A DESIGN SPEED OF 30 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY=30		WIDTH=16 FT			WIDTH=18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT		
		IGRDS EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)																	
		1 @ 8'			1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'		
RADIUS (FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w
20000	2.1	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0
15000	2.1	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0
10000	2.1	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0
7000	2.1	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0
5000	2.1	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0
4000	2.1	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0
3000	2.1	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0
2500	2.1	22	100	3.8	23	100	2.8	100	100	0.0	100	100	0.0	100	100	0.0	100	100	0.0
2250	2.2	22	100	3.9	23	100	2.9	96	100	0.0	96	100	0.0	96	100	0.0	96	100	0.0
2000	2.4	21	100	4.0	23	100	3.0	24	100	2.0	88	100	0.0	88	100	0.0	88	100	0.0
1750	2.7	21	100	4.0	23	100	3.0	24	100	2.0	78	100	0.0	78	100	0.0	78	100	0.0
1500	3.1	21	100	4.1	23	100	3.1	24	100	2.0	68	100	0.0	68	100	0.0	68	100	0.0
1300	3.5	21	100	4.3	23	100	3.3	24	100	2.3	60	100	0.0	60	100	0.0	60	100	0.0
1150	3.8	21	100	4.4	23	100	3.4	24	100	2.4	56	100	0.0	56	100	0.0	67	120	0.0
1000	4.2	21	100	4.5	22	100	3.5	24	100	2.5	50	100	0.0	50	100	0.0	60	120	0.0
900	4.6	21	100	4.6	22	100	3.6	24	100	2.6	46	100	0.0	46	100	0.0	64	140	0.0
800	4.9	21	100	4.7	22	100	3.7	24	100	2.7	43	100	0.0	43	100	0.0	60	140	0.0
750	5.2	21	100	4.8	22	100	3.8	24	100	2.8	41	100	0.0	41	100	0.0	57	140	0.0
700	5.4	21	100	4.9	22	100	3.9	23	100	2.9	39	100	0.0	39	100	0.0	63	160	0.0
650	5.6	20	100	5.0	22	100	4.0	23	100	3.0	29	120	2.0	45	120	0.0	60	160	2.0
600	5.9	20	100	5.1	22	100	4.1	28	120	3.1	29	120	2.0	43	120	0.0	46	180	2.2
550	6.1	20	100	5.2	26	120	4.2	28	120	3.2	29	120	2.2	42	120	0.0	45	180	2.4
500	6.4	24	120	5.4	26	120	4.4	27	120	3.4	29	120	2.4	40	120	0.0	50	200	2.8
475	6.6	24	120	5.5	26	120	4.5	27	120	3.5	33	140	2.5	39	120	0.0	50	200	3.0
450	6.8	24	120	5.5	26	120	4.5	27	120	3.5	33	140	2.5	44	140	0.0	50	200	3.0
425	7.0	24	120	5.7	25	120	4.7	32	140	3.7	33	140	2.7	42	140	0.0	54	220	3.4
400	7.1	24	120	5.8	30	140	4.8	31	140	3.8	33	140	2.8	42	140	0.0	54	220	3.6
375	7.3	24	120	5.9	29	140	4.9	31	140	3.9	33	140	2.9	41	140	0.0	54	220	3.8
350	7.5	27	140	6.0	29	140	5.0	31	140	4.0	33	140	3.0	39	160	2.0	54	220	4.0
325	7.7	27	140	6.2	29	140	5.2	30	140	4.2	37	160	3.2	39	160	2.2	58	240	4.4
300	7.9	27	140	6.4	29	140	5.4	35	160	4.4	37	160	3.4	39	160	2.4	58	240	4.8
280	8.0	27	140	6.6	33	160	5.6	35	160	4.6	37	160	3.6	38	160	2.6	57	240	5.2
265	8.0	26	140	6.7	32	160	5.7	35	160	4.7	36	160	3.7	38	160	2.7	57	240	5.4
⊛ 250	8.0	26	140	6.9	32	160	5.9	34	160	4.9	36	160	3.9	43	180	2.9	61	260	5.8

NOTE:

Lt, Lr & w VALUES IN FEET.

⊛ MINIMUM ALLOWABLE RADIUS

DESIGN FACTORS FOR A DESIGN SPEED OF 35 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY=35		WIDTH=18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT			WIDTH=72 FT		
		IGRDS EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)																	
		1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'			3 @ 12'		
RADIUS (FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w
20000	2.1	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0
15000	2.1	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0
10000	2.1	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0
7000	2.1	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0
5000	2.1	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0
4000	2.1	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0
3000	2.1	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0
2500	2.5	28	120	2.9	101	120	0.0	101	120	0.0	101	120	0.0	101	120	0.0	101	120	0.0
2250	2.8	27	120	3.0	29	120	2.0	90	120	0.0	90	120	0.0	90	120	0.0	90	120	0.0
2000	3.0	27	120	3.1	29	120	2.0	84	120	0.0	84	120	0.0	84	120	0.0	84	120	0.0
1750	3.4	27	120	3.2	29	120	2.2	75	120	0.0	75	120	0.0	75	120	0.0	87	140	0.0
1500	3.8	27	120	3.3	29	120	2.3	67	120	0.0	67	120	0.0	67	120	0.0	89	160	0.0
1300	4.3	27	120	3.4	29	120	2.4	59	120	0.0	59	120	0.0	69	140	0.0	88	180	0.0
1150	4.7	27	120	3.5	28	120	2.5	54	120	0.0	54	120	0.0	63	140	0.0	81	180	0.0
1000	5.2	27	120	3.6	28	120	2.6	49	120	0.0	49	120	0.0	65	160	0.0	81	200	0.0
900	5.5	27	120	3.8	28	120	2.8	46	120	0.0	46	120	0.0	62	160	0.0	84	220	0.0
800	5.9	26	120	3.9	28	120	2.9	43	120	0.0	43	120	0.0	65	180	0.0	61	240	2.7
750	6.1	26	120	4.0	28	120	3.0	29	120	2.0	42	120	0.0	51	200	2.0	66	260	3.0
700	6.4	26	120	4.1	28	120	3.1	34	140	2.0	46	140	0.0	51	200	2.2	66	260	3.3
650	6.6	26	120	4.2	32	140	3.2	34	140	2.2	45	140	0.0	50	200	2.4	70	280	3.6
600	6.9	30	140	4.3	32	140	3.3	34	140	2.3	43	140	0.0	55	220	2.6	70	280	3.9
550	7.1	30	140	4.4	32	140	3.4	34	140	2.4	42	140	0.0	55	220	2.8	75	300	4.2
500	7.4	30	140	4.6	32	140	3.6	38	160	2.6	46	160	0.0	60	240	3.2	79	320	4.8
475	7.6	30	140	4.7	36	160	3.7	38	160	2.7	45	160	0.0	59	240	3.4	79	320	5.1
450	7.7	30	140	4.8	36	160	3.8	38	160	2.8	44	160	0.0	59	240	3.6	79	320	5.4
425	7.8	34	160	4.9	36	160	3.9	38	160	2.9	44	160	0.0	64	260	3.8	83	340	5.7
400	7.9	33	160	5.0	35	160	4.0	37	160	3.0	44	180	2.0	63	260	4.0	83	340	6.0
375	8.0	33	160	5.2	35	160	4.2	37	160	3.2	44	180	2.2	63	260	4.4	82	340	6.6
350 ⊛	8.0	33	160	5.3	35	160	4.3	42	180	3.3	44	180	2.3	63	260	4.6	82	340	6.9

NOTE:

Lt, Lr, & w VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY IGRDS.

⊛ MINIMUM ALLOWABLE RADIUS.

TC-5

DESIGN FACTORS FOR A DESIGN SPEED OF 40 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY=40		WIDTH=18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT			WIDTH=72 FT		
		IGRDS EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)																	
		1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'			3 @ 12'		
RADIUS(FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w
20000	2.1	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0
15000	2.1	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0
10000	2.1	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0
7000	2.1	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0
5000	2.1	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0
4000	2.1	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0	120	120	0.0
3000	2.6	97	120	0.0	97	120	0.0	97	120	0.0	97	120	0.0	97	120	0.0	97	120	0.0
2500	3.1	27	120	3.0	29	120	2.0	82	120	0.0	82	120	0.0	82	120	0.0	95	140	0.0
2250	3.4	27	120	3.1	29	120	2.0	75	120	0.0	75	120	0.0	75	120	0.0	99	160	0.0
2000	3.7	27	120	3.2	29	120	2.2	69	120	0.0	69	120	0.0	69	120	0.0	91	160	0.0
1750	4.1	27	120	3.3	29	120	2.3	62	120	0.0	62	120	0.0	72	140	0.0	93	180	0.0
1500	4.6	27	120	3.4	29	120	2.4	55	120	0.0	55	120	0.0	74	160	0.0	92	200	0.0
1300	5.1	27	120	3.5	28	120	2.5	50	120	0.0	50	120	0.0	66	160	0.0	91	220	0.0
1150	5.5	27	120	3.7	28	120	2.7	45	120	0.0	45	120	0.0	68	180	0.0	90	240	0.0
1000	6.0	27	120	3.8	28	120	2.8	42	120	0.0	49	140	0.0	70	200	0.0	91	270	0.0
900	6.4	31	140	3.9	33	140	2.9	46	140	0.0	46	140	0.0	66	200	0.0	92	280	0.0
800	6.8	30	140	4.1	32	140	3.1	39	160	2.0	50	160	0.0	61	240	2.2	76	300	3.3
750	7.0	30	140	4.2	32	140	3.2	39	160	2.2	48	160	0.0	60	240	2.4	80	340	3.6
700	7.3	34	160	4.3	37	160	3.3	39	160	2.3	47	160	0.0	60	240	2.6	80	340	3.9
650	7.5	34	160	4.4	36	160	3.4	38	160	2.4	45	160	0.0	65	270	2.8	85	340	4.2
600	7.7	34	160	4.5	36	160	3.5	43	180	2.5	44	160	0.0	65	270	3.0	84	340	4.5
550	7.9	34	160	4.6	41	180	3.6	43	180	2.6	48	180	0.0	69	280	3.2	89	360	4.8
500	8.0	34	160	4.8	40	180	3.8	42	180	2.8	48	180	0.0	69	280	3.6	88	360	5.4
475	8.0	34	160	4.9	40	180	3.9	42	180	2.9	48	180	0.0	69	280	3.8	88	360	5.7
⊛ 465	8.0	33	160	5.0	40	180	4.0	42	180	3.0	44	180	2.0	68	280	4.0	88	360	6.0

NOTE:

Lt, Lr & w VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET
USE Lr VALUES DEVELOPED BY IGRDS.

⊛ MINIMUM ALLOWABLE RADIUS

DESIGN FACTORS FOR A DESIGN SPEED OF 45 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY=45		WIDTH=18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT			WIDTH=72 FT		
		IGRDS EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)																	
		1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'			3 @ 12'		
RADIUS (FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w
20000	2.1	140	140	0.0	140	140	0.0	140	140	0.0	140	140	0.0	140	140	0.0	140	140	0.0
15000	2.1	140	140	0.0	140	140	0.0	140	140	0.0	140	140	0.0	140	140	0.0	140	140	0.0
10000	2.1	140	140	0.0	140	140	0.0	140	140	0.0	140	140	0.0	140	140	0.0	140	140	0.0
7000	2.1	140	140	0.0	140	140	0.0	140	140	0.0	140	140	0.0	140	140	0.0	140	140	0.0
5000	2.1	140	140	0.0	140	140	0.0	140	140	0.0	140	140	0.0	140	140	0.0	140	140	0.0
4000	2.5	118	140	0.0	118	140	0.0	118	140	0.0	118	140	0.0	118	140	0.0	118	140	0.0
3000	3.2	92	140	0.0	92	140	0.0	92	140	0.0	92	140	0.0	92	140	0.0	105	160	0.0
2500	3.7	32	140	3.1	34	140	2.0	80	140	0.0	80	140	0.0	80	140	0.0	103	180	0.0
2250	4.0	32	140	3.2	34	140	2.2	74	140	0.0	74	140	0.0	74	140	0.0	95	180	0.0
2000	4.4	32	140	3.3	33	140	2.3	67	140	0.0	67	140	0.0	77	160	0.0	96	200	0.0
1750	4.9	31	140	3.4	33	140	2.4	60	140	0.0	60	140	0.0	78	180	0.0	95	220	0.0
1500	5.4	31	140	3.5	33	140	2.5	55	140	0.0	55	140	0.0	70	180	0.0	94	240	0.0
1300	6.0	31	140	3.7	33	140	2.7	49	140	0.0	49	140	0.0	70	200	0.0	98	280	0.0
1150	6.4	31	140	3.8	33	140	2.8	46	140	0.0	53	160	0.0	73	220	0.0	99	300	0.0
1000	6.9	35	160	4.0	37	160	3.0	39	160	2.0	49	160	0.0	74	240	0.0	98	320	0.0
900	7.3	35	160	4.1	37	160	3.1	44	180	2.0	52	160	0.0	75	260	0.0	98	340	0.0
800	7.6	34	160	4.3	41	180	3.3	43	180	2.3	50	180	0.0	70	280	2.6	90	360	3.9
750	7.8	39	180	4.3	41	180	3.3	43	180	2.3	49	180	0.0	70	280	2.6	95	380	3.9
700	7.9	38	180	4.4	41	180	3.4	43	180	2.4	48	180	0.0	70	280	2.8	95	380	4.2
650	8.0	38	180	4.6	41	180	3.6	47	200	2.6	48	180	0.0	74	300	3.2	94	380	4.8
⊛ 602	8.0	38	180	4.7	40	180	3.7	47	200	2.7	48	180	0.0	74	300	3.4	99	400	5.1

NOTE:

Lt, Lr & w VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET
USE Lr VALUES DEVELOPED BY IGRDS.

⊛ MINIMUM ALLOWABLE RADIUS

TC-5

DESIGN FACTORS FOR A DESIGN SPEED OF 50 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY=50		WIDTH=18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT			WIDTH=72 FT		
		IGRDS EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)																	
		1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'			3 @ 12'		
RADIUS (FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w
20000	2.1	160	160	0.0	160	160	0.0	160	160	0.0	160	160	0.0	160	160	0.0	160	160	0.0
15000	2.1	160	160	0.0	160	160	0.0	160	160	0.0	160	160	0.0	160	160	0.0	160	160	0.0
10000	2.1	160	160	0.0	160	160	0.0	160	160	0.0	160	160	0.0	160	160	0.0	160	160	0.0
7000	2.1	160	160	0.0	160	160	0.0	160	160	0.0	160	160	0.0	160	160	0.0	160	160	0.0
5000	2.4	140	160	0.0	140	160	0.0	140	160	0.0	140	160	0.0	140	160	0.0	140	160	0.0
4000	2.9	116	160	0.0	116	160	0.0	116	160	0.0	116	160	0.0	116	160	0.0	116	160	0.0
3000	3.7	91	160	0.0	91	160	0.0	91	160	0.0	91	160	0.0	91	160	0.0	103	180	0.0
2500	4.3	36	160	3.2	38	160	2.2	79	160	0.0	79	160	0.0	79	160	0.0	108	220	0.0
2250	4.7	36	160	3.3	38	160	2.3	72	160	0.0	72	160	0.0	81	180	0.0	108	240	0.0
2000	5.1	36	160	3.4	38	160	2.4	66	160	0.0	66	160	0.0	83	200	0.0	108	260	0.0
1750	5.6	36	160	3.5	38	160	2.5	60	160	0.0	60	160	0.0	83	220	0.0	105	280	0.0
1500	6.2	35	160	3.7	38	160	2.7	55	160	0.0	55	160	0.0	82	240	0.0	102	300	0.0
1300	6.7	35	160	3.8	37	160	2.8	51	160	0.0	57	180	0.0	82	260	0.0	107	340	0.0
1150	7.2	35	160	3.9	42	180	2.9	47	160	0.0	53	180	0.0	76	260	0.0	105	360	0.0
1000	7.6	39	180	4.1	41	180	3.1	48	200	2.0	56	200	0.0	78	280	0.0	105	380	0.0
900	7.9	39	180	4.3	46	200	3.3	48	200	2.3	54	200	0.0	80	300	0.0	102	380	0.0
800	8.0	38	180	4.4	45	200	3.4	48	200	2.4	53	200	0.0	80	320	2.8	105	420	4.2
⊛ 760	8.0	38	180	4.5	45	200	3.5	48	200	2.5	53	200	0.0	80	320	3.0	104	420	4.5

NOTE:

Lt, Lr & w VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET
USE Lr VALUES DEVELOPED BY IGRDS.

⊛ MINIMUM ALLOWABLE RADIUS

DESIGN FACTORS FOR A DESIGN SPEED OF 55 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY=55		WIDTH=18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT			WIDTH=72 FT		
		IGRDS EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)																	
		1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'			3 @ 12'		
RADIUS (FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w
20000	2.1	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0
15000	2.1	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0
10000	2.1	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0
7000	2.1	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0
5000	2.8	135	180	0.0	135	180	0.0	135	180	0.0	135	180	0.0	135	180	0.0	135	180	0.0
4000	3.4	112	180	0.0	112	180	0.0	112	180	0.0	112	180	0.0	112	180	0.0	112	180	0.0
3000	4.4	86	180	0.0	86	180	0.0	86	180	0.0	86	180	0.0	86	180	0.0	115	240	0.0
2500	5.0	40	180	3.3	43	180	2.3	76	180	0.0	76	180	0.0	84	200	0.0	110	260	0.0
2250	5.4	40	180	3.4	43	180	2.4	70	180	0.0	70	180	0.0	86	220	0.0	109	280	0.0
2000	5.9	40	180	3.5	42	180	2.5	65	180	0.0	65	180	0.0	86	240	0.0	114	320	0.0
1750	6.4	40	180	3.6	42	180	2.6	60	180	0.0	60	180	0.0	86	260	0.0	112	340	0.0
1500	7.0	40	180	3.8	42	180	2.8	54	180	0.0	54	180	0.0	84	280	0.0	108	360	0.0
1300	7.5	39	180	4.0	46	200	3.0	49	200	2.0	56	200	0.0	84	300	0.0	112	400	0.0
1150	7.8	43	200	4.1	46	200	3.1	48	200	2.0	54	200	0.0	81	300	0.0	108	400	0.0
1000	8.0	43	200	4.3	46	200	3.3	53	220	2.3	58	220	0.0	84	320	0.0	111	420	0.0
⊛ 964	8.0	43	200	4.3	46	200	3.3	53	220	2.3	58	220	0.0	84	320	0.0	111	420	3.9

NOTE:

Lt, Lr & w VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET
USE Lr VALUES DEVELOPED BY IGRDS.

⊛ MINIMUM ALLOWABLE RADIUS

TC-5

DESIGN FACTORS FOR A DESIGN SPEED OF 60 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY=60		WIDTH=18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT			WIDTH=72 FT		
		IGRDS EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)																	
		1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'			3 @ 12'		
RADIUS(FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w
20000	2.1	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0
15000	2.1	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0
10000	2.1	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0	180	180	0.0
7000	2.4	158	180	0.0	158	180	0.0	158	180	0.0	158	180	0.0	158	180	0.0	158	180	0.0
5000	3.3	115	180	0.0	115	180	0.0	115	180	0.0	115	180	0.0	115	180	0.0	115	180	0.0
4000	4.0	95	180	0.0	95	180	0.0	95	180	0.0	95	180	0.0	95	180	0.0	116	220	0.0
3000	5.0	76	180	0.0	76	180	0.0	76	180	0.0	76	180	0.0	84	200	0.0	118	280	0.0
2500	5.8	40	180	3.4	43	180	2.4	66	180	0.0	66	180	0.0	87	240	0.0	116	320	0.0
2250	6.2	40	180	3.5	42	180	2.5	61	180	0.0	61	180	0.0	89	260	0.0	116	340	0.0
2000	6.7	40	180	3.6	42	180	2.6	57	180	0.0	57	180	0.0	88	280	0.0	113	360	0.0
1750	7.2	40	180	3.8	47	200	2.8	53	180	0.0	59	200	0.0	88	300	0.0	117	400	0.0
1500	7.7	44	200	3.9	46	200	2.9	55	200	0.0	60	220	0.0	88	320	0.0	115	420	0.0
1300	8.0	43	200	4.1	50	220	3.1	58	220	2.0	58	220	0.0	84	320	0.0	116	440	0.0
⊛ 1204	8.0	43	200	4.2	50	220	3.2	58	220	2.2	58	220	0.0	84	320	0.0	116	440	0.0

NOTE:

Lt, Lr & w VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET
USE Lr VALUES DEVELOPED BY IGRDS.

⊛ MINIMUM ALLOWABLE RADIUS

DESIGN FACTORS FOR A DESIGN SPEED OF 65 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY=65		WIDTH=18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT			WIDTH=72 FT		
		IGRDS EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)																	
		1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'			3 @ 12'		
RADIUS(FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w
20000	2.1	200	200	0.0	200	200	0.0	200	200	0.0	200	200	0.0	200	200	0.0	200	200	0.0
15000	2.1	200	200	0.0	200	200	0.0	200	200	0.0	200	200	0.0	200	200	0.0	200	200	0.0
10000	2.1	200	200	0.0	200	200	0.0	200	200	0.0	200	200	0.0	200	200	0.0	200	200	0.0
7000	2.7	156	200	0.0	156	200	0.0	156	200	0.0	156	200	0.0	156	200	0.0	156	200	0.0
5000	3.7	114	200	0.0	114	200	0.0	114	200	0.0	114	200	0.0	114	200	0.0	125	220	0.0
4000	4.4	96	200	0.0	96	200	0.0	96	200	0.0	96	200	0.0	96	200	0.0	125	260	0.0
3000	5.6	75	200	0.0	75	200	0.0	75	200	0.0	75	200	0.0	98	260	0.0	128	340	0.0
2500	6.5	44	200	3.5	47	200	2.5	65	200	0.0	65	200	0.0	97	300	0.0	130	400	0.0
2250	6.9	44	200	3.6	47	200	2.6	61	200	0.0	67	220	0.0	98	320	0.0	128	420	0.0
2000	7.4	44	200	3.7	51	220	2.7	57	200	0.0	63	220	0.0	97	340	0.0	125	440	0.0
1750	7.8	48	220	3.9	51	220	2.9	60	220	0.0	65	240	0.0	97	360	0.0	124	460	0.0
1500	8.0	48	220	4.1	55	240	3.1	58	240	2.0	63	240	0.0	95	360	0.0	126	480	0.0
⊛ 1488	8.0	48	220	4.1	55	240	3.1	58	240	2.0	63	240	0.0	95	360	0.0	126	480	0.0

NOTE:

Lt, Lr & w VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET
USE Lr VALUES DEVELOPED BY IGRDS.

⊛ MINIMUM ALLOWABLE RADIUS

DESIGN FACTORS FOR A DESIGN SPEED OF 70 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY=70		WIDTH=18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT			WIDTH=72 FT		
		IGRDS EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)																	
		1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'			3 @ 12'		
RADIUS (FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w
20000	2.1	220	220	0.0	220	220	0.0	220	220	0.0	220	220	0.0	220	220	0.0	220	220	0.0
15000	2.1	220	220	0.0	220	220	0.0	220	220	0.0	220	220	0.0	220	220	0.0	220	220	0.0
10000	2.2	210	220	0.0	210	220	0.0	210	220	0.0	210	220	0.0	210	220	0.0	210	220	0.0
7000	3.0	154	220	0.0	154	220	0.0	154	220	0.0	154	220	0.0	154	220	0.0	154	220	0.0
5000	4.1	113	220	0.0	113	220	0.0	113	220	0.0	113	220	0.0	113	220	0.0	134	260	0.0
4000	5.0	93	220	0.0	93	220	0.0	93	220	0.0	93	220	0.0	101	240	0.0	126	300	0.0
3000	6.3	74	220	0.0	74	220	0.0	74	220	0.0	74	220	0.0	100	300	0.0	127	380	0.0
2500	7.2	49	220	3.6	52	220	2.6	65	220	0.0	65	220	0.0	100	340	0.0	129	440	0.0
2250	7.6	48	220	3.7	51	220	2.7	61	220	0.0	67	240	0.0	100	360	0.0	128	460	0.0
2000	8.0	48	220	3.9	56	240	2.9	58	220	0.0	63	240	0.0	95	360	0.0	126	480	0.0
⊛1821	8.0	45	220	4.0	55	240	3.0	58	240	2.0	63	240	0.0	95	360	0.0	126	480	0.0

NOTE:

Lt, Lr & w VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET
USE Lr VALUES DEVELOPED BY IGRDS.

⊛ MINIMUM ALLOWABLE RADIUS

STANDARD SYMBOLS

LOCATION ℄.....ALIGNMENT ON WHICH THE PROPOSED RIGHT-OF-WAY AND CONSTRUCTION IS BASED.
STANDARD PAVEMENT.....THE TYPICAL PAVEMENT SECTION TO BE SHOWN ON THE ROAD PLANS.
P.C. .....POINT OF BEGINNING OF BASELINE CIRCULAR CURVE.
P.T. .....POINT OF ENDING OF BASELINE CIRCULAR CURVE.
P.C.C. .....POINT OF BASELINE COMPOUND CURVATURE.
P.R.C.....POINT OF BASELINE REVERSE CURVE.
T.S. .....POINT OF CHANGE FROM TANGENT TO TRANSITION CURVE. (TANGENT TO SPIRAL)
S.C. .....POINT OF CHANGE FROM TRANSITION CURVE TO CIRCULAR CURVE. (SPIRAL TO CIRCULAR)
C.S. .....POINT OF CHANGE FROM CIRCULAR CURVE TO TRANSITION CURVE. (CIRCULAR TO SPIRAL)
S.T. .....POINT OF CHANGE FROM TRANSITION CURVE TO TANGENT. (SPIRAL TO TANGENT)
RADIUS .....RADIUS OF BASELINE CIRCULAR CURVE.
DV .....APPROXIMATE MAXIMUM SAFE SPEED IN MILES PER HOUR USING STANDARD RATE OF SUPER-ELEVATION.
NC .....APPROXIMATE MAXIMUM SAFE SPEED IN MILES PER HOUR WITH NO SUPERELEVATION. FACTORS APPLY ONLT TO URBAN LOW SPEED CONDITIONS.
Lr .....LENGTH OF TRANSITION CURVE MEASURED ALONG BASELINE. WHERE NO TRANSITION CURVE IS APPLIED Lr IS LENGTH OF SUPERELEVATION RUNOFF SECTION.
W OR PW .....WIDTH OF STANDARD PAVEMENT.
ZT .....DISTANCE FROM TRANSITIONED BASELINE TO EDGES OF TRANSITIONED PAVEMENT
w .....MAXIMUM TOTAL PAVEMENT WIDENING.
E .....RATE OF SUPERELEVATION.
F .....SAFE SIDE FRICTION FACTOR.
S .....AMOUNT OF SUPERELEVATION TO BE APPLIED TO THE BASELINE GRADE TO OBTAIN THE ELEVATIONS OF THE EDGES OF TRANSITIONED PAVEMENT.
C .....DIFFERENCE IN ELEVATION BETWEEN BASELINE (CENTER) AND EDGE OF PAVEMENT FOR STANDARD PAVEMENT CROWN.
Lt .....STANDARD PAVEMENT CROWN TRANSITION OR TANGENT RUNOUT SECTION.
CP .....CHORD POINT (1/10 INCREMENTS OF TRANSITION CURVE).
NPC.....NORMAL PAVEMENT CROWN.

ALL DISTANCES (HORIZONTAL AND VERTICAL) ARE MEASURED IN FEET.

SPECIFICATION REFERENCE

TRANSITION CURVES FOR RURAL AND URBAN HIGHWAYS AND STREET CONDITIONS

VIRGINIA DEPARTMENT OF TRANSPORTATION

REV. 1/07

802.01

URBAN CONDITION

URBAN CONDITIONS APPLY TO URBAN STREET SYSTEMS AND ANY OTHER ROAD WITH PRESENT OR FUTURE URBAN STREET OPERATING CONDITIONS.

THESE TABLES CONTAIN THE MINIMUM SUPERELEVATION RATES AND TRANSITION LENGTHS FOR STANDARD URBAN PAVEMENT WIDTHS THROUGH A RANGE OF DESIGN VELOCITIES CONSIDERED MOST LIKELY TO BE USED IN URBAN ROAD DESIGN.

DEFINITIONS FOR THE STANDARD SYMBOLS USED THROUGHOUT THESE TABLES ARE FOUND ON SHEET 802.01.

A TABLE FOR "LOW SPEED URBAN" DESIGNS IS ON SHEET 802.24 WITH A RANGE OF STANDARD PAVEMENT WIDTHS (W), SUPERELEVATION RUNOFF (Lr), AND RADII OF CURVE WHEN SUPERELEVATED BY AN AMOUNT EQUAL TO THE NORMAL CROWN AND THE APPROXIMATE MAXIMUM SAFE SPEEDS (DV) AFFORDED THEREBY. VALUES IN THIS TABLE CAN BE USED ON STREETS WITH OPERATING SPEEDS LESS THAN OR EQUAL TO 45 MPH. ALSO SHOWN ARE THE APPROXIMATE MAXIMUM SAFE SPEEDS (NC) WITH NO SUPERELEVATION. VALUES FOR (NC) CAN BE USED ON URBAN ARTERIAL, COLLECTOR, AND LOCAL STREETS.

FOR MINIMUM DESIGN FACTORS FOR VARIOUS DESIGN SPEEDS FOR URBAN CONDITIONS SEE SHEETS 802.25 THRU 802.33

WHEN URBAN CONDITIONS APPLY THERE WILL BE NO BASELINE TRANSITION OR PAVEMENT WIDENING. THE LENGTH OF SUPERELEVATION RUNOFF (Lr) DETERMINES THE LENGTH OF SUPERELEVATION TRANSITION THROUGH WHICH THE OUTER EDGE OF PAVEMENT IS RAISED ABOVE THE BASELINE GRADE TO A MAXIMUM OF E ($\frac{W}{2}$). SEE SHEET 802.07 FOR A GRAPHICAL ILLUSTRATION OF THE APPLICATION OF THIS CORRECTION.

FOR CURVE RADII NOT LISTED IN TABLES REFER TO SHEET 802.22 TO CALCULATE SUPERELEVATION RUNOFF (Lr).

Lr SHOULD BE SHOWN ON THE PLANS FOR ALL CURVES.

E SHOULD BE SHOWN ON THE PLANS FOR ALL CURVES WITH URBAN STREET CONDITIONS.

FOR GRAPHICAL ILLUSTRATION OF DESIGN SUPERELEVATION RATES FOR URBAN CONDITIONS SEE SHEET 802.19.

FOR ADDITIONAL GENERAL INSTRUCTIONS (BOTH URBAN AND RURAL) SEE SHEET 802.04.

RURAL CONDITION

RURAL CONDITIONS APPLY TO INTERSTATE, ARTERIAL, PRIMARY AND SECONDARY SYSTEMS OR TO ANY OTHER ROAD WITH RURAL TYPE DESIGN AND OPERATING CONDITIONS.

THESE TABLES CONTAIN THE MINIMUM ALLOWABLE SUPERELEVATION, TRANSITION LENGTHS, AND WIDENING CORRECTIONS FOR STANDARD RURAL PAVEMENT WIDTHS THROUGH A RANGE OF DESIGN VELOCITIES CONSIDERED MOST LIKELY TO BE USED IN RURAL HIGHWAY DESIGN.

DEFINITIONS FOR THE STANDARD SYMBOLS USED THROUGHOUT THESE TABLES ARE FOUND ON SHEET 802.01.

FOR MINIMUM DESIGN FACTORS FOR VARIOUS DESIGN SPEEDS FOR RURAL CONDITIONS SEE SHEETS 802.34 THRU 802.44.

ON CURVES WITH GREATER THAN 2865 FT RADIUS, THERE WILL BE NO SPIRAL TRANSITION OR PAVEMENT WIDENING. PAVEMENT WILL BE SUPERELEVATED BY AN AMOUNT EQUAL TO THE RATE SHOWN IN THE TABLES. SEE SHEET 802.06 FOR A GRAPHICAL ILLUSTRATION OF THE APPLICATION OF THIS CORRECTION.

ON CURVES WITH PAVEMENT WIDTHS OF 24' OR WIDER AND A RADIUS OF 882 FT. OR GREATER, THERE WILL BE NO SPIRAL TRANSITION OR PAVEMENT WIDENING. PAVEMENT WILL BE SUPERELEVATED BY AN AMOUNT EQUAL TO THE RATE SHOWN IN THESE TABLES.

FOR CURVE RADII NOT LISTED IN TABLES, REFER TO SHEET 802.22 TO CALCULATE SUPERELEVATION RUNOFF LENGTH (Lr) AND PAVEMENT WIDENING (w).

Lr AND E SHOULD BE SHOWN ON THE PLANS FOR ALL CURVES..

FOR GRAPHICAL ILLUSTRATION OF DESIGN SUPERELEVATION RATES FOR RURAL CONDITIONS SEE SHEET 802.20.

FOR ADDITIONAL GENERAL INSTRUCTIONS (BOTH URBAN AND RURAL) SEE SHEET 802.04.

SEE SHEET 802.05 FOR A GRAPHICAL ILLUSTRATION OF SPIRAL TRANSITIONS.

GENERAL CONDITION

ALL ORIGINAL CROSS SECTIONS SHALL BE TAKEN FROM THE BASELINE AT STATIONS, PLUS FIFTIES, AND UNUSUAL BREAKS IN THE GROUND AS ON TANGENT ALIGNMENT.

WHERE A PART OR ALL OF A SUPERELEVATION TRANSITION CURVE FALLS ON A VERTICAL CURVE, ELEVATIONS ON THE VERTICAL CURVE SHOULD BE COMPUTED FOR THE POSITIONS GIVEN ON SHEET 802.16 FOR CROWN TRANSITIONS, SHEET 802.17 FOR URBAN PROJECTS AND SHEET 802.18 FOR RURAL PROJECTS. THESE ELEVATIONS AND PLUSES SHOULD BE SHOWN ON THE PLANS FOR THE CONVENIENCE OF THE SURVEY PARTY IN STAKING OUT THE PROJECT. THROUGHOUT THESE SECTIONS OF THE GRADE, ELEVATIONS AT EVEN STATIONS AND PLUS FIFTIES SHOULD BE OMITTED.

SLOPE STAKES SHOULD BE SET AT THE POSITIONS ON THE TRANSITION GIVEN ON SHEETS 802.16, 802.17 AND 802.18 AND GROUND CROSS SECTIONS TAKEN AT THESE POSITIONS OMITTING THE STATIONS AND PLUS FIFTIES THROUGHOUT THE TRANSITION. IF UNUSUAL BREAKS IN THE GROUND OCCUR, ADDITIONAL SECTIONS SHOULD, OF COURSE, BE TAKEN. ADDITIONAL SECTIONS SHOULD ALSO BE TAKEN WHERE LOCATION IS THROUGH ROCK CUT IN ANTICIPATION OF UNUSUAL BREAKAGE WHICH MAY OCCUR DURING CONSTRUCTION.

AFTER ROUGH GRADING HAS BEEN DONE, FINE GRADING (BLUE TOP) AND FORM STAKES SHOULD BE SET AT THE POSITIONS GIVEN ON SHEET 802.16 FOR CROWN TRANSITIONS, SHEET 802.17 FOR URBAN PROJECTS OR AS GIVEN ON SHEET 802.18 FOR RURAL PROJECTS.

FINAL CROSS SECTIONS SHOULD, OF COURSE, BE TAKEN AT THOSE POSITIONS AT WHICH THE SLOPE STAKE SECTIONS WERE TAKEN. WHERE UNUSUAL BREAKAGE IN ROCK OCCURS, AND THIS WAS NOT ANTICIPATED, ADDITIONAL FINAL SECTIONS SHOULD BE TAKEN AND ORIGINAL GROUND SECTIONS INTERPOLATED.

BASELINE STAKES SHOULD BE SET AT ALL P.C.'S, P.T.'S, T.S.'S, S.T.'S, S.C.'S, AND C.S.'S IN STAKING OUT ALIGNMENT BUT SLOPE STAKES NEED NOT BE SET NOR CROSS SECTIONS TAKEN AT P.C.'S OR P.T.'S EXCEPT WHERE CALLED FOR IN THE ACCOMPANYING TABLES. THE TRANSITION WILL TAKE ITS FORM FROM THE POSITIONS GIVEN ON SHEETS 802.17 AND 802.18.

THE RIGHT OF WAY SHALL, IN ALL CASES, BE REFERENCED FROM THE BASELINE.

THE DESIGNER SHOULD EXERCISE CAUTION IN THE USE OF COMPOUND AND REVERSE CURVES UNLESS TOPOGRAPHICAL OR RIGHT OF WAY RESTRICTIONS MAKE THEIR USE APPROPIATE. THE USE OF BROKEN-BACK CURVES SHOULD BE AVOIDED EXCEPT WHERE VERY UNUSUAL TOPOGRAPHICAL OR RIGHT OF WAY CONDITIONS MAKE OTHER ALTERNATIVES IMPRACTICAL. THE USE OF BROKEN-BACK CURVES MAY REQUIRE A DESIGN EXCEPTION FROM THE STATE LOCATION AND DESIGN ENGINEER. SEE SHEETS 802.11 THRU 802.14 FOR GENERAL INFORMATION ON COMPOUND, REVERSE AND BROKEN-BACK CURVE INFORMATION. REFER TO APPENDIX A OF THE ROAD DESIGN MANUAL FOR SPECIFIC COMPOUND AND REVERSE CURVE DESIGN INFORMATION.

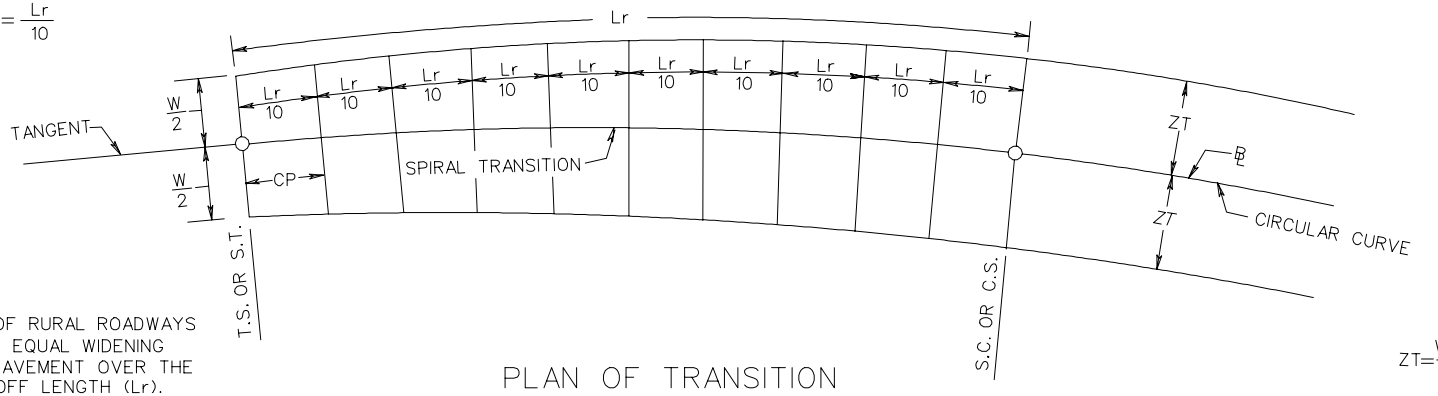
A DESIGN EXCEPTION IS NOT REQUIRED WHEN USING VALUES FROM SHEETS 802.24 THRU 802.44 SINCE THESE TABLES WERE DERIVED WITHIN AASHTO GUIDELINES.

REFER TO CHAPTER 4 OF AASHTO'S A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS FOR INFORMATION ON THE USE OF 18' PAVEMENT WIDTHS (9' LANE WIDTHS).

ALL TANGENT RUNOUT SECTION (Lt) VALUES AND SUPERELEVATION RUNOFF LENGTHS (Lr) LISTED IN THE TABLES HAVE BEEN ROUNDED UP TO THE NEAREST FOOT. ALL Lt VALUES ARE BASED ON A 2% CROWN.

TC-5.01

CHORD POINTS (CP) = $\frac{Lr}{10}$

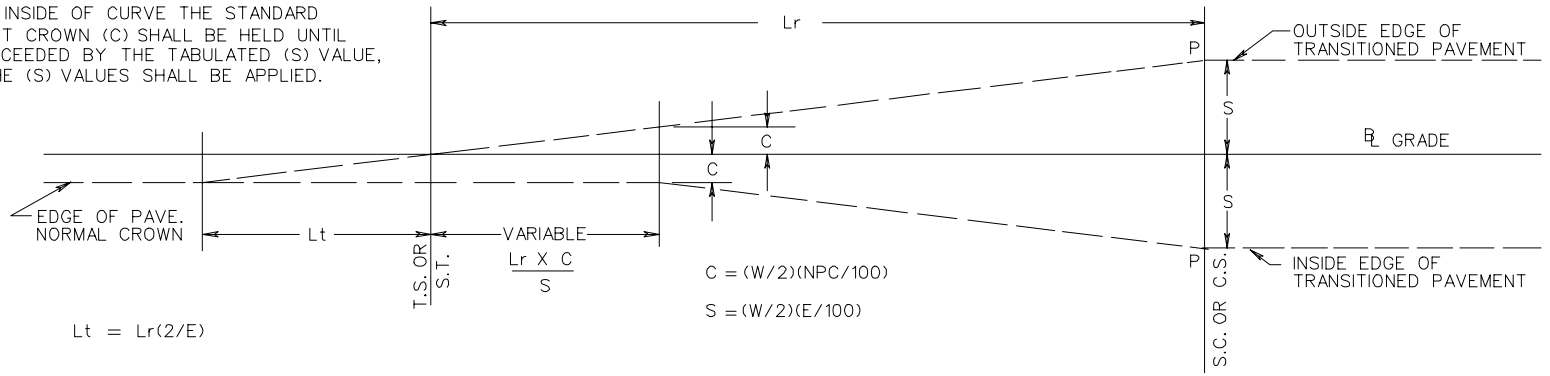


NOTE:
PAVEMENT WIDENING OF RURAL ROADWAYS WILL BE ACHIEVED BY EQUAL WIDENING OF BOTH EDGES OF PAVEMENT OVER THE SUPERELEVATION RUNOFF LENGTH (Lr).

PLAN OF TRANSITION

$ZT = \frac{W + w}{2}$

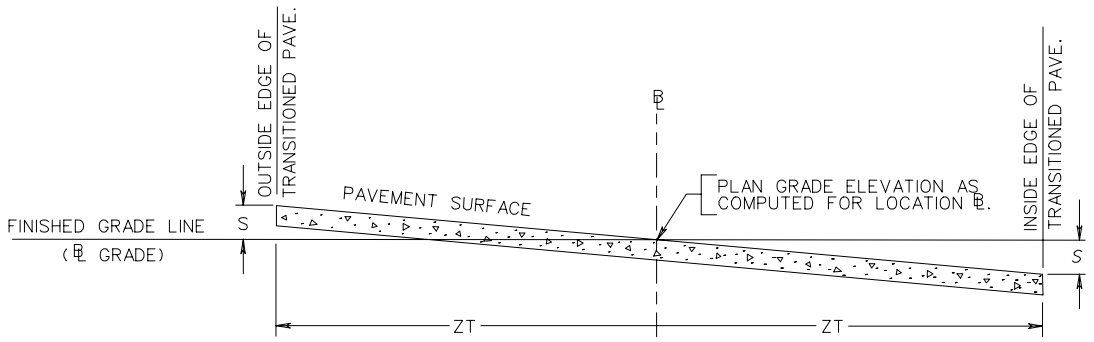
NOTE:
ON THE INSIDE OF CURVE THE STANDARD PAVEMENT CROWN (C) SHALL BE HELD UNTIL IT IS EXCEEDED BY THE TABULATED (S) VALUE, THEN THE (S) VALUES SHALL BE APPLIED.



Lt = Lr(2/E)

PROFILE OF TRANSITION

NOTE: SHORT VERTICAL CURVES SHOULD BE INSERTED BY EYE AT POINTS (P) IF CONSIDERED NECESSARY.



CROSS SECTION THRU TRANSITION

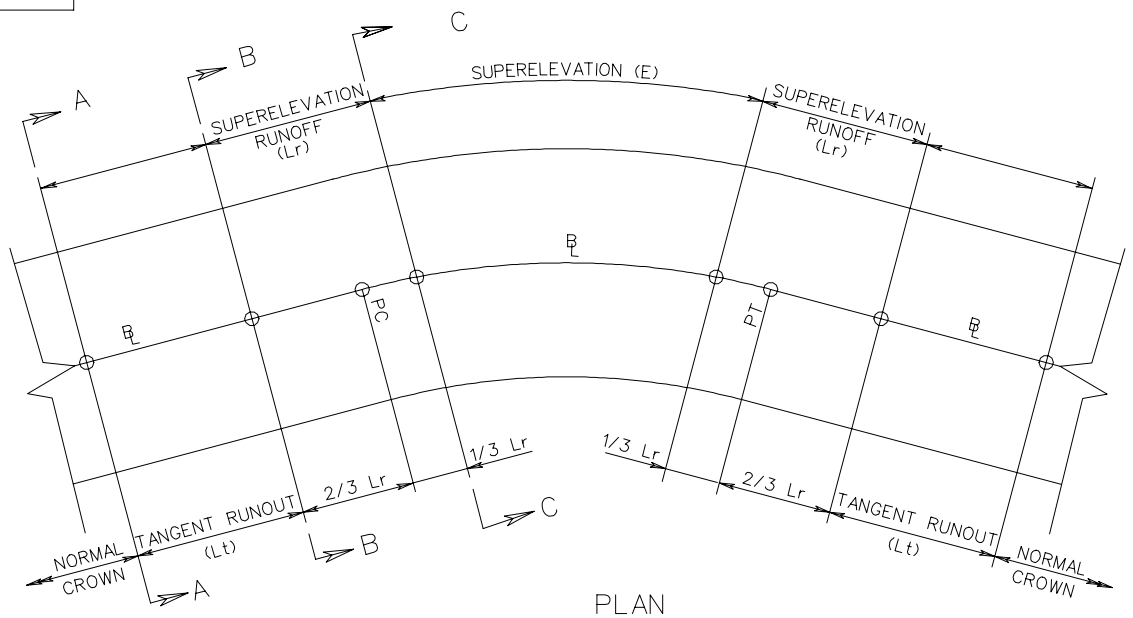
DETAILS FOR TRANSITIONED ℄ RURAL CONDITION WITH PAVEMENT WIDENING

VIRGINIA DEPARTMENT OF TRANSPORTATION

REV. 1/07

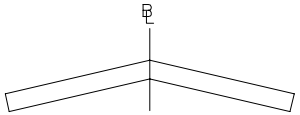
802.05

TC-5.01

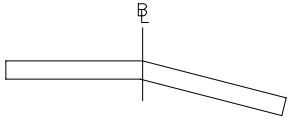


PLAN

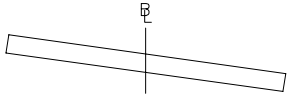
Lt = Lr(2/E)



SECTION A-A
NORMAL CROWN

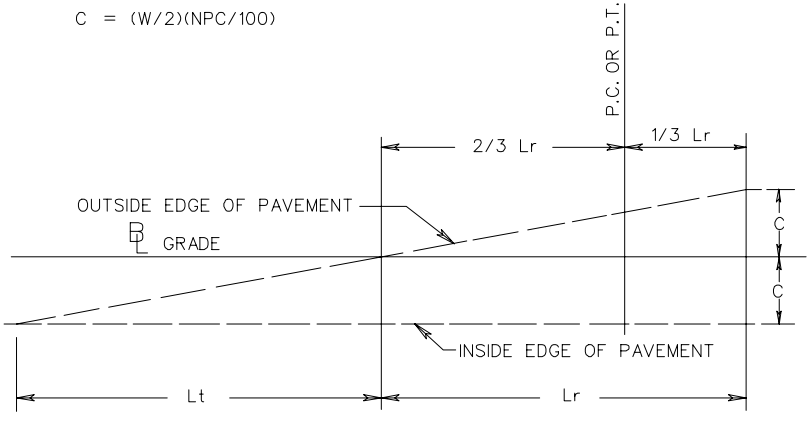


SECTION B-B
NORMAL CROWN
REMOVED (FLAT)



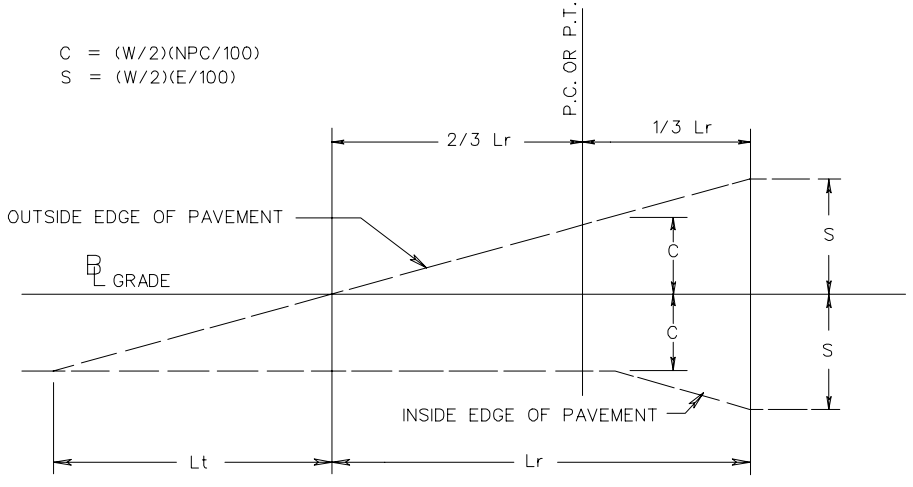
SECTION C-C
FULL SUPERELEVATION

C = (W/2)(NPC/100)



SUPERELEVATED BY AN AMOUNT EQUAL TO THE STANDARD PAVEMENT CROWN

C = (W/2)(NPC/100)
S = (W/2)(E/100)



NOTE : ON THE INSIDE OF CURVE THE STANDARD PAVEMENT CROWN (C) SHALL BE HELD UNTIL IT IS EXCEEDED BY THE TABULATED RATE OF SUPERELEVATION (E).

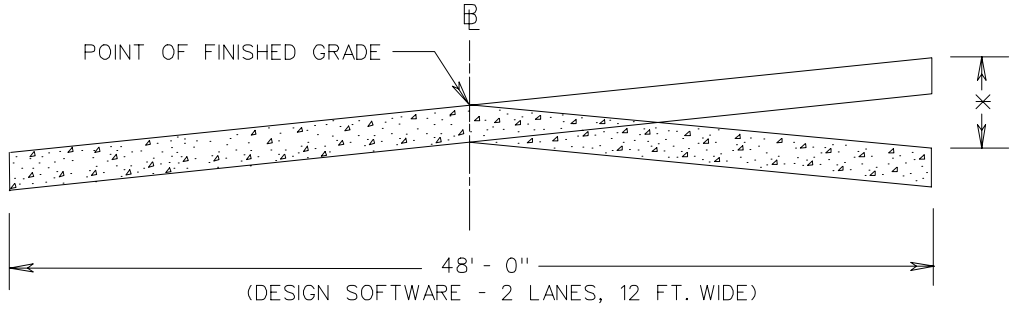
SUPERELEVATED BY AN AMOUNT EXCEEDING THE STANDARD PAVEMENT CROWN

DETAILS FOR NON-TRANSITION ℄ URBAN CONDITIONS AND RURAL CONDITIONS WITHOUT PAVEMENT WIDENING

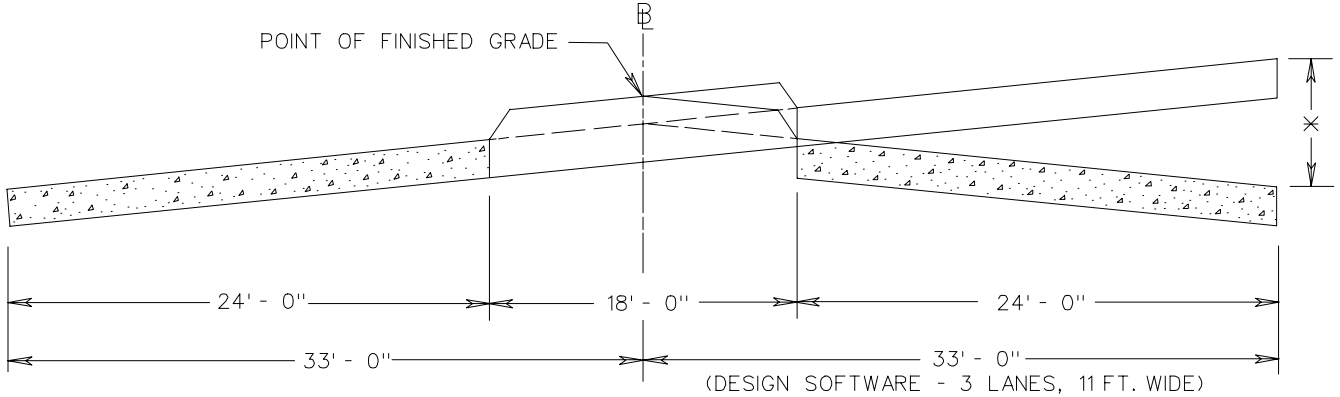
REV. 1/07

802.06

VIRGINIA DEPARTMENT OF TRANSPORTATION



(DESIGN SOFTWARE - 2 LANES, 12 FT. WIDE)



(DESIGN SOFTWARE - 3 LANES, 11 FT. WIDE)

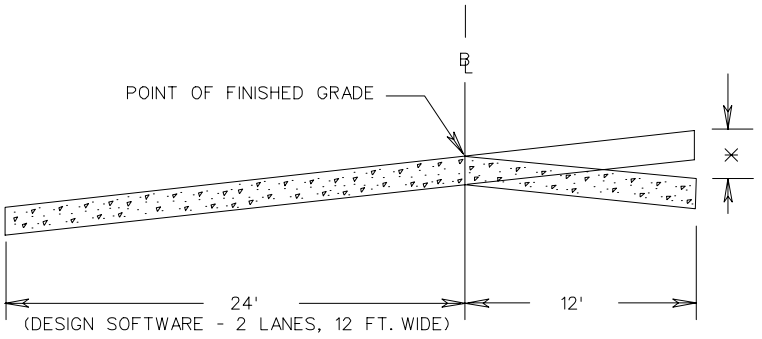
X THE ELEVATION DIFFERENTIAL BETWEEN NORMAL CROWN AND MAXIMUM SUPERELEVATION, RELATIVE TO THE BASELINE PROFILE.

ADDITIONAL INFORMATION MAY BE OBTAINED FROM A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS (AASHTO) BOOK, CHAPTER III - ELEMENTS OF DESIGN (SUPERELEVATION RUNOFF).

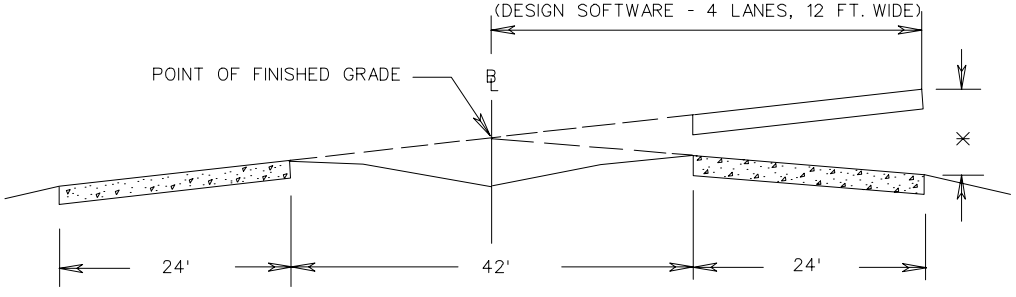
ON STANDARD TC-5.01ULS, TC-5.01U , AND TC-5.01R (WITHOUT PAVEMENT WIDENING) SUPERELEVATED CURVES, POSITION THE SUPERELEVATION RUNOFF SECTION (Lr) TWO THIRDS (2/3) ON THE TANGENT AND ONE THIRD (1/3) INTO THE CURVE. STATIONS AND ELEVATIONS FOR THESE TRANSITIONS WILL NEED TO BE COMPUTED FOR ALL CHORD POINTS AND SHOWN ON THE PROFILES.

DETAILS OF SUPERELEVATION ABOUT BASELINE

VIRGINIA DEPARTMENT OF TRANSPORTATION



THE PAVEMENT WIDTHS SHOWN IN THE STANDARD TC-5.01 TABLES ON SHEET 802.25 THROUGH 802.44 REPRESENT TWICE THE DISTANCE FROM THE CROWNLINE TO THE EDGE OF PAVEMENT ON THE HIGH SIDE.



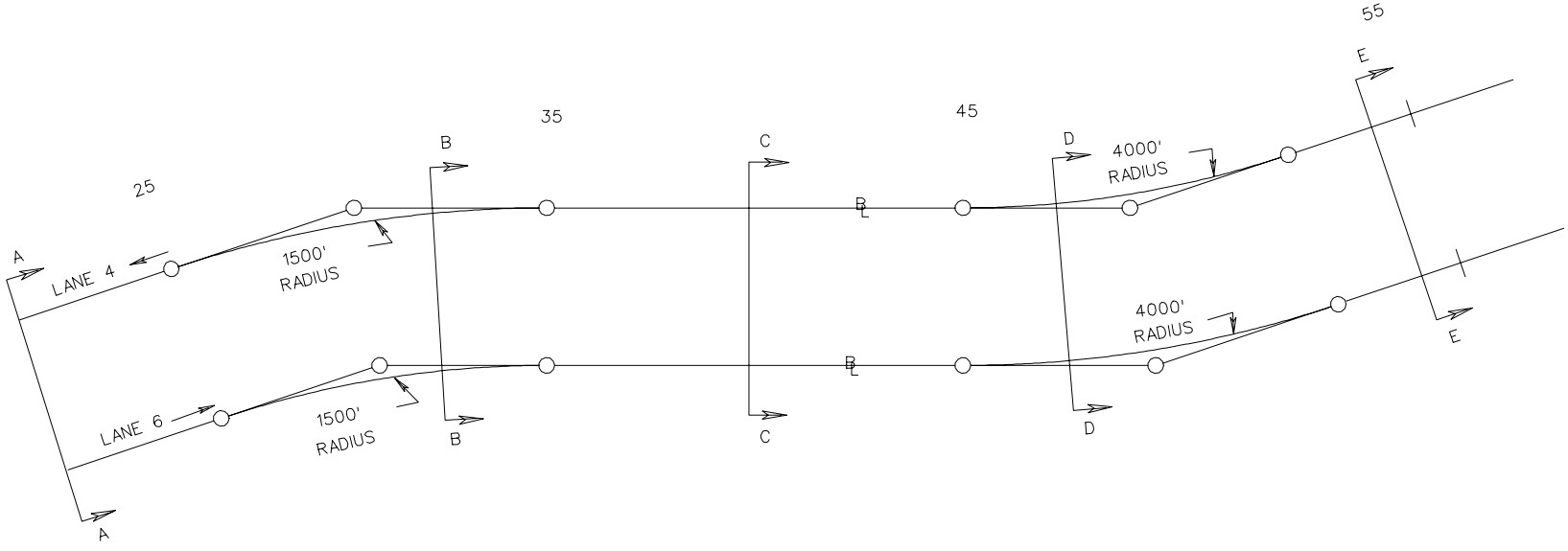
* THE ELEVATION DIFFERENTIAL BETWEEN NORMAL CROWN AND MAXIMUM SUPERELEVATION, RELATIVE TO THE BASELINE PROFILE.

ADDITIONAL INFORMATION MAY BE OBTAINED FROM A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS (AASHTO) BOOK, CHAPTER III - ELEMENTS OF DESIGN (SUPERELEVATION RUNOFF).

PROJECTS IN WHICH LANES MAY BE ADDED IN THE FUTURE IN THE MEDIAN AREA SHOULD BE DESIGNED WITH THE CONSTRUCTION BASELINE AND POINT OF FINISHED GRADE LOCATED IN THE MIDDLE OF THE MEDIAN. SUPERELEVATION IS TO BE ROTATED FROM THIS BASELINE POINT. THIS WILL PREVENT UNEVEN PAVEMENT PROBLEMS (WHEN ADDITIONAL LANES ARE ADDED IN THE MEDIAN AREA) SUCH AS CROSSOVER GRADES AS WELL AS THE NEED FOR RETAINING WALLS, MEDIAN BARRIERS AND SPECIAL DESIGN DRAINAGE STRUCTURES. ADDITIONAL RIGHT OF WAY OR EASEMENTS, IN MOST SITUATIONS, WILL NOT BE REQUIRED.

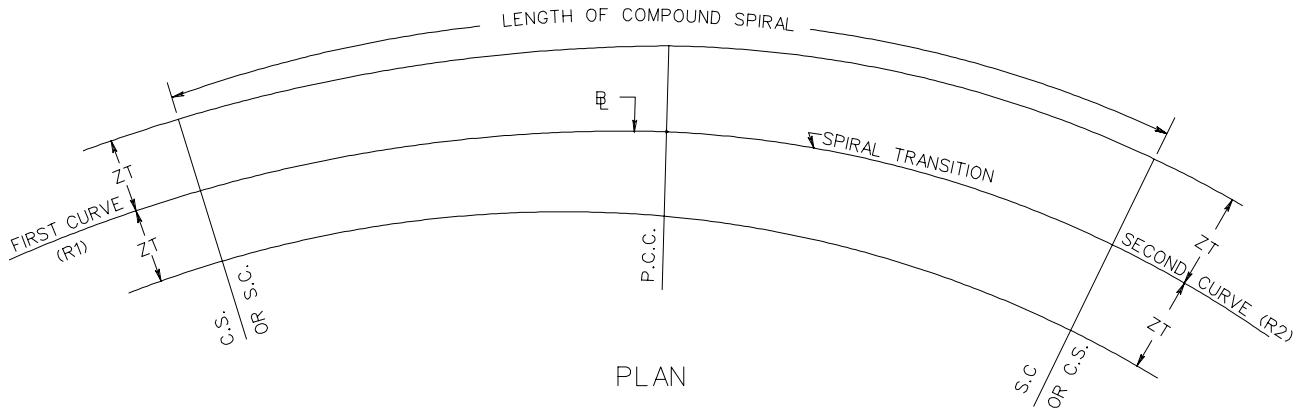
DETAILS OF SUPERELEVATION ABOUT BASELINE

VIRGINIA DEPARTMENT OF TRANSPORTATION

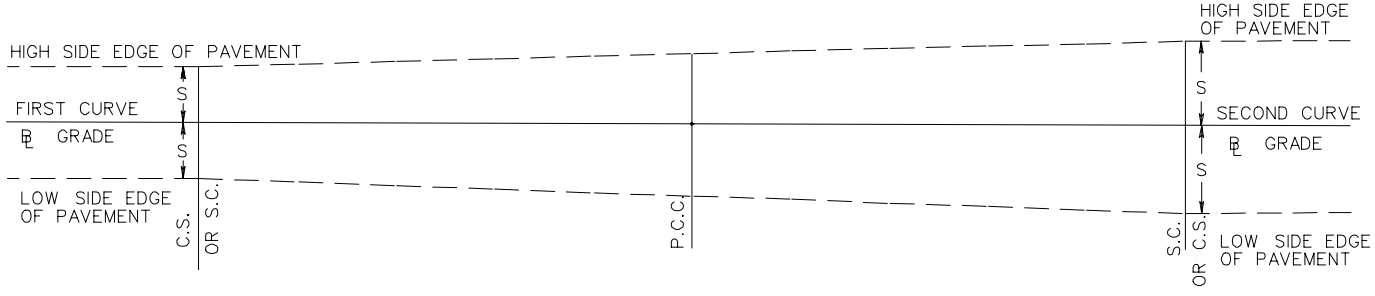


EXAMPLE FOR FOUR LANE ROADWAYS

VIRGINIA DEPARTMENT OF TRANSPORTATION



PLAN



PROFILE

NOTE:

1. FOR COMPOUND CURVES ON OPEN ROADWAYS, THE RATIO OF FLATTER RADIUS (R1) TO THE SHARPER RADIUS (R2) SHALL NOT EXCEED 1.5:1. WHERE PRACTICAL, A DESIRABLE MAXIMUM RATIO OF 1.75:1 SHOULD BE USED.
2. FOR COMPOUND CURVES ON RAMPS AND AT INTERSECTIONS, THE RATIO OF THE FLATTER RADIUS (R1) TO THE SHARPER RADIUS (R2) SHALL NOT EXCEED 2:1.
3. COMPUTE STRAIGHT LINE WIDENING AND SUPERELEVATION TRANSITION FROM MAXIMUM OF FIRST CURVE TO MAXIMUM OF SECOND CURVE.
4. REFER TO CHAPTER 3 OF THE AASHTO GREEN BOOK FOR ADDITIONAL COMPOUND CURVE DESIGN INFORMATION.

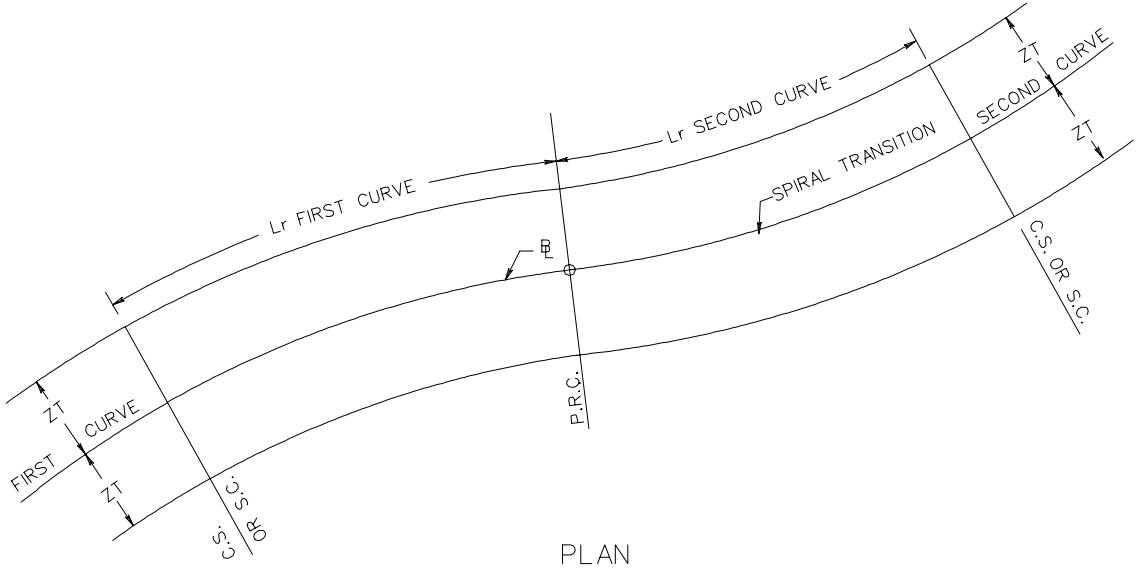
SPECIFICATION REFERENCE

METHOD OF APPLYING TC-5.01 ON COMPOUND CURVES RURAL CONDITIONS WITH PAVEMENT WIDENING

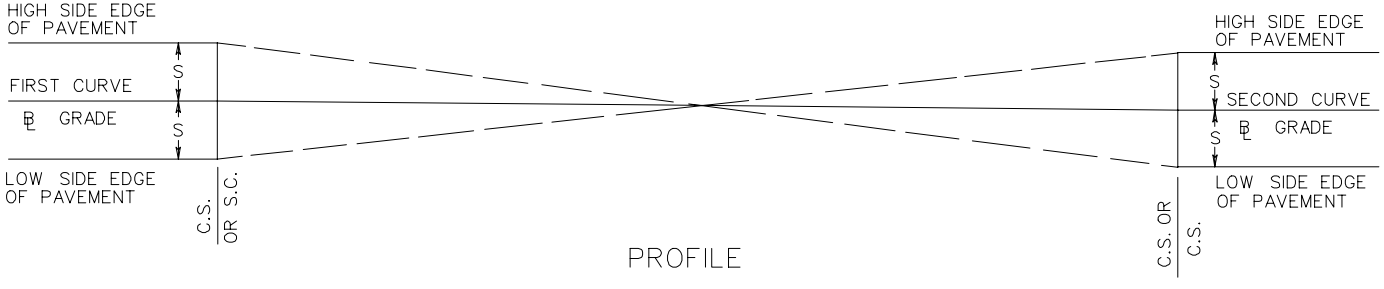
VIRGINIA DEPARTMENT OF TRANSPORTATION

REV. 1/07

802.11



PLAN



PROFILE

NOTE:

1. COMPUTE STRAIGHT LINE WIDENING AND SUPERELEVATION TRANSITION FROM MAXIMUM OF FIRST CURVE TO MAXIMUM OF SECOND CURVE.
2. REFER TO CHAPTER 3 OF THE AASHTO'S A POLICY ON THE GEOMETRIC DESIGN OF HIGHWAYS AND STREETS FOR ADDITIONAL REVERSE CURVE DESIGN INFORMATION.

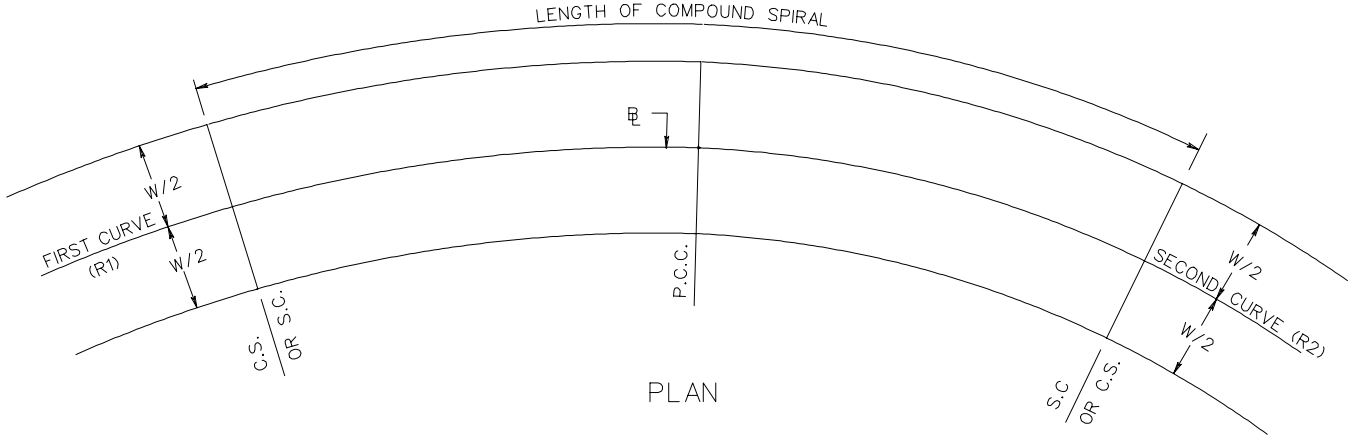
METHOD OF APPLYING TC-5.01 ON REVERSE CURVES RURAL CONDITIONS WITH PAVEMENT WIDENING

VIRGINIA DEPARTMENT OF TRANSPORTATION

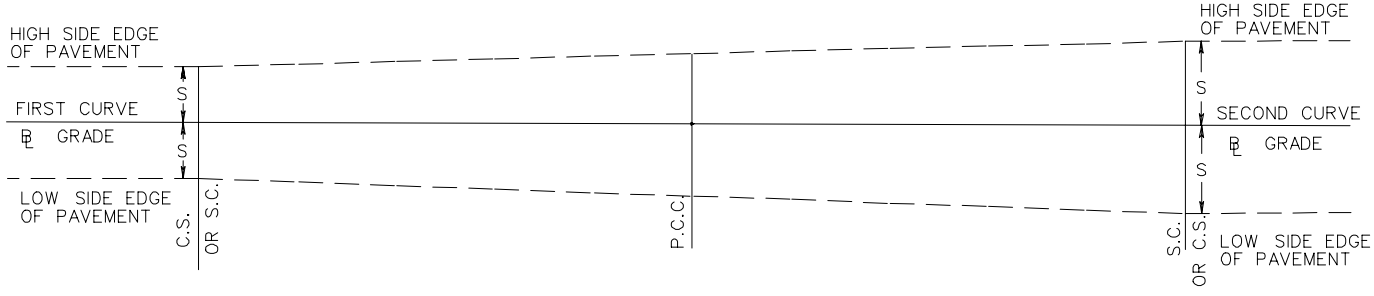
SPECIFICATION REFERENCE

REV. 1/07

802.12



PLAN



PROFILE

NOTE:

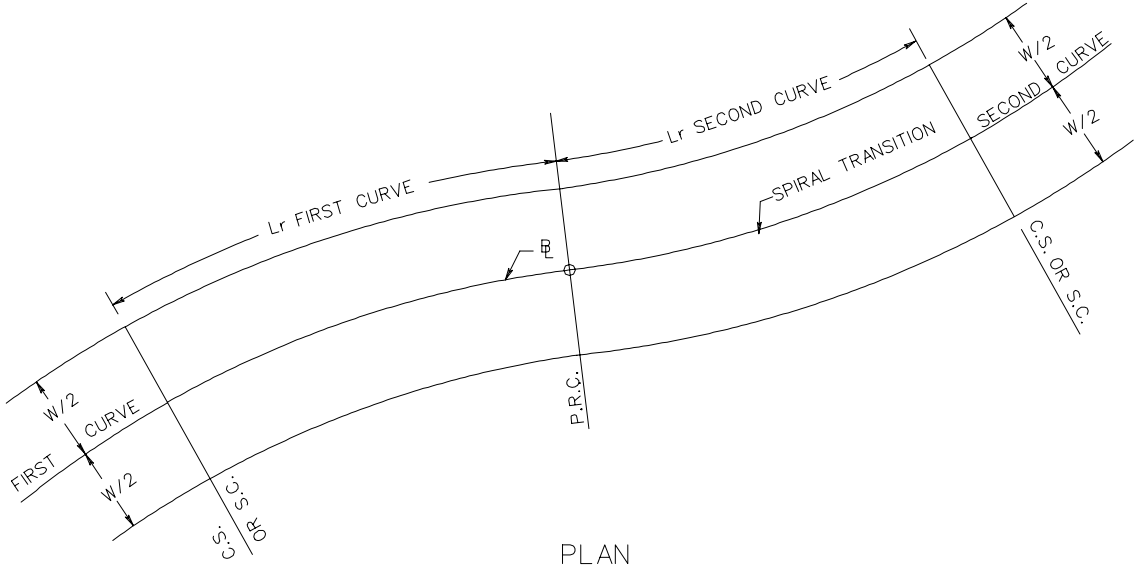
1. FOR COMPOUND CURVES ON OPEN ROADWAYS, THE RATIO OF FLATTER RADIUS (R1) TO THE SHARPER RADIUS (R2) SHALL NOT EXCEED 1.5:1. WHERE PRACTICAL, A DESIRABLE MAXIMUM RATIO OF 1.75:1 SHOULD BE USED.
2. FOR COMPOUND CURVES ON RAMPS AND AT INTERSECTIONS, THE RATIO OF THE FLATTER RADIUS (R1) TO THE SHARPER RADIUS (R2) SHALL NOT EXCEED 2:1.
3. COMPUTE SUPERELEVATION TRANSITION FROM MAXIMUM OF FIRST CURVE TO MAXIMUM OF SECOND CURVE. LENGTH OF COMPOUND SPIRAL COMPUTED PER PAGE 802.22.
4. REFER TO CHAPTER 3 OF THE AASHTO GREEN BOOK FOR ADDITIONAL COMPOUND CURVE DESIGN INFORMATION.

SPECIFICATION REFERENCE

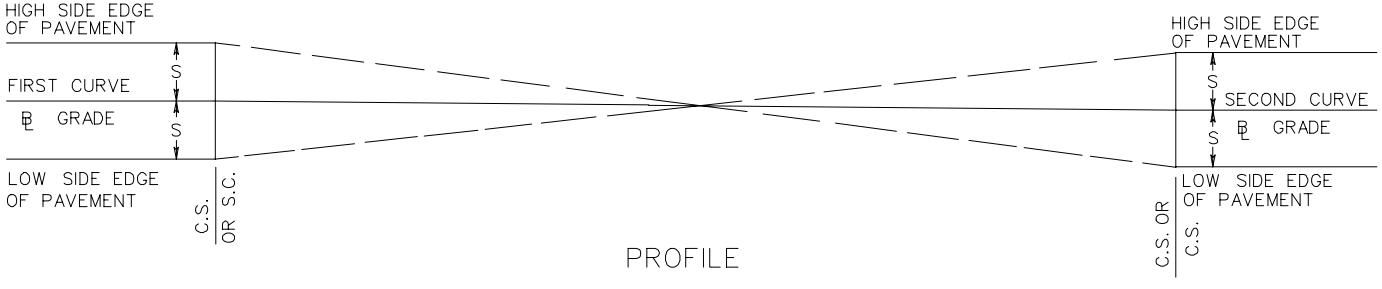
METHOD OF APPLYING TC-5.01 ON COMPOUND CURVES URBAN CONDITIONS & RURAL CONDITIONS WITHOUT PAVEMENT WIDENING

REV. 1/07

VIRGINIA DEPARTMENT OF TRANSPORTATION



PLAN



PROFILE

NOTE:

1. COMPUTE SUPERELEVATION TRANSITION FROM MAXIMUM OF FIRST CURVE TO MAXIMUM OF SECOND CURVE. LENGTH OF SUPERELEVATION RUNOFF (Lr) COMPUTED PER PAGE 802.22.

2. REFER TO CHAPTER 3 OF THE AASHTO'S A POLICY ON THE GEOMETRIC DESIGN OF HIGHWAYS AND STREETS FOR ADDITIONAL REVERSE CURVE DESIGN INFORMATION.

METHOD OF APPLYING TC-5.01 ON REVERSE CURVES URBAN CONDITIONS & RURAL CONDITIONS WITHOUT PAVEMENT WIDENING

SPECIFICATION REFERENCE

REV. 1/07

802.14

VIRGINIA DEPARTMENT OF TRANSPORTATION

TRANSITION TABLE

LENGTH OF TANGENT RUNOUT (Lt)	START/END OF SUPERELEVATION RUNOFF (Lr)	DISTANCE IN FEET FROM START/END OF SUPERELEVATION RUNOFF SECTION (Lr)				NORMAL CROWN
		1	2	3	4	
220	0	44	88	132	176	220
200	0	40	80	120	140	200
180	0	36	72	108	144	180
160	0	32	64	96	128	160
140	0	28	56	84	112	140
120	0	24	48	72	96	120
100	0	20	40	60	80	100
90	0	18	36	54	72	90
80	0	16	32	48	64	80
60	0	15	30	45	———	60
40	0	20	———	———	———	40

NOTE:

TABLE LISTS POSTIONS ON TRANSITIONS AT WHICH SLOPE STAKES SHOULD BE SET, CONSTRUCTION AND FINAL CROSS-SECTIONS TAKEN, FINE GRADING STAKES (BLUE TOP) SET, AND FORM STAKES SET (CONCRETE PAVEMENT ONLY).

CROWN TRANSITION / TANGENT RUNOUT (Lt) TABLE

VIRGINIA DEPARTMENT OF TRANSPORTATION

URBAN CONDITIONS
RURAL CONDITIONS WITHOUT PAVEMENT WIDENING

FOR USE WITH FLEXIBLE AND CONCRETE PAVEMENT

(Lr POSITIONED 2/3 ±ON TANGENT, 1/3 ±ON CURVE)

LENGTH OF SUPERELEVATION RUNOFF (Lr)	END/ BEGIN TANGENT RUNOUT (Lt)	DISTANCE IN FEET FROM P.C. OR P.T. ON TANGENT						P.C. OR P.T.	DISTANCE IN FEET FROM P.C. OR P.T. ON CURVE			FULL SUPER ELEVATION (E)
		1	2	3	4	5	6		7	8	9	
480	320	272	224	176	128	80	32	STAKE	16	64	112	160
460	307	261	215	169	123	77	31	STAKE	15	61	107	153
440	293	249	205	161	117	73	29	STAKE	15	59	103	147
420	280	238	196	154	112	70	28	STAKE	14	56	98	140
400	267	227	187	147	107	67	27	STAKE	13	53	93	133
380	253	215	177	139	101	63	25	STAKE	13	51	89	127
360	240	204	168	132	96	60	24	STAKE	12	48	84	120
340	227	193	159	125	91	57	23	STAKE	11	45	79	113
320	213	181	149	117	85	53	21	STAKE	11	43	75	107
300	200	170	140	110	80	50	20	STAKE	10	40	70	100
280	187	159	131	103	75	47	19	STAKE	9	37	65	93
260	173	147 *	121	95 *	69	43 *	17	STAKE *	9	35 *	61	87
240	160	136 *	112	88 *	64	40 *	16	STAKE *	8	32 *	56	80
220	147	125 *	103	81 *	59	37 *	15	STAKE *	7	29 *	51	73
200	133	113 *	93	73 *	53	33 *	13	STAKE *	7	27 *	47	67
180	120	102 *	84	66 *	48	30 *	12	STAKE *	6	24 *	42	60
160	107	91 *	75	59 *	43	27 *	11	STAKE *	5	21 *	37	53

NOTE :

TABLE GIVING POSITIONS ON CURVES AT WHICH SLOPE STAKES SHOULD BE SET, CONSTRUCTION AND FINAL CROSS-SECTIONS TAKEN, FINE GRADING STAKES (BLUE TOP) SET, AND FORM STAKES SET (CONCRETE PAVEMENT ONLY).

* DENOTES ADDITIONAL STAKING POSITIONS FOR USE WITH CONCRETE PAVEMENT ONLY.

TABLE I

VIRGINIA DEPARTMENT OF TRANSPORTATION

TC-5.01

RURAL CONDITIONS WITH PAVEMENT WIDENING

FOR USE WITH FLEXIBLE AND CONCRETE PAVEMENT

LENGTH OF SUPERELEVATION RUNOFF (Lr)	T.S. OR S.T.	DISTANCE IN FEET FROM T.S. OR S.T. ALONG SPIRAL TRANSITION									S.C. OR C.S.
		1	2	3	4	5	6	7	8	9	
480	0	48	96	144	192	240	288	336	384	432	480
460	0	46	92	138	184	230	276	322	368	414	460
440	0	44	88	132	176	220	264	308	352	396	440
420	0	42	84	126	168	210	252	294	336	378	420
400	0	40	80	120	160	200	240	280	320	360	400
380	0	38	76	114	152	190	228	266	304	342	380
360	0	36	72	108	144	180	216	252	288	324	360
340	0	34	68	102	136	170	204	238	272	306	340
320	0	32	64	96	128	160	192	224	256	288	320
300	0	30	60	90	120	150	180	210	240	270	300
280	0	28	56	84	112	140	168	196	224	252	280
260	0	26 *	52	78 *	104	130 *	156	182 *	208	234 *	260
240	0	24 *	48	72 *	96	120 *	144	168 *	192	216 *	240
220	0	22 *	44	66 *	88	110 *	132	154 *	176	198 *	220
200	0	20 *	40	60 *	80	100 *	120	140 *	160	180 *	200
180	0	18 *	36	54 *	72	90 *	108	126 *	144	162 *	180
160	0	16 *	32	48 *	64	80 *	96	112 *	128	144 *	160

NOTE :

TABLE GIVING POSITIONS ON TRANSITION CURVES AT WHICH SLOPE STAKES SHOULD BE SET, CONSTRUCTION AND FINAL CROSS-SECTIONS TAKEN, FINE GRADING STAKES (BLUE TOP) SET, AND FORM STAKES SET (CONCRETE PAVEMENT ONLY).

* DENOTES ADDITIONAL STAKING POSITIONS FOR USE WITH CONCRETE PAVEMENT ONLY.

TABLE 2

VIRGINIA DEPARTMENT OF TRANSPORTATION

REV. 1/07

802.18

LEGEND

C- RATE OF CHANGE OF SIDE FRICTION (f) IN FT./SEC.^{3}

e- SUPERELEVATION RATE.

f- FRICTION FACTOR.

Lr- LENGTH OF SUPERELEVATION RUNOFF SECTION.

Lt- LENGTH OF TANGENT RUNOUT SECTION.

R- RADIUS OF CURVE.

DV- DESIGN VELOCITY UTILIZING SUPERELEVATION.

NC- MAXIMUM VELOCITY WITH NO SUPERELEVATION (NORMAL CROWN).

URBAN LOW SPEED DESIGN TABLE

DV/NC (MPH)	MAX. f	C	MIN. Lr (FEET)
45	0.161	2.75	125
40	0.178	3.00	115
35	0.197	3.25	100
30	0.221	3.50	90
25	0.252	3.75	80
20	0.300	4.00	75

FRICTION FACTORS (f) FOR ODD VELOCITIES NOT LISTED SHOULD BE DERIVED BY INTERPOLATION.

FOR Lr LENGTHS FOR INTERMEDIATE VELOCITIES NOT LISTED IN TABLE USE THE Lr FOR NEAREST VELOCITY IN TABLE.

GENERAL DESIGN CONSIDERATIONS

1. WHEN "URBAN LOW SPEED" DESIGNS UTILIZE SUPERELEVATION, THEY WILL BE SUPERELEVATED BY AN AMOUNT EQUAL TO THE NORMAL CROWN (TYPICALLY 2.0%) AND THE APPROXIMATE MAXIMUM SAFE SPEED (DV) AFFORDED THEREBY.
2. WHEN "URBAN LOW SPEED" DESIGNS UTILIZE NO SUPERELEVATION, THE APPROXIMATE MAXIMUM SAFE SPEED (NC) IS CALCULATED USING A NEGATIVE NORMAL CROWN (TYPICALLY -2.0 %).
3. WHEN THE CURVE IS SUPERELEVATED, THE Lr IS APPLIED IN THE SAME MANNER AS IN URBAN CONDITIONS WITH THE TANGENT RUNOUT (Lt) BEING EQUAL TO THE Lr VALUE. THE TANGENT RUNOUT (Lt) IS ALWAYS ACHIEVED OUTSIDE OF THE SUPERELEVATION RUNOFF SECTION(Lr).
4. PLEASE NOTE THAT THE RADIUS VALUES LISTED ON PAGE 802.24 HAVE BEEN ROUNDED UP TO THE NEAREST FOOT.

EXAMPLES

DV = 21 mph

e = $^{+}$2.0 %

f = MAX f $\pm$ INTERPOLATED DIFFERENCE BETWEEN LISTED FRICTION FACTORS

f = 0.300-[1/5(0.300-0.252)]=0.2904 (ROUND TO 0.29)

Lr = 47.2 f DV/C

Lr = 47.2(0.29)(21)/4=71.862 FT.

71.862 <90 THEREFORE Lr=90 FT.

Rmin. = DV^2/15(e+f)

Rmin. = $(21)^2$/15(0.02 + 0.29)=94.83870968 FT.

NC = 37 mph

e = −2.0 %

f = MAX f $\pm$ INTERPOLATED DIFFERENCE BETWEEN LISTED FRICTION FACTORS

f = 0.197-[2/5(0.197-0.178)]=0.1894 (ROUND TO 0.189)

Rmin. = NC^2/15(-e + f)

Rmin. = $(37)^2$/15(-0.02 + 0.189)=540.0394477 FT.

METHODOLOGIES FOR CALCULATING TC-5.01 VALUES FOR URBAN LOW-SPEED STREETS

VIRGINIA DEPARTMENT OF TRANSPORTATION

URBAN LOW SPEED DESIGN TABLE						
DV/NC (MPH)	45	40	35	30	25	20
MAX. f	0.150	0.160	0.180	0.200	0.230	0.270

FRICTION FACTORS (f) FOR ODD VELOCITIES NOT LISTED SHOULD BE DERIVED BY INTERPOLATION.

LEGEND

e- SUPERELEVATION RATE.

f- FRICTION FACTOR.

Lr- LENGTH OF SUPERELEVATION RUNOFF SECTION.

Lt- LENGTH OF TANGENT RUNOUT SECTION.

R- RADIUS OF CURVE.

DV- DESIGN VELOCITY UTILIZING SUPERELEVATION.

NC- MAXIMUM VELOCITY WITH NO SUPERELEVATION (NORMAL CROWN).

GENERAL DESIGN CONSIDERATIONS

1. WHEN "URBAN LOW SPEED" DESIGNS UTILIZE SUPERELEVATION, THEY WILL BE SUPERELEVATED BY AN AMOUNT EQUAL TO THE NORMAL CROWN (TYPICALLY 2.0%) AND THE APPROXIMATE MAXIMUM SAFE SPEED (DV) AFFORDED THEREBY.

2. WHEN "URBAN LOW SPEED DESIGN" WITH NO SUPERELEVATION, THE APPROXIMATE MAXIMUM SAFE SPEED (NC) IS CALCULATED USING A NEGATIVE NORMAL CROWN (TYPICALLY -2.0 %).

3. WHEN THE CURVE IS SUPERELEVATED, THE Lr IS APPLIED IN THE SAME MANNER AS IN URBAN CONDITIONS WITH THE TANGENT RUNOUT (Lt) BEING EQUAL TO THE Lr VALUE. THE TANGENT RUNOUT (Lt) IS ALWAYS ACHIEVED OUTSIDE OF THE SUPERELEVATION RUNOFF (Lr).

4. PLEASE NOTE THAT THE RADIUS VALUES LISTED ON PAGE 802.24A HAVE BEEN ROUNDED UP TO THE NEAREST FOOT.

EXAMPLES

DV = 21 mph

e = +2.0 %

f = MAX f ± INTERPOLATED DIFFERENCE BETWEEN LISTED FRICTION FACTORS

f = 0.270-[1/5(0.270-0.230)]=0.262

Rmin. = $DV^2/15(e + f)$

Rmin. = $(21)^2/15(0.02 + 0.262)$=104.2553191 FT.

NC = 37 mph

e = −2.0 %

f = MAX f ± INTERPOLATED DIFFERENCE BETWEEN LISTED FRICTION FACTORS

f = 0.18-[2/5(0.18-0.16)]=0.172

Rmin. = $NC^2/15(-e + f)$

Rmin. = $(37)^2/15(-0.02 + 0.172)$=600.4385965 FT.

METHODOLOGIES FOR CALCULATING TC-5.04 VALUES FOR URBAN LOW-SPEED STREETS

VIRGINIA DEPARTMENT OF TRANSPORTATION

TC-5.01

CURVE WIDENING TABLES

SU DESIGN VEHICLE

COMPONENT	SIZE
OVERALL WIDTH (u)	8.0 ft
WHEELBASE (L)	20 ft
FRONT OVERHANG (A)	4 ft

LATERAL CLEARANCE

LANE WIDTH	CLEARANCE (C)
9 ft	1.5 ft
10 ft	2 ft
11 ft	2.5 ft
12 ft	3 ft
16 ft	5 ft

ADJUSTMENT FACTORS

NUMBER OF LANES ROTATED n_1	ADJUSTMENT FACTOR (b_w)
1	1.00
1.5	0.8333
2	0.75
2.5	0.70
3	0.6667
3.5	0.6425

RELATIVE GRADIENTS

DESIGN SPEED V_D MPH	MAXIMUM RELATIVE GRADIENT (rg)	MIN. TRANSITION LENGTH IN FEET RURAL CONDITIONS WITH PAVEMENT WIDENING AND REVERSE CURVES FOR ALL CONDITIONS (2 SECOND RULE)
20	0.74	59
25	0.70	74
30	0.66	88
35	0.62	103
40	0.58	117
45	0.54	132
50	0.50	147
55	0.47	161
60	0.45	176
65	0.43	191
70	0.40	205

A - FRONT OVERHANG OF DESIGN VEHICLE FROM APPROPRIATE TABLE.

bw - ADJUSTMENT FACTOR FROM TABLE.

C - LATERAL CLEARANCE OF DESIGN VEHICLE FROM APPROPRIATE TABLE.

E - SUPERELEVATION RATE FROM APPROPRIATE TABLE.

F_A - CALCULATED WIDTH OF OVERHANG FOR DESIGN VEHICLE.

L - WHEELBASE OF DESIGN VEHICLE FROM APPROPRIATE TABLE.

Lr - LENGTH OF SUPERELEVATION RUNOFF SECTION.

DEFINITIONS

Lt - LENGTH OF TANGENT RUNOUT SECTION

M - MULTIPLE LANE FACTOR.

N - NUMBER OF LANES.

n_1 - NUMBER OF LANES ROTATED (FROM TABLES).

Pw - PAVEMENT WIDTH.

R - RADIUS OF CURVE.

rg - RELATIVE GRADIENT FROM APPROPRIATE TABLE.

U - CALCULATED TRACK WIDTH OF DESIGN VEHICLE.

u - TRACK WIDTH OF DESIGN VEHICLE FROM APPROPRIATE TABLE.

V_D - DESIGN VELOCITY.

w - CALCULATED WIDENING.

W - PAVEMENT WIDTH

W_C - CALCULATED TOTAL CURVE WIDTH.

W_n - WIDTH OF LANE.

Z - CALCULATED EXTRA WIDTH ALLOWANCE.

GENERAL DESIGN CONSIDERATIONS

1. WHERE PAVEMENT WIDENING IS REQUIRED, THE APPROPRIATE WIDENING IS ADDED TO THE LANE WIDTH WHEN CALCULATING THE SUPERELEVATION RUNOFF LENGTH (Lr).
2. THE COMPUTED SUPERELEVATION RUNOFF LENGTH (Lr) IS ROUNDED UP TO THE NEAREST FOOT.
3. WHEN THE SUPERELEVATION RUNOFF LENGTH (Lr) IS CALCULATED, IT MUST BE COMPARED WITH THE MINIMUM VALUE LISTED IN THE APPROPRIATE COLUMN ON THE RELATIVE GRADIENT TABLE.
4. TANGENT RUNOUT (Lt) IS ALWAYS ACHIEVED OUTSIDE OF THE SUPERELEVATION RUNOFF SECTION (Lr).
5. NO PAVEMENT WIDENING IS REQUIRED FOR URBAN ROADWAYS.
6. NO PAVEMENT WIDENING IS REQUIRED FOR RURAL ROADWAYS WITH A CURVE RADIUS GREATER THAN 2865 FEET.
7. NO PAVEMENT WIDENING IS REQUIRED FOR RURAL ROADWAYS WITH 12 FOOT WIDE LANES AND A CURVE RADIUS GREATER THAN 881 FEET.
8. PAVEMENT WIDENING IS APPLIED ONLY WHEN CALCULATED WIDENING (w) IS EQUAL TO OR GREATER THAN 2 FEET.
9. WHEN CALCULATING WIDENING (w) FOR MULTI-LANE RURAL ROADWAYS, WIDENING IS FIRST CALCULATED USING THE SINGLE LANE WIDTH FOR "W".
10. AN ALTERNATE METHOD FOR MULTI-LANE UNDIVIDED PAVEMENTS (48'). THE Lr IS 1.5 TIMES (M=1.5) THE CORRESPONDING LENGTH FOR TWO LANE HIGHWAYS; AND FOR SIX LANE UNDIVIDED PAVEMENTS (72'), THE Lr IS TWO TIMES (M=2) THE CORRESPONDING LENGTH FOR TWO LANE HIGHWAYS.
11. CALCULATED WIDENING IS ROUNDED UP TO THE NEAREST 0.1 FOOT.
12. CURVES WITH SPIRAL CURVE TRANSITIONS MUST HAVE A MINIMUM SUPERELEVATION RUNOFF LENGTH (Lr) EQUAL TO 2 SECONDS OF TRAVEL TIME AT THE ROADWAY'S DESIGN SPEED AS NOTED IN THE RELATIVE GRADIENT TABLE.

NO WIDENING REQUIRED FORMULAS USED TO CALCULATE SUPERELEVATION RUNOFF (Lr) AND WIDENING (w)

$Lr = b_w (W_n \, E/rg)$

$Lr = M(WE/rg)$ (ALT. MULTI-LANE)

WIDENING REQUIRED

$Lr = b_w [E \, n_1 (W_n + w/N)/rg]$

$Lr = m[E(W + w/N)/rg]$ (ALT. MULTI-LANE)

$U = u + R - \sqrt{R^2 - L^2}$

$F_a = \sqrt{R^2 + A(2L + A)} - R$

$Z = (V_D / \sqrt{R})$

$W_C = N(U + C) + F_A + Z$

$w = W_C - 2W_n$

FOR SOLVED PROBLEMS USING THIS METHODOLOGY, SEE THE EXAMPLES ON PAGE 802.23

METHODOLOGIES FOR CALCULATING TC-5.01 VALUES

RURAL EXAMPLE

20 FT PAVEMENT WIDTH
(DESIGN SOFTWARE - 1 LANE AT 10 FT)

$V_D = 50$ MPH R = 1000 FT
$W_n = 10$ FT rg = 0.50
E = 7.6 (7.6% PER 802.40)

$$U = u + R - \sqrt{R^2 - L^2}$$
$$U = 8.0 + 1000 - \sqrt{(1000)^2 - (20)^2}$$
$$U = 8.20002$$

$$F_A = \sqrt{R^2 + A\,(2L + A)} - R$$
$$F_A = \sqrt{(1000)^2 + 4[\,2(20) + 4]} - 1000$$
$$F_A = .087996$$

$$Z = (V_D / \sqrt{R})$$
$$Z = (50 / \sqrt{1000})$$
$$Z = 1.58$$

$$W_C = N\,(U + C) + F_A + Z$$
$$W_C = 2(8.20002 + 2) + 0.087996 + 1.58$$
$$W_C = 22.0680$$

$$w = W_C - 2W_n = 22.0680 - 2(10) = 2.1$$

(R<2865 & w>2 THEREFORE WIDENING IS REQUIRED)

$$Lr = [E\ n_1 (W_n + w/2) / rg\ ]\ b_w$$
$$Lr = [7.6(1)(10 + 2.1/2) / 0.50]\ 1$$
$$Lr = 7.6\ (11.05)/0.50$$
$$Lr = 167.96$$

RURAL EXAMPLE

72 FT PAVEMENT WIDTH
(DESIGN SOFTWARE - 3 LANES AT 12 FT)

$V_D = 40$ MPH R = 500 FT
$W_n = 12$ FT rg = 0.58
E = 8.0 (8% PER PAGE 802.38)

$$U = u + R - \sqrt{R^2 - L^2}$$
$$U = 8.0 + 500 - \sqrt{(500)^2 - (20)^2}$$
$$U = 8.4002$$

$$F_A = \sqrt{R^2 + A\,(2L + A)} - R$$
$$F_A = \sqrt{(500)^2 + 4[\,2(20) + 4]} - 500$$
$$F_A = .1760$$

$$Z = (V_D / \sqrt{R})$$
$$Z = (40 / \sqrt{500})$$
$$Z = 1.7885$$

$$W_C = 2\,(U + C) + F_A + Z$$
$$W_C = 2(8.4002 + 3.0) + .1760 + 1.7885$$
$$W_C = 24.7651$$

$$w = W_C - 2W_n = 24.7651 - 2(12) = 0.7651(0.8)$$

FOR 72' PAVEMENT WIDTH
$w = 3(0.8) = 2.4$

(R<881 & w>2 THEREFORE WIDENING IS REQUIRED)

$$Lr = [E\ n_1 (W_n + w/3) / rg]\ b_w$$
$$Lr = [8\ (3)\ (12 + 2.4/3) / 0.58]\ 0.6667$$
$$Lr = (307.2/0.58)\ 0.6667$$
$$Lr = 353.1211$$

OR

$$Lr = M[E(W_n + w/N)/rg]$$
$$Lr = 2\ [8(12 + 4.5/3) / 0.58]$$
$$Lr = 2\ (102.4/0.58)$$
$$Lr = 353.1034$$

URBAN EXAMPLES

24 FT PAVEMENT WIDTH
(DESIGN SOFTWARE - 1 LANE AT 12 FT)

$V_D = 40$ MPH R = 600 FT
$W_n = 12$ FT rg = 0.58
E = 4.0 (4% PER PAGE 802.29)

$$Lr = (W_n\ n_1\ E/rg)\ b_w$$
$$Lr = [12(1)(4)/0.58]\ 1.00$$
$$Lr = (48/.058)$$
$$Lr = 82.7586$$

66 FT PAVEMENT WIDTH
(DESIGN SOFTWARE - 3 LANES AT 11 FT)

$V_D = 40$ MPH R = 600 FT
$W_n = 11$ FT rg = 0.58
E = 4.0 (4% PER PAGE 802.29)

$$Lr = b_w\ (W_n\ n_1 E/rg)$$
$$Lr = 0.6667\ [11(3)(4)/\ 0.58]$$
$$Lr = 0.6667\ (132/0.58)$$
$$Lr = 151.7317$$

OR

$$Lr = M\ (E\ W_n/rg)$$
$$Lr = 2\ [4(11)/\ 0.58]$$
$$Lr = 2\ (44/0.58)$$
$$Lr = 151.7241$$

CALCULATED TC-5.01 EXAMPLES

VIRGINIA DEPARTMENT OF TRANSPORTATION

MINIMUM RADII AND SUPERELEVATION RUNOFF SECTION (Lr) LENGTHS FOR 2% SUPERELEVATION

RADIUS (FEET)	E (%)	F	DV (MPH)	Lr (FEET)	
				PAVEMENT WIDTH (W)	
				W ≤ 72 FT.	W > 72 FT
>738	2.0	.163	45	126	NOTE: FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY THE DESIGN SOFTWARE.
539	2.0	.178	40	113	
377	2.0	.197	35	101	
249	2.0	.221	30	90	
154	2.0	.252	25	80	
84	2.0	.300	20	75	

MINIMUM RADII FOR DESIGNS UTILIZING NORMAL PAVEMENT CROWN

RADIUS (FEET)	F	NC (MPH)
> 945	.163	45
676	.178	40
462	.197	35
299	.221	30
180	.252	25
96	.300	20

SUMMARY OF STD. TC-5.01 ULS (URBAN-LOW SPEED) DESIGN FACTORS

MINIMUM RADII AND SUPERELEVATION RUNOFF SECTION LENGTHS (Lr) FOR +2% SUPERELEVATION

RADIUS (FEET)	E (%)	f	DV (MPH)	LENGTH OF SUPERELEVATION RUNOFF (Lr) IN FEET						
				PAVEMENT WIDTH (W)						W > 72'
				24' (1@12')	36' (1.5@12')	48' (2@12')	60' (3@10')	66' (3@11')	72' (3@12')	
> 795	2.0	0.150	45	45	56	67	75	82	90	*
593	2.0	0.160	40	42	52	63	70	77	84	*
408	2.0	0.180	35	39	49	59	65	72	78	*
273	2.0	0.200	30	37	46	55	61	67	74	*
167	2.0	0.230	25	35	43	52	58	64	69	*
92	2.0	0.270	20	33	41	49	55	60	66	*

* FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY THE DESIGN SOFTWARE.

MINIMUM RADII FOR DESIGNS UTILIZING -2% SUPERELEVATION NORMAL PAVEMENT CROWN

RADIUS (FEET)	f	NC (MPH)
> 1039	.150	45
762	.160	40
510	.180	35
333	.200	30
198	.230	25
107	.270	20

SUMMARY OF STD. TC-5.04 ULS (URBAN-LOW SPEED) DESIGN FACTORS

DESIGN FACTORS FOR A DESIGN SPEED OF 20 MPH (URBAN) USING E= 4% MAX.

RADIUS (FEET)	E (%)	PAVEMENT WIDTH											
		24 FT		36 FT		48 FT		60 FT		66 FT		72 FT	
		DESIGN SOFTWARE EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)											
		1 @ 12'		1.5 @ 12'		2 @ 12'		3 @ 10'		3 @ 11'		3 @ 12'	
		Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr
1400	NC	0	0	0	0	0	0	0	0	0	0	0	0
961	2.0	33	33	41	41	49	49	55	55	60	60	65	65
884	2.1	33	35	41	43	49	52	55	57	60	63	65	69
810	2.2	33	36	41	45	49	54	55	60	60	66	65	72
735	2.3	33	38	41	47	49	56	55	63	60	69	65	75
653	2.4	33	39	41	49	49	59	55	65	60	72	65	78
578	2.5	33	41	41	51	49	61	55	68	60	75	65	82
516	2.6	33	43	41	53	49	64	55	71	60	78	65	85
464	2.7	33	44	41	55	49	66	55	73	60	81	65	88
421	2.8	33	46	41	57	49	69	55	76	60	84	65	91
383	2.9	33	48	41	59	49	71	55	79	60	87	65	95
351	3.0	33	49	41	61	49	73	55	82	60	90	65	98
322	3.1	33	51	41	63	49	76	55	84	60	93	65	101
296	3.2	33	52	41	65	49	78	55	87	60	96	65	104
273	3.3	33	54	41	67	49	81	55	90	60	99	65	108
252	3.4	33	56	41	69	49	83	55	92	60	102	65	111
232	3.5	33	57	41	71	49	86	55	95	60	105	65	114
214	3.6	33	59	41	73	49	88	55	98	60	108	65	117
196	3.7	33	60	41	75	49	90	55	100	60	110	65	120
179	3.8	33	62	41	77	49	93	55	103	60	113	65	124
160	3.9	33	64	41	79	49	95	55	106	60	116	65	127
127	4.0	33	65	41	81	49	98	55	109	60	119	65	130

NOTE:

Lt AND Lr VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY THE DESIGN SOFTWARE.

LISTED RADIUS IS THE MINIMUM ALLOWABLE RADIUS FOR THE CORRESPONDING E, Lt, AND Lr VALUES.

SPECIFICATION REFERENCE

TRANSITION CURVES - URBAN
20 MPH DESIGN SPEED

VIRGINIA DEPARTMENT OF TRANSPORTATION

TC-5.01

DESIGN FACTORS FOR A DESIGN SPEED OF 25 MPH (URBAN) USING E= 4% MAX.

RADIUS (FEET)	E (%)	PAVEMENT WIDTH											
		24 FT		36 FT		48 FT		60 FT		66 FT		72 FT	
		DESIGN SOFTWARE EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)											
		1 @ 12'		1.5 @ 12'		2 @ 12'		3 @ 10'		3 @ 11'		3 @ 12'	
		Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr
2500	NC	0	0	0	0	0	0	0	0	0	0	0	0
1407	2.0	35	35	43	43	52	52	58	58	63	63	69	69
1299	2.1	35	36	43	45	52	54	58	60	63	66	69	72
1195	2.2	35	38	43	48	52	57	58	63	63	70	69	76
1094	2.3	35	40	43	50	52	60	58	66	63	73	69	79
990	2.4	35	42	43	52	52	62	58	69	63	76	69	83
883	2.5	35	43	43	54	52	65	58	72	63	79	69	86
793	2.6	35	45	43	56	52	67	58	75	63	82	69	90
718	2.7	35	47	43	58	52	70	58	78	63	85	69	93
654	2.8	35	48	43	60	52	72	58	80	63	88	69	96
598	2.9	35	50	43	63	52	75	58	83	63	92	69	100
548	3.0	35	52	43	65	52	78	58	86	63	95	69	103
505	3.1	35	54	43	67	52	80	58	89	63	98	69	107
466	3.2	35	55	43	69	52	83	58	92	63	101	69	110
430	3.3	35	57	43	71	52	85	58	95	63	104	69	114
397	3.4	35	59	43	73	52	88	58	98	63	107	69	117
367	3.5	35	60	43	75	52	90	58	100	63	110	69	120
339	3.6	35	62	43	78	52	93	58	103	63	114	69	124
311	3.7	35	64	43	80	52	96	58	106	63	117	69	127
284	3.8	35	66	43	82	52	98	58	109	63	120	69	131
255	3.9	35	67	43	84	52	101	58	112	63	123	69	134
204	4.0	35	69	43	86	52	103	58	115	63	126	69	138

NOTE:

Lt AND Lr VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY THE DESIGN SOFTWARE.

LISTED RADIUS IS THE MINIMUM ALLOWABLE RADIUS FOR THE CORRESPONDING E, Lt, AND Lr VALUES.

REV. 1/07

802.26

TRANSITION CURVES - URBAN
25 MPH DESIGN SPEED

VIRGINIA DEPARTMENT OF TRANSPORTATION

DESIGN FACTORS FOR A DESIGN SPEED OF 30 MPH (URBAN) USING E= 4% MAX.

RADIUS (FEET)	E (%)	PAVEMENT WIDTH											
		24 FT		36 FT		48 FT		60 FT		66 FT		72 FT	
		DESIGN SOFTWARE EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)											
		1 @ 12'		1.5 @ 12'		2 @ 12'		3 @ 10'		3 @ 11'		3 @ 12'	
		Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr
3000	NC	0	0	0	0	0	0	0	0	0	0	0	0
1940	2.0	37	37	46	46	55	55	61	61	67	67	73	73
1795	2.1	37	39	46	48	55	58	61	64	67	70	73	77
1658	2.2	37	40	46	50	55	60	61	67	67	74	73	80
1525	2.3	37	42	46	53	55	63	61	70	67	77	73	84
1393	2.4	37	44	46	55	55	66	61	73	67	80	73	88
1255	2.5	37	46	46	57	55	69	61	76	67	84	73	91
1134	2.6	37	48	46	60	55	71	61	79	67	87	73	95
1030	2.7	37	50	46	62	55	74	61	82	67	90	73	99
941	2.8	37	51	46	64	55	77	61	85	67	94	73	102
863	2.9	37	53	46	66	55	80	61	88	67	97	73	106
794	3.0	37	55	46	69	55	82	61	91	67	100	73	110
732	3.1	37	57	46	71	55	85	61	94	67	104	73	113
677	3.2	37	59	46	73	55	88	61	97	67	107	73	117
627	3.3	37	60	46	75	55	90	61	100	67	110	73	120
580	3.4	37	62	46	78	55	93	61	104	67	114	73	124
537	3.5	37	64	46	80	55	96	61	107	67	117	73	128
496	3.6	37	66	46	82	55	99	61	110	67	120	73	131
457	3.7	37	68	46	85	55	101	61	113	67	124	73	135
417	3.8	37	70	46	87	55	104	61	116	67	127	73	139
375	3.9	37	71	46	89	55	107	61	119	67	130	73	142
300	4.0	37	73	46	91	55	110	61	122	67	134	73	146

NOTE:

Lt AND Lr VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY THE DESIGN SOFTWARE.

LISTED RADIUS IS THE MINIMUM ALLOWABLE RADIUS FOR THE CORRESPONDING E, Lt, AND Lr VALUES.

TRANSITION CURVES - URBAN
30 MPH DESIGN SPEED

VIRGINIA DEPARTMENT OF TRANSPORTATION

TC-5.01

DESIGN FACTORS FOR A DESIGN SPEED OF 35 MPH (URBAN) USING E= 4% MAX.

RADIUS (FEET)	E (%)	PAVEMENT WIDTH											
		24 FT		36 FT		48 FT		60 FT		66 FT		72 FT	
		DESIGN SOFTWARE EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)											
		1 @ 12'		1.5 @ 12'		2 @ 12'		3 @ 10'		3 @ 11'		3 @ 12'	
		Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	CR	Lr
4000	NC	0	0	0	0	0	0	0	0	0	0	0	0
2561	2.0	39	39	49	49	59	59	65	65	71	71	78	78
2374	2.1	39	41	49	51	59	61	65	68	71	75	78	82
2199	2.2	39	43	49	54	59	64	65	71	71	79	78	86
2031	2.3	39	45	49	56	59	67	65	75	71	82	78	90
1866	2.4	39	47	49	59	59	70	65	78	71	86	78	93
1697	2.5	39	49	49	61	59	73	65	81	71	89	78	97
1538	2.6	39	51	49	63	59	76	65	84	71	93	78	101
1403	2.7	39	53	49	66	59	79	65	88	71	96	78	105
1285	2.8	39	55	49	68	59	82	65	91	71	100	78	109
1182	2.9	39	57	49	71	59	85	65	94	71	103	78	113
1090	3.0	39	59	49	73	59	88	65	97	71	107	78	117
1008	3.1	39	60	49	75	59	90	65	100	71	110	78	120
933	3.2	39	62	49	78	59	93	65	104	71	114	78	124
865	3.3	39	64	49	80	59	96	65	107	71	118	78	128
802	3.4	39	66	49	83	59	99	65	110	71	121	78	132
743	3.5	39	68	49	85	59	102	65	113	71	125	78	136
688	3.6	39	70	49	88	59	105	65	117	71	128	78	140
634	3.7	39	72	49	90	59	108	65	120	71	132	78	144
580	3.8	39	74	49	92	59	111	65	123	71	135	78	148
522	3.9	39	76	49	95	59	114	65	126	71	139	78	151
420	4.0	39	78	49	97	59	117	65	130	71	142	78	155

NOTE:

Lt AND Lr VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY THE DESIGN SOFTWARE.

LISTED RADIUS IS THE MINIMUM ALLOWABLE RADIUS FOR THE CORRESPONDING E, Lt, AND Lr VALUES.

TRANSITION CURVES - URBAN
35 MPH DESIGN SPEED

VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE

REV. 1/07

802.28

DESIGN FACTORS FOR A DESIGN SPEED OF 40 MPH (URBAN) USING E= 4% MAX.

RADIUS (FEET)	E (%)	PAVEMENT WIDTH											
		24 FT		36 FT		48 FT		60 FT		66 FT		72 FT	
		DESIGN SOFTWARE EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)											
		1 @ 12'		1.5 @ 12'		2 @ 12'		3 @ 10'		3 @ 11'		3 @ 12'	
		Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr
5000	NC	0	0	0	0	0	0	0	0	0	0	0	0
3273	2.0	42	42	52	52	63	63	69	69	76	76	83	83
3039	2.1	42	44	52	55	63	66	69	73	76	80	83	87
2820	2.2	42	46	52	57	63	69	69	76	76	84	83	92
2612	2.3	42	48	52	60	63	72	69	80	76	88	83	96
2411	2.4	42	50	52	63	63	75	69	83	76	92	83	100
2209	2.5	42	52	52	65	63	78	69	87	76	95	83	104
2010	2.6	42	54	52	68	63	81	69	90	76	99	83	108
1839	2.7	42	56	52	70	63	84	69	94	76	103	83	112
1689	2.8	42	58	52	73	63	87	69	97	76	107	83	116
1557	2.9	42	60	52	75	63	90	69	100	76	110	83	120
1439	3.0	42	63	52	78	63	94	69	104	76	114	83	125
1332	3.1	42	65	52	81	63	97	69	107	76	118	83	129
1236	3.2	42	67	52	83	63	100	69	111	76	122	83	133
1148	3.3	42	69	52	86	63	103	69	114	76	126	83	137
1066	3.4	42	71	52	88	63	106	69	118	76	129	83	141
989	3.5	42	73	52	91	63	109	69	121	76	133	83	145
916	3.6	42	75	52	94	63	112	69	125	76	137	83	149
845	3.7	42	77	52	96	63	115	69	128	76	141	83	154
774	3.8	42	79	52	99	63	118	69	132	76	145	83	158
698	3.9	42	81	52	101	63	122	69	135	76	148	83	162
563	4.0	42	83	52	104	63	125	69	138	76	152	83	166

NOTE:

Lt AND Lr VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY THE DESIGN SOFTWARE.

LISTED RADIUS IS THE MINIMUM ALLOWABLE RADIUS FOR THE CORRESPONDING E, Lt, AND Lr VALUES.

TRANSITION CURVES - URBAN
40 MPH DESIGN SPEED

VIRGINIA DEPARTMENT OF TRANSPORTATION

TC-5.01

DESIGN FACTORS FOR A DESIGN SPEED OF 45 MPH (URBAN) USING E= 4% MAX.

RADIUS (FEET)	E (%)	PAVEMENT WIDTH											
		24 FT		36 FT		48 FT		60 FT		66 FT		72 FT	
		DESIGN SOFTWARE EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)											
		1 @ 12'		1.5 @ 12'		2 @ 12'		3 @ 10'		3 @ 11'		3 @ 12'	
		Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr
6000	NC	0	0	0	0	0	0	0	0	0	0	0	0
4076	2.0	45	45	56	56	67	67	75	75	82	82	89	89
3790	2.1	45	47	56	59	67	70	75	78	82	86	89	94
3523	2.2	45	49	56	62	67	74	75	82	82	90	89	98
3271	2.3	45	52	56	64	67	77	75	86	82	94	89	103
3029	2.4	45	54	56	67	67	80	75	89	82	98	89	107
2790	2.5	45	56	56	70	67	84	75	93	82	102	89	112
2552	2.6	45	58	56	73	67	87	75	97	82	106	89	116
2341	2.7	45	60	56	75	67	90	75	100	82	110	89	120
2155	2.8	45	63	56	78	67	94	75	104	82	115	89	125
1990	2.9	45	65	56	81	67	97	75	108	82	119	89	129
1843	3.0	45	67	56	84	67	100	75	112	82	123	89	134
1710	3.1	45	69	56	87	67	104	75	115	82	127	89	138
1589	3.2	45	72	56	89	67	107	75	119	82	131	89	143
1477	3.3	45	74	56	92	67	110	75	123	82	135	89	147
1374	3.4	45	76	56	95	67	114	75	126	82	139	89	152
1276	3.5	45	78	56	98	67	117	75	130	82	143	89	156
1184	3.6	45	80	56	100	67	120	75	134	82	147	89	160
1093	3.7	45	83	56	103	67	124	75	138	82	151	89	165
1003	3.8	45	85	56	106	67	127	75	141	82	155	89	169
905	3.9	45	87	56	109	67	130	75	145	82	159	89	174
730	4.0	45	89	56	112	67	134	75	149	82	163	89	178

NOTE:

Lt AND Lr VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY THE DESIGN SOFTWARE.

LISTED RADIUS IS THE MINIMUM ALLOWABLE RADIUS FOR THE CORRESPONDING E, Lt, AND Lr VALUES.

TRANSITION CURVES - URBAN
45 MPH DESIGN SPEED

VIRGINIA DEPARTMENT OF TRANSPORTATION

REV. 1/07

802.30

DESIGN FACTORS FOR A DESIGN SPEED OF 50 MPH (URBAN) USING E= 4 % MAX.

RADIUS (FEET)	E (%)	PAVEMENT WIDTH											
		24 FT		36 FT		48 FT		60 FT		66 FT		72 FT	
		DESIGN SOFTWARE EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)											
		1 @ 12'		1.5 @ 12'		2 @ 12'		3 @ 10'		3 @ 11'		3 @ 12'	
		Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr
8000	NC	0	0	0	0	0	0	0	0	0	0	0	0
4792	2.0	48	48	60	60	72	72	80	80	88	88	96	96
4629	2.1	48	51	60	63	72	76	80	84	88	93	96	101
4310	2.2	48	53	60	66	72	80	80	88	88	97	96	106
4010	2.3	48	56	60	69	72	83	80	92	88	102	96	111
3723	2.4	48	58	60	72	72	87	80	96	88	106	96	116
3444	2.5	48	60	60	75	72	90	80	100	88	110	96	120
3166	2.6	48	63	60	78	72	94	80	104	88	115	96	125
2911	2.7	48	65	60	81	72	98	80	108	88	119	96	130
2686	2.8	48	68	60	84	72	101	80	112	88	124	96	135
2486	2.9	48	70	60	87	72	105	80	116	88	128	96	140
2306	3.0	48	72	60	90	72	108	80	120	88	132	96	144
2143	3.1	48	75	60	93	72	112	80	124	88	137	96	149
1994	3.2	48	77	60	96	72	116	80	128	88	141	96	154
1857	3.3	48	80	60	99	72	119	80	132	88	146	96	159
1729	3.4	48	82	60	102	72	123	80	136	88	150	96	164
1608	3.5	48	84	60	105	72	126	80	140	88	154	96	168
1493	3.6	48	87	60	108	72	130	80	144	88	159	96	173
1381	3.7	48	89	60	111	72	134	80	148	88	163	96	178
1268	3.8	48	92	60	114	72	137	80	152	88	168	96	183
1146	3.9	48	94	60	117	72	141	80	156	88	172	96	188
929	4.0	48	96	60	120	72	144	80	160	88	176	96	192

NOTE:

Lt AND Lr VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY THE DESIGN SOFTWARE.

LISTED RADIUS IS THE MINIMUM ALLOWABLE RADIUS FOR THE CORRESPONDING E, Lt AND Lr VALUES.

TRANSITION CURVES - URBAN
50 MPH DESIGN SPEED

VIRGINIA DEPARTMENT OF TRANSPORTATION

TC-5.01

DESIGN FACTORS FOR A DESIGN SPEED OF 55 MPH (URBAN) USING E= 4% MAX.

RADIUS (FEET)	E (%)	PAVEMENT WIDTH											
		24 FT		36 FT		48 FT		60 FT		66 FT		72 FT	
		DESIGN SOFTWARE EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)											
		1 @ 12'		1.5 @ 12'		2 @ 12'		3 @ 10'		3 @ 11'		3 @ 12'	
		Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr
10000	NC	0	0	0	0	0	0	0	0	0	0	0	0
5995	2.0	52	52	64	64	77	77	86	86	94	94	103	103
5592	2.1	52	54	64	68	77	81	86	90	94	99	103	108
5218	2.2	52	57	64	71	77	85	86	94	94	103	103	113
4869	2.3	52	59	64	74	77	89	86	98	94	108	103	118
4538	2.4	52	62	64	77	77	92	86	103	94	113	103	123
4220	2.5	52	64	64	80	77	96	86	107	94	118	103	128
3909	2.6	52	67	64	83	77	100	86	111	94	122	103	133
3610	2.7	52	69	64	87	77	104	86	115	94	127	103	138
3343	2.8	52	72	64	90	77	108	86	120	94	132	103	143
3104	2.9	52	75	64	93	77	112	86	124	94	136	103	149
2888	3.0	52	77	64	96	77	115	86	128	94	141	103	154
2691	3.1	52	80	64	99	77	119	86	132	94	146	103	159
2510	3.2	52	82	64	103	77	123	86	137	94	150	103	164
2343	3.3	52	85	64	106	77	127	86	141	94	155	103	169
2186	3.4	52	87	64	109	77	131	86	145	94	160	103	174
2037	3.5	52	90	64	112	77	135	86	149	94	164	103	179
1895	3.6	52	92	64	115	77	138	86	154	94	169	103	184
1756	3.7	52	95	64	119	77	142	86	158	94	174	103	189
1615	3.8	52	98	64	122	77	146	86	162	94	178	103	195
1462	3.9	52	100	64	125	77	150	86	166	94	183	103	200
1190	4.0	52	103	64	128	77	154	86	171	94	188	103	205

NOTE:

Lt AND Lr VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY THE DESIGN SOFTWARE.

LISTED RADIUS IS THE MINIMUM ALLOWABLE RADIUS FOR THE CORRESPONDING E, Lt, AND Lr VALUES.

TRANSITION CURVES - URBAN
55 MPH DESIGN SPEED

VIRGINIA DEPARTMENT OF TRANSPORTATION

REV. 1/07

802.32

DESIGN FACTORS FOR A DESIGN SPEED OF 60 MPH (URBAN) USING E= 4 % MAX.

RADIUS (FEET)	E (%)	PAVEMENT WIDTH											
		24 FT		36 FT		48 FT		60 FT		66 FT		72 FT	
		DESIGN SOFTWARE EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)											
		1 @ 12'		1.5 @ 12'		2 @ 12'		3 @ 10'		3 @ 11'		3 @ 12'	
		Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr	Lt	Lr
10000	NC	0	0	0	0	0	0	0	0	0	0	0	0
7131	2.0	54	54	67	67	80	80	89	89	98	98	107	107
6663	2.1	54	56	67	70	80	84	89	94	98	103	107	112
6232	2.2	54	59	67	74	80	88	89	98	98	108	107	118
5829	2.3	54	62	67	77	80	92	89	103	98	113	107	123
5451	2.4	54	64	67	80	80	96	89	107	98	118	107	128
5092	2.5	54	67	67	84	80	100	89	112	98	123	107	134
4746	2.6	54	70	67	87	80	104	89	116	98	128	107	139
4408	2.7	54	72	67	90	80	108	89	120	98	132	107	144
4098	2.8	54	75	67	94	80	112	89	125	98	137	107	150
3818	2.9	54	78	67	97	80	116	89	129	98	142	107	155
3563	3.0	54	80	67	100	80	120	89	134	98	147	107	160
3330	3.1	54	83	67	104	80	124	89	138	98	152	107	166
3114	3.2	54	86	67	107	80	128	89	143	98	157	107	171
2913	3.3	54	88	67	110	80	132	89	147	98	162	107	176
2724	3.4	54	91	67	114	80	136	89	152	98	167	107	182
2544	3.5	54	94	67	117	80	140	89	156	98	172	107	187
2372	3.6	54	96	67	120	80	144	89	160	98	176	107	192
2202	3.7	54	99	67	124	80	148	89	165	98	181	107	198
2030	3.8	54	102	67	127	80	152	89	169	98	186	107	203
1842	3.9	54	104	67	130	80	156	89	174	98	191	107	208
1505	4.0	54	107	67	134	80	160	89	178	98	196	107	214

NOTE:

Lt AND Lr VALUES IN FEET.

FOR PAVEMENT WIDTHS GREATER THAN 72 FEET USE Lr VALUES DEVELOPED BY THE DESIGN SOFTWARE.

LISTED RADIUS IS THE MINIMUM ALLOWABLE RADIUS FOR THE CORRESPONDING E, Lt, AND Lr VALUES.

TRANSITION CURVES - URBAN
60 MPH DESIGN SPEED

VIRGINIA DEPARTMENT OF TRANSPORTATION

TRANSITION CURVES - RURAL
20 MPH DESIGN SPEED

VIRGINIA DEPARTMENT OF TRANSPORTATION

DESIGN FACTORS FOR A DESIGN SPEED OF 20 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY =20		WIDTH= 18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT			INTERCHANGE RAMPS			
		DESIGN SOFTWARE EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)															WIDTH			
		1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'			16 FT		18 FT	
RADIUS(FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	Lt	Lr
1800	NC	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0	0
1213	2.0	59	59	2.0	28	28	0.0	30	30	0.0	33	33	0.0	49	49	0.0	39	39	41	41
1148	2.1	57	59	2.1	28	29	0.0	30	32	0.0	33	35	0.0	49	52	0.0	39	40	41	43
1090	2.2	54	59	2.1	28	30	0.0	30	33	0.0	33	36	0.0	49	54	0.0	39	42	41	45
1036	2.3	52	59	2.1	28	32	0.0	30	35	0.0	33	38	0.0	49	56	0.0	39	44	41	47
987	2.4	50	59	2.2	28	33	0.0	30	36	0.0	33	39	0.0	49	59	0.0	39	46	41	49
941	2.5	48	59	2.2	28	34	0.0	30	38	0.0	33	41	0.0	49	61	0.0	39	48	41	51
899	2.6	46	59	2.3	28	36	0.0	30	39	0.0	33	43	0.0	49	64	0.0	39	50	41	53
860	2.7	44	59	2.3	28	37	0.0	30	41	0.0	33	44	0.0	49	66	0.0	39	52	41	55
824	2.8	43	59	2.3	28	38	0.0	30	42	0.0	33	46	0.0	49	69	0.0	39	54	41	57
790	2.9	41	59	2.4	28	40	0.0	30	44	0.0	33	48	0.0	49	71	0.0	39	56	41	59
759	3.0	40	59	2.4	28	41	0.0	30	45	0.0	33	49	0.0	49	73	0.0	39	58	41	61
729	3.1	39	59	2.5	28	42	0.0	30	47	0.0	33	51	0.0	49	76	0.0	39	60	41	63
701	3.2	37	59	2.5	28	44	0.0	30	48	0.0	33	52	0.0	49	78	0.0	39	61	41	65
674	3.3	36	59	2.5	28	45	0.0	30	50	0.0	33	54	0.0	49	81	0.0	39	63	41	67
650	3.4	35	59	2.6	28	46	0.0	30	51	0.0	33	56	0.0	49	83	0.0	39	65	41	69
626	3.5	34	59	2.6	28	48	0.0	30	53	0.0	33	57	0.0	49	86	0.0	39	67	41	71
604	3.6	33	59	2.7	28	49	0.0	30	54	0.0	33	59	0.0	49	88	0.0	39	69	41	73
582	3.7	32	59	2.7	28	50	0.0	30	55	0.0	33	60	0.0	49	90	0.0	39	71	41	75
562	3.8	32	59	2.8	28	52	0.0	30	57	0.0	33	62	0.0	49	93	0.0	39	73	41	77
543	3.9	31	59	2.8	28	53	0.0	30	58	0.0	33	64	0.0	49	95	0.0	39	75	41	79
524	4.0	30	59	2.9	28	55	0.0	30	60	0.0	33	66	0.0	49	98	0.0	39	77	41	81
506	4.1	29	59	2.9	28	56	0.0	30	61	0.0	33	67	0.0	49	100	0.0	39	79	41	83
489	4.2	29	60	3.0	30	63	2.0	30	63	0.0	33	69	0.0	49	103	0.0	39	80	41	85
473	4.3	29	62	3.0	30	64	2.0	30	64	0.0	33	70	0.0	49	105	0.0	39	82	41	87
457	4.4	29	63	3.0	30	66	2.0	30	66	0.0	33	72	0.0	49	108	0.0	39	84	41	89
442	4.5	29	65	3.1	31	68	2.1	30	67	0.0	33	73	0.0	49	110	0.0	39	86	41	92
427	4.6	29	66	3.2	30	69	2.2	30	69	0.0	33	75	0.0	49	112	0.0	39	88	41	94
413	4.7	29	68	3.2	31	71	2.2	30	70	0.0	33	77	0.0	49	115	0.0	39	90	41	96
399	4.8	30	70	3.3	31	73	2.3	30	72	0.0	33	78	0.0	49	117	0.0	39	92	41	98
385	4.9	29	71	3.3	31	74	2.3	30	73	0.0	33	80	0.0	49	120	0.0	39	94	41	100
372	5.0	30	73	3.4	31	76	2.4	30	75	0.0	33	82	0.0	49	122	0.0	39	96	41	102
358	5.1	30	75	3.5	31	78	2.5	30	76	0.0	33	83	0.0	49	125	0.0	39	98	41	104
345	5.2	30	76	3.5	31	80	2.5	30	78	0.0	33	85	0.0	49	127	0.0	39	100	41	106
332	5.3	30	78	3.6	31	81	2.6	30	79	0.0	33	86	0.0	49	129	0.0	39	101	41	108
320	5.4	30	80	3.7	31	83	2.7	30	81	0.0	33	88	0.0	49	132	0.0	39	103	41	110
308	5.5	30	82	3.8	31	85	2.8	30	82	0.0	33	90	0.0	49	134	0.0	39	105	41	112
297	5.6	30	83	3.9	32	87	2.9	30	84	0.0	33	91	0.0	49	137	0.0	39	107	41	114
286	5.7	30	85	3.9	32	89	2.9	30	85	0.0	33	93	0.0	49	139	0.0	39	109	41	116
276	5.8	30	87	4.0	32	91	3.0	33	95	2.0	33	95	0.0	53	153	2.0	39	111	41	118
266	5.9	31	89	4.1	32	93	3.1	33	97	2.1	33	96	0.0	54	157	2.2	39	113	41	120
258	6.0	30	90	4.2	32	95	3.2	33	99	2.2	33	98	0.0	54	161	2.4	39	115	41	122
248	6.1	31	92	4.3	32	97	3.3	34	101	2.3	33	99	0.0	55	165	2.6	39	117	41	124
240	6.2	31	94	4.4	32	99	3.4	34	103	2.4	33	101	0.0	55	169	2.8	39	119	41	126
232	6.3	31	96	4.5	33	101	3.5	34	105	2.5	33	103	0.0	55	173	3.0	39	120	41	128
225	6.4	31	98	4.6	33	103	3.6	34	107	2.6	33	104	0.0	56	177	3.2	39	122	41	130
217	6.5	31	100	4.7	33	105	3.7	34	109	2.7	33	106	0.0	56	181	3.4	39	124	41	132
209	6.6	31	102	4.8	33	107	3.8	34	111	2.8	33	108	0.0	57	185	3.6	39	126	41	134
202	6.7	32	104	4.9	33	109	3.9	34	113	2.9	33	109	0.0	57	189	3.8	39	128	41	136
196	6.8	32	106	5.0	33	111	4.0	34	115	3.0	36	120	2.0	57	193	4.0	39	130	41	138
189	6.9	32	108	5.1	33	113	4.1	35	118	3.1	36	122	2.1	58	198	4.2	39	132	41	140
183	7.0	32	110	5.2	33	115	4.2	35	120	3.2	36	124	2.2	58	202	4.4	39	134	41	142
176	7.1	32	112	5.3	33	117	4.3	35	122	3.3	36	127	2.3	59	206	4.6	39	136	41	144
170	7.2	32	115	5.5	34	120	4.5	35	125	3.5	36	129	2.5	59	212	5.0	39	138	41	146
164	7.3	33	117	5.6	34	122	4.6	35	127	3.6	37	132	2.6	60	217	5.2	39	140	41	148
158	7.4	33	119	5.8	34	124	4.8	35	129	3.8	37	134	2.8	60	222	5.6	39	141	41	150
152	7.5	33	122	5.9	34	127	4.9	36	132	3.9	37	137	2.9	61	227	5.8	39	143	41	152
146	7.6	33	124	6.1	34	129	5.1	36	135	4.1	37	140	3.1	62	233	6.2	39	145	41	154
139	7.7	33	127	6.3	35	132	5.3	36	137	4.3	38	143	3.3	63	239	6.6	39	147	41	156
132	7.8	34	130	6.5	35	135	5.5	36	140	4.5	38	145	3.5	64	246	7.0	39	149	41	158
124	7.9	34	133	6.8	35	138	5.8	37	144	4.8	38	149	3.8	65	254	7.6	39	151	41	160
108	8.0	35	139	7.6	36	144	6.6	38	150	5.6	39	155	4.6	68	270	9.2	39	153	41	162

NOTE:
Lt, Lr & w VALUES IN FEET. LISTED RADIUS IS THE MINIMUM ALLOWABLE RADIUS FOR THE CORRESPONDING E, Lt, Lr, AND w VALUES.

SPECIFICATION REFERENCE

SPECIFICATION REFERENCE

DESIGN FACTORS FOR A DESIGN SPEED OF 25 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY =25		WIDTH= 18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT			INTERCHANGE RAMPS WIDTH			
		DESIGN SOFTWARE EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)																		
		1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'			16 FT		18 FT	
RADIUS(FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	Lt	Lr
2500	NC	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0	0
1756	2.0	26	26	0.0	29	29	0.0	32	32	0.0	35	35	0.0	52	52	0.0	40	40	43	43
1664	2.1	71	74	2.0	29	30	0.0	32	33	0.0	35	36	0.0	52	54	0.0	40	42	43	45
1579	2.2	68	74	2.0	29	32	0.0	32	35	0.0	35	38	0.0	52	57	0.0	40	44	43	48
1502	2.3	65	74	2.0	29	33	0.0	33	37	0.0	35	40	0.0	52	60	0.0	40	46	43	50
1431	2.4	62	74	2.1	29	35	0.0	32	38	0.0	35	42	0.0	52	62	0.0	40	48	43	52
1366	2.5	60	74	2.1	29	36	0.0	32	40	0.0	35	43	0.0	52	65	0.0	40	50	43	54
1306	2.6	57	74	2.1	29	38	0.0	32	41	0.0	35	45	0.0	52	67	0.0	40	52	43	56
1250	2.7	55	74	2.1	29	39	0.0	32	43	0.0	35	47	0.0	52	70	0.0	40	54	43	58
1198	2.8	53	74	2.2	29	40	0.0	32	44	0.0	35	48	0.0	52	72	0.0	40	56	43	60
1149	2.9	52	74	2.2	29	42	0.0	32	46	0.0	35	50	0.0	52	75	0.0	40	58	43	63
1104	3.0	50	74	2.2	29	43	0.0	32	48	0.0	35	52	0.0	52	78	0.0	40	60	43	65
1061	3.1	48	74	2.3	29	45	0.0	32	49	0.0	35	54	0.0	52	80	0.0	40	62	43	67
1021	3.2	47	74	2.3	29	46	0.0	32	51	0.0	35	55	0.0	52	83	0.0	40	64	43	69
983	3.3	45	74	2.3	29	48	0.0	32	52	0.0	35	57	0.0	52	85	0.0	40	66	43	71
948	3.4	44	74	2.4	29	49	0.0	32	54	0.0	35	59	0.0	52	88	0.0	40	68	43	73
914	3.5	43	74	2.4	29	50	0.0	32	55	0.0	35	60	0.0	52	90	0.0	40	70	43	75
882	3.6	42	74	2.4	29	52	0.0	32	57	0.0	35	62	0.0	52	93	0.0	40	72	43	78
852	3.7	40	74	2.5	29	53	0.0	32	59	0.0	35	64	0.0	52	96	0.0	40	74	43	80
823	3.8	39	74	2.5	29	55	0.0	32	60	0.0	35	66	0.0	52	98	0.0	40	76	43	82
795	3.9	38	74	2.6	29	56	0.0	32	62	0.0	35	67	0.0	52	101	0.0	40	78	43	84
769	4.0	37	74	2.6	29	58	0.0	32	63	0.0	35	69	0.0	52	103	0.0	40	80	43	86
744	4.1	37	74	2.6	29	59	0.0	32	65	0.0	35	71	0.0	52	106	0.0	40	82	43	88
720	4.2	36	74	2.7	29	60	0.0	32	66	0.0	35	72	0.0	52	108	0.0	40	84	43	90
696	4.3	35	74	2.7	29	62	0.0	32	68	0.0	35	74	0.0	52	111	0.0	40	86	43	93
674	4.4	34	74	2.7	29	63	0.0	32	70	0.0	35	76	0.0	52	114	0.0	40	88	43	95
652	4.5	33	74	2.8	29	65	0.0	32	71	0.0	35	78	0.0	52	116	0.0	40	90	43	97
632	4.6	33	74	2.8	29	66	0.0	32	73	0.0	35	79	0.0	52	119	0.0	40	92	43	99
612	4.7	32	74	2.9	29	68	0.0	32	74	0.0	35	81	0.0	52	121	0.0	40	94	43	101
592	4.8	31	74	2.9	29	69	0.0	32	76	0.0	35	83	0.0	52	124	0.0	40	96	43	103
573	4.9	31	75	2.9	29	70	0.0	32	77	0.0	35	84	0.0	52	126	0.0	40	98	43	105
555	5.0	30	75	3.0	32	79	2.0	32	79	0.0	35	86	0.0	52	129	0.0	40	100	43	108
537	5.1	31	77	3.0	32	81	2.0	32	81	0.0	35	88	0.0	52	132	0.0	40	102	43	110
519	5.2	31	79	3.1	32	83	2.1	32	82	0.0	35	90	0.0	52	134	0.0	40	104	43	112
502	5.3	31	80	3.1	32	84	2.1	32	84	0.0	35	91	0.0	52	137	0.0	40	106	43	114
485	5.4	31	82	3.2	32	86	2.2	32	85	0.0	35	93	0.0	52	139	0.0	40	108	43	116
468	5.5	31	84	3.2	32	88	2.2	32	87	0.0	35	95	0.0	52	142	0.0	40	110	43	118
452	5.6	31	86	3.3	33	90	2.3	32	88	0.0	35	96	0.0	52	144	0.0	40	112	43	120
437	5.7	31	88	3.4	33	92	2.4	32	90	0.0	35	98	0.0	52	147	0.0	40	114	43	123
423	5.8	31	89	3.4	33	93	2.4	32	92	0.0	35	100	0.0	52	150	0.0	40	116	43	125
409	5.9	31	91	3.5	33	95	2.5	32	93	0.0	35	102	0.0	52	152	0.0	40	118	43	127
396	6.0	31	93	3.5	33	97	2.5	32	95	0.0	35	103	0.0	52	155	0.0	40	120	43	129
383	6.1	32	95	3.6	33	99	2.6	32	96	0.0	35	105	0.0	52	157	0.0	40	122	43	131
371	6.2	32	97	3.7	33	101	2.7	32	98	0.0	35	107	0.0	52	160	0.0	40	124	43	133
359	6.3	32	98	3.7	33	103	2.7	32	99	0.0	35	108	0.0	52	162	0.0	40	126	43	135
347	6.4	32	100	3.8	33	105	2.8	32	101	0.0	35	110	0.0	52	165	0.0	40	128	43	138
336	6.5	32	102	3.9	33	103	2.9	32	103	0.0	35	112	0.0	52	168	0.0	40	130	43	140
326	6.6	32	104	3.9	33	108	2.9	32	104	0.0	35	114	0.0	52	170	0.0	40	132	43	142
315	6.7	32	106	4.0	34	111	3.0	35	115	2.0	35	115	0.0	56	187	2.0	40	134	43	144
305	6.8	32	108	4.1	34	113	3.1	35	118	2.1	35	117	0.0	57	191	2.2	40	136	43	146
295	6.9	32	110	4.2	34	115	3.2	35	120	2.2	35	119	0.0	57	196	2.4	40	138	43	148
286	7.0	32	111	4.2	34	116	3.2	35	121	2.2	35	120	0.0	57	198	2.4	40	140	43	150
276	7.1	33	114	4.3	34	119	3.3	35	124	2.3	35	122	0.0	58	203	2.6	40	142	43	153
267	7.2	33	116	4.4	34	121	3.4	35	126	2.4	35	124	0.0	58	207	2.8	40	144	43	155
258	7.3	33	118	4.5	34	123	3.5	36	128	2.5	35	126	0.0	59	212	3.0	40	146	43	157
248	7.4	33	120	4.6	34	125	3.6	36	131	2.6	35	127	0.0	59	216	3.2	40	148	43	159
239	7.5	33	122	4.7	34	127	3.7	36	133	2.7	35	129	0.0	59	221	3.4	40	150	43	161
229	7.6	33	124	4.8	35	130	3.8	36	135	2.8	35	131	0.0	60	225	3.6	40	152	43	163
219	7.7	33	127	5.0	35	132	4.0	36	138	3.0	38	143	2.0	60	231	4.0	40	154	43	165
209	7.8	34	129	5.1	35	135	4.1	36	140	3.1	38	146	2.1	61	236	4.2	40	156	43	168
196	7.9	34	132	5.3	35	138	4.3	37	143	3.3	38	149	2.3	62	243	4.6	40	158	43	170
171	8.0	34	136	5.8	36	142	4.8	37	148	3.8	39	154	2.8	64	254	5.6	40	160	43	172

NOTE:
Lt, Lr & w VALUES IN FEET. LISTED RADIUS IS THE MINIMUM ALLOWABLE RADIUS FOR THE CORRESPONDING E, Lt, Lr, AND w VALUES.

TRANSITION CURVES - RURAL
25 MPH DESIGN SPEED

VIRGINIA DEPARTMENT OF TRANSPORTATION

REV. 1/07
802.35

TC-5.01

TRANSITION CURVES - RURAL
30 MPH DESIGN SPEED

VIRGINIA DEPARTMENT OF TRANSPORTATION

DESIGN FACTORS FOR A DESIGN SPEED OF 30 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY =30		WIDTH= 18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT			INTERCHANGE RAMPS			
		DESIGN SOFTWARE EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)															WIDTH			
		1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'			16 FT		18 FT	
RADIUS(FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	Lt	Lr
3500	NC	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0	0
2402	2.0	28	28	0.0	31	31	0.0	34	34	0.0	37	37	0.0	55	55	0.0	43	43	45	45
2276	2.1	28	29	0.0	31	32	0.0	34	35	0.0	37	39	0.0	55	58	0.0	43	45	45	48
2161	2.2	28	30	0.0	31	34	0.0	34	37	0.0	37	40	0.0	55	60	0.0	43	47	45	50
2056	2.3	28	32	0.0	31	35	0.0	34	39	0.0	37	42	0.0	55	63	0.0	43	50	45	52
1960	2.4	74	88	2.0	31	37	0.0	34	40	0.0	37	44	0.0	55	66	0.0	43	52	45	54
1871	2.5	71	88	2.0	31	38	0.0	34	42	0.0	37	46	0.0	55	69	0.0	43	54	45	57
1789	2.6	68	88	2.0	31	40	0.0	34	44	0.0	37	48	0.0	55	71	0.0	43	56	45	59
1713	2.7	66	88	2.1	31	41	0.0	34	45	0.0	37	50	0.0	55	74	0.0	43	58	45	61
1643	2.8	63	88	2.1	31	43	0.0	34	47	0.0	37	51	0.0	55	77	0.0	43	60	45	63
1577	2.9	61	88	2.1	31	44	0.0	34	49	0.0	37	53	0.0	55	80	0.0	43	62	45	66
1515	3.0	59	88	2.1	31	46	0.0	34	50	0.0	37	55	0.0	55	82	0.0	43	64	45	68
1457	3.1	57	88	2.2	31	47	0.0	34	52	0.0	37	57	0.0	55	85	0.0	43	67	45	70
1403	3.2	55	88	2.2	31	49	0.0	34	54	0.0	37	59	0.0	55	88	0.0	43	69	45	72
1352	3.3	54	88	2.2	31	50	0.0	34	55	0.0	37	60	0.0	55	90	0.0	43	71	45	75
1303	3.4	52	88	2.3	31	52	0.0	34	57	0.0	37	62	0.0	55	93	0.0	43	73	45	77
1258	3.5	51	88	2.3	31	54	0.0	34	59	0.0	37	64	0.0	55	96	0.0	43	75	45	79
1214	3.6	49	88	2.3	31	55	0.0	34	60	0.0	37	66	0.0	55	99	0.0	43	77	45	81
1173	3.7	48	88	2.3	31	57	0.0	34	62	0.0	37	68	0.0	55	101	0.0	43	79	45	84
1134	3.8	47	88	2.4	31	58	0.0	34	64	0.0	37	70	0.0	55	104	0.0	43	82	45	86
1097	3.9	46	88	2.4	31	60	0.0	34	65	0.0	37	71	0.0	55	107	0.0	43	84	45	88
1061	4.0	44	88	2.4	31	61	0.0	34	67	0.0	37	73	0.0	55	110	0.0	43	86	45	90
1028	4.1	43	88	2.5	31	63	0.0	34	69	0.0	37	75	0.0	55	112	0.0	43	88	45	93
995	4.2	42	88	2.5	31	64	0.0	34	70	0.0	37	77	0.0	55	115	0.0	43	90	45	95
964	4.3	41	88	2.5	31	66	0.0	34	72	0.0	37	79	0.0	55	118	0.0	43	92	45	97
934	4.4	40	88	2.6	31	67	0.0	34	74	0.0	37	80	0.0	55	120	0.0	43	94	45	99
905	4.5	40	88	2.6	31	69	0.0	34	75	0.0	37	82	0.0	55	123	0.0	43	96	45	102
877	4.6	39	88	2.6	31	70	0.0	34	77	0.0	37	84	0.0	55	126	0.0	43	99	45	104
851	4.7	38	88	2.7	31	72	0.0	34	79	0.0	37	86	0.0	55	129	0.0	43	101	45	106
825	4.8	37	88	2.7	31	73	0.0	34	80	0.0	37	88	0.0	55	131	0.0	43	103	45	108
800	4.9	36	88	2.7	31	75	0.0	34	82	0.0	37	90	0.0	55	134	0.0	43	105	45	111
775	5.0	36	88	2.8	31	76	0.0	34	84	0.0	37	91	0.0	55	137	0.0	43	107	45	113
752	5.1	35	88	2.8	31	78	0.0	34	85	0.0	37	93	0.0	55	140	0.0	43	109	45	115
729	5.2	34	88	2.8	31	79	0.0	34	87	0.0	37	95	0.0	55	142	0.0	43	111	45	117
706	5.3	34	88	2.9	31	81	0.0	34	89	0.0	37	97	0.0	55	145	0.0	43	114	45	120
684	5.4	33	88	2.9	31	82	0.0	34	90	0.0	37	99	0.0	55	148	0.0	43	116	45	122
663	5.5	32	88	3.0	34	92	2.0	34	92	0.0	37	100	0.0	55	150	0.0	43	118	45	124
641	5.6	33	90	3.0	34	94	2.0	34	94	0.0	37	102	0.0	55	153	0.0	43	120	45	126
621	5.7	32	91	3.0	34	95	2.0	34	95	0.0	37	104	0.0	55	156	0.0	43	122	45	129
602	5.8	33	93	3.1	34	98	2.1	34	97	0.0	37	106	0.0	55	159	0.0	43	124	45	131
583	5.9	33	95	3.1	34	99	2.1	34	99	0.0	37	108	0.0	55	161	0.0	43	126	45	133
565	6.0	33	97	3.2	34	101	2.2	34	100	0.0	37	110	0.0	55	164	0.0	43	128	45	135
548	6.1	33	98	3.2	34	103	2.2	34	102	0.0	37	111	0.0	55	167	0.0	43	131	45	138
531	6.2	33	101	3.3	34	105	2.3	34	104	0.0	37	113	0.0	55	170	0.0	43	133	45	140
515	6.3	33	102	3.3	34	107	2.3	34	105	0.0	37	115	0.0	55	172	0.0	43	135	45	142
499	6.4	33	104	3.4	35	109	2.4	34	107	0.0	37	117	0.0	55	175	0.0	43	137	45	144
484	6.5	33	106	3.4	35	111	2.4	34	109	0.0	37	119	0.0	55	178	0.0	43	139	45	147
469	6.6	33	108	3.5	35	113	2.5	34	110	0.0	37	120	0.0	55	180	0.0	43	141	45	149
455	6.7	33	110	3.5	35	115	2.5	34	112	0.0	37	122	0.0	55	183	0.0	43	143	45	151
441	6.8	33	112	3.6	35	117	2.6	34	114	0.0	37	124	0.0	55	186	0.0	43	146	45	153
427	6.9	33	113	3.6	35	119	2.6	34	115	0.0	37	126	0.0	55	189	0.0	43	148	45	156
414	7.0	34	116	3.7	35	121	2.7	34	117	0.0	37	128	0.0	55	191	0.0	43	150	45	158
400	7.1	34	118	3.8	35	123	2.8	34	119	0.0	37	130	0.0	55	194	0.0	43	152	45	160
387	7.2	34	119	3.8	35	125	2.8	34	120	0.0	37	131	0.0	55	197	0.0	43	154	45	162
374	7.3	34	122	3.9	35	127	2.9	34	122	0.0	37	133	0.0	55	200	0.0	43	156	45	165
361	7.4	34	124	4.0	35	129	3.0	37	135	2.0	37	135	0.0	60	219	2.0	43	158	45	167
348	7.5	34	126	4.1	36	132	3.1	37	137	2.1	37	137	0.0	60	224	2.2	43	160	45	169
334	7.6	34	128	4.2	36	134	3.2	37	140	2.2	37	139	0.0	60	228	2.4	43	163	45	171
320	7.7	35	131	4.3	36	136	3.3	37	142	2.3	37	140	0.0	61	233	2.6	43	165	45	174
305	7.8	35	133	4.4	36	139	3.4	38	145	2.4	37	142	0.0	62	238	2.8	43	167	45	176
287	7.9	35	135	4.5	36	141	3.5	38	147	2.5	37	144	0.0	62	243	3.0	43	169	45	178
251	8.0	35	139	4.9	37	145	3.9	38	151	2.9	37	146	0.0	64	253	3.8	43	171	45	180

NOTE:
Lt, Lr & w VALUES IN FEET. LISTED RADIUS IS THE MINIMUM ALLOWABLE RADIUS FOR THE CORRESPONDING E, Lt, Lr, AND w VALUES.

SPECIFICATION REFERENCE

SPECIFICATION REFERENCE

TRANSITION CURVES - RURAL
35 MPH DESIGN SPEED
VIRGINIA DEPARTMENT OF TRANSPORTATION

DESIGN FACTORS FOR A DESIGN SPEED OF 35 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY =35		WIDTH= 18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT			WIDTH=72 FT			INTERCHANGE RAMPS WIDTH			
		DESIGN SOFTWARE EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)																					
		1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'			3 @ 12'			16 FT		18 FT	
RADIUS(FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	Lt	Lr
5000	NC	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0	0
3149	2.0	30	30	0.0	33	33	0.0	36	36	0.0	39	39	0.0	59	59	0.0	78	78	0.0	46	46	48	48
2866	2.1	30	31	0.0	33	34	0.0	36	38	0.0	39	41	0.0	59	61	0.0	78	82	0.0	46	48	48	51
2865	2.2	30	32	0.0	33	36	0.0	36	40	0.0	39	43	0.0	59	64	0.0	78	86	0.0	46	50	48	53
2835	2.2	30	32	0.0	33	36	0.0	36	40	0.0	39	43	0.0	59	64	0.0	78	86	0.0	46	50	48	53
2698	2.3	30	34	0.0	33	38	0.0	36	41	0.0	39	45	0.0	59	67	0.0	78	90	0.0	46	52	48	56
2573	2.4	30	35	0.0	33	39	0.0	36	43	0.0	33	47	0.0	59	70	0.0	78	93	0.0	46	55	48	58
2457	2.5	83	103	2.0	33	41	0.0	36	45	0.0	39	49	0.0	59	73	0.0	78	97	0.0	46	57	48	60
2350	2.6	80	103	2.0	33	42	0.0	36	47	0.0	39	51	0.0	59	76	0.0	78	101	0.0	46	59	48	63
2251	2.7	77	103	2.0	33	44	0.0	36	48	0.0	39	53	0.0	59	79	0.0	78	105	0.0	46	61	48	65
2159	2.8	74	103	2.0	33	46	0.0	36	50	0.0	39	55	0.0	59	82	0.0	78	109	0.0	46	64	48	68
2073	2.9	72	103	2.1	33	47	0.0	36	52	0.0	39	57	0.0	59	85	0.0	78	113	0.0	46	66	48	70
1993	3.0	69	103	2.1	33	49	0.0	36	54	0.0	39	59	0.0	59	88	0.0	78	117	0.0	46	68	48	72
1917	3.1	67	103	2.1	33	50	0.0	36	55	0.0	39	60	0.0	59	90	0.0	78	120	0.0	46	70	48	75
1847	3.2	65	103	2.1	33	52	0.0	36	57	0.0	39	62	0.0	59	93	0.0	78	124	0.0	46	73	48	77
1780	3.3	63	103	2.2	33	54	0.0	36	59	0.0	39	64	0.0	59	96	0.0	78	128	0.0	46	75	48	80
1717	3.4	61	103	2.2	33	55	0.0	36	61	0.0	39	66	0.0	59	99	0.0	78	132	0.0	46	77	48	82
1658	3.5	59	103	2.2	33	57	0.0	36	63	0.0	39	68	0.0	59	102	0.0	78	136	0.0	46	79	48	84
1602	3.6	58	103	2.2	33	59	0.0	36	64	0.0	39	70	0.0	59	105	0.0	78	140	0.0	46	82	48	87
1548	3.7	56	103	2.3	33	60	0.0	36	66	0.0	39	72	0.0	59	108	0.0	78	144	0.0	46	84	48	89
1497	3.8	55	103	2.3	33	62	0.0	36	68	0.0	39	74	0.0	59	111	0.0	78	148	0.0	46	86	48	92
1449	3.9	53	103	2.3	33	63	0.0	36	70	0.0	39	76	0.0	59	114	0.0	78	151	0.0	46	88	48	94
1403	4.0	52	103	2.3	33	65	0.0	36	71	0.0	39	78	0.0	59	117	0.0	78	155	0.0	46	91	48	96
1359	4.1	51	103	2.4	33	67	0.0	36	73	0.0	39	80	0.0	59	120	0.0	78	159	0.0	46	93	48	99
1317	4.2	50	103	2.4	33	68	0.0	36	75	0.0	39	82	0.0	59	122	0.0	78	163	0.0	46	95	48	101
1277	4.3	48	103	2.4	33	70	0.0	36	77	0.0	39	84	0.0	59	125	0.0	78	167	0.0	46	97	48	104
1238	4.4	47	103	2.4	33	71	0.0	36	79	0.0	39	86	0.0	59	128	0.0	78	171	0.0	46	100	48	106
1201	4.5	46	103	2.5	33	73	0.0	36	80	0.0	39	88	0.0	59	131	0.0	78	175	0.0	46	102	48	108
1165	4.6	45	103	2.5	33	75	0.0	36	82	0.0	39	90	0.0	59	134	0.0	78	179	0.0	46	104	48	111
1131	4.7	44	103	2.5	33	76	0.0	36	84	0.0	39	91	0.0	59	137	0.0	78	182	0.0	46	106	48	113
1097	4.8	43	103	2.6	33	78	0.0	36	86	0.0	39	93	0.0	59	140	0.0	78	186	0.0	46	109	48	116
1065	4.9	43	103	2.6	33	80	0.0	36	87	0.0	39	95	0.0	59	143	0.0	78	190	0.0	46	111	48	118
1034	5.0	42	103	2.6	33	81	0.0	36	89	0.0	39	97	0.0	59	146	0.0	78	194	0.0	46	113	48	120
1004	5.1	41	103	2.6	33	83	0.0	36	91	0.0	39	99	0.0	59	149	0.0	78	198	0.0	46	115	48	123
975	5.2	40	103	2.7	33	84	0.0	36	93	0.0	39	101	0.0	59	151	0.0	78	202	0.0	46	118	48	125
946	5.3	39	103	2.7	33	86	0.0	36	95	0.0	39	103	0.0	59	154	0.0	78	206	0.0	46	120	48	128
918	5.4	39	103	2.7	33	88	0.0	36	96	0.0	39	105	0.0	59	157	0.0	78	210	0.0	46	122	48	130
891	5.5	38	103	2.8	33	89	0.0	36	98	0.0	39	107	0.0	59	160	0.0	78	213	0.0	46	124	48	132
864	5.6	37	103	2.8	33	91	0.0	36	100	0.0	39	109	0.0	59	163	0.0	78	217	0.0	46	127	48	135
838	5.7	37	103	2.8	33	92	0.0	36	102	0.0	39	111	0.0	59	166	0.0	78	221	0.0	46	129	48	137
813	5.8	36	103	2.9	33	94	0.0	36	103	0.0	39	113	0.0	59	169	0.0	78	225	0.0	46	131	48	140
789	5.9	35	103	2.9	33	96	0.0	36	105	0.0	39	115	0.0	59	172	0.0	78	229	0.0	46	133	48	142
766	6.0	35	103	3.0	36	107	2.0	36	107	0.0	39	117	0.0	59	175	0.0	78	233	0.0	46	136	48	144
743	6.1	35	104	3.0	36	109	2.0	36	109	0.0	39	119	0.0	59	178	0.0	78	237	0.0	46	138	48	147
722	6.2	34	105	3.0	36	110	2.0	36	110	0.0	39	120	0.0	59	180	0.0	78	240	0.0	46	140	48	149
701	6.3	35	108	3.1	36	113	2.1	36	112	0.0	39	122	0.0	59	183	0.0	78	244	0.0	46	142	48	152
680	6.4	35	109	3.1	36	115	2.1	36	114	0.0	39	124	0.0	59	186	0.0	78	248	0.0	46	145	48	154
660	6.5	35	112	3.2	36	117	2.2	36	116	0.0	39	126	0.0	59	189	0.0	78	252	0.0	46	147	48	156
641	6.6	35	113	3.2	37	119	2.2	36	118	0.0	39	128	0.0	59	192	0.0	78	256	0.0	46	149	48	159
622	6.7	35	115	3.2	36	120	2.2	36	119	0.0	39	130	0.0	59	195	0.0	78	260	0.0	46	151	48	161
603	6.8	35	117	3.3	37	123	2.3	36	121	0.0	39	132	0.0	59	198	0.0	78	264	0.0	46	154	48	164
585	6.9	35	119	3.3	37	125	2.3	36	123	0.0	39	134	0.0	59	201	0.0	78	268	0.0	46	156	48	166
567	7.0	35	121	3.4	37	127	2.4	36	125	0.0	39	136	0.0	59	204	0.0	78	271	0.0	46	158	48	168
550	7.1	35	123	3.4	37	129	2.4	36	126	0.0	39	138	0.0	59	207	0.0	78	275	0.0	46	160	48	171
532	7.2	35	125	3.5	37	131	2.5	36	128	0.0	39	140	0.0	59	210	0.0	78	279	0.0	46	163	48	173
515	7.3	35	127	3.5	37	133	2.5	36	130	0.0	39	142	0.0	59	212	0.0	78	283	0.0	46	165	48	176
497	7.4	35	129	3.6	37	135	2.6	36	132	0.0	39	144	0.0	59	215	0.0	78	287	0.0	46	167	48	178
480	7.5	35	132	3.7	37	138	2.7	36	134	0.0	39	146	0.0	59	218	0.0	83	308	2.1	46	170	48	180
461	7.6	35	133	3.7	37	140	2.7	36	135	0.0	39	148	0.0	59	221	0.0	83	312	2.1	46	172	48	183
442	7.7	36	136	3.8	37	142	2.8	36	137	0.0	39	150	0.0	59	224	0.0	83	318	2.4	46	174	48	185
422	7.8	36	138	3.9	38	145	2.9	36	139	0.0	39	151	0.0	59	227	0.0	84	325	2.7	46	176	48	188
397	7.9	36	141	4.0	38	147	3.0	39	153	2.0	39	153	0.0	64	249	2.0	85	332	3.0	46	179	48	190
350	8.0	36	144	4.3	38	151	3.3	40	157	2.3	39	155	0.0	65	258	2.6	86	344	3.9	46	181	48	192

NOTE:
Lt, Lr & w VALUES IN FEET. LISTED RADIUS IS THE MINIMUM ALLOWABLE RADIUS FOR THE CORRESPONDING E, Lt, Lr, AND w VALUES.

REV. 1/07
802.37

TRANSITION CURVES - RURAL
40 MPH DESIGN SPEED

VIRGINIA DEPARTMENT OF TRANSPORTATION

DESIGN FACTORS FOR A DESIGN SPEED OF 40 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY =40		WIDTH= 18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT			WIDTH=72 FT			INTERCHANGE RAMPS WIDTH			
		DESIGN SOFTWARE EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)																					
		1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'			3 @ 12'			16 FT		18 FT	
RADIUS(FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	Lt	Lr
6000	NC	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0	0
4000	2.0	32	32	0.0	35	35	0.0	38	38	0.0	42	42	0.0	63	63	0.0	83	83	0.0	49	49	52	52
3792	2.1	32	33	0.0	35	37	0.0	38	40	0.0	42	44	0.0	63	66	0.0	83	87	0.0	49	51	52	54
3603	2.2	32	35	0.0	35	38	0.0	38	42	0.0	42	46	0.0	63	69	0.0	83	92	0.0	49	54	52	57
3430	2.3	32	36	0.0	35	40	0.0	38	44	0.0	42	48	0.0	63	72	0.0	83	96	0.0	49	56	52	60
3271	2.4	32	38	0.0	35	42	0.0	38	46	0.0	42	50	0.0	63	75	0.0	83	100	0.0	49	59	52	62
3125	2.5	32	39	0.0	35	44	0.0	38	48	0.0	42	52	0.0	63	78	0.0	83	104	0.0	49	61	52	65
2990	2.6	32	41	0.0	35	45	0.0	38	50	0.0	42	54	0.0	63	81	0.0	83	108	0.0	49	64	52	67
2866	2.7	32	42	0.0	35	47	0.0	38	52	0.0	42	56	0.0	63	84	0.0	83	112	0.0	49	66	52	70
2865	2.7	87	117	2.0	35	47	0.0	38	52	0.0	42	56	0.0	63	84	0.0	83	112	0.0	49	66	52	70
2748	2.8	84	117	2.0	35	49	0.0	38	54	0.0	42	58	0.0	63	87	0.0	83	116	0.0	49	68	52	72
2640	2.9	81	117	2.0	35	50	0.0	38	55	0.0	42	60	0.0	63	90	0.0	83	120	0.0	49	71	52	75
2538	3.0	78	117	2.0	35	52	0.0	38	57	0.0	42	63	0.0	63	94	0.0	83	125	0.0	49	73	52	78
2443	3.1	76	117	2.1	35	54	0.0	38	59	0.0	42	65	0.0	63	97	0.0	83	129	0.0	49	76	52	80
2354	3.2	74	117	2.1	35	56	0.0	38	61	0.0	42	67	0.0	63	100	0.0	83	133	0.0	49	78	52	83
2269	3.3	71	117	2.1	35	57	0.0	38	63	0.0	42	69	0.0	63	103	0.0	83	137	0.0	49	80	52	85
2190	3.4	69	117	2.1	35	59	0.0	38	65	0.0	42	71	0.0	63	106	0.0	83	141	0.0	49	83	52	88
2115	3.5	67	117	2.2	35	61	0.0	38	67	0.0	42	73	0.0	63	109	0.0	83	145	0.0	49	85	52	90
2044	3.6	65	117	2.2	35	63	0.0	38	69	0.0	42	75	0.0	63	112	0.0	83	149	0.0	49	88	52	93
1977	3.7	64	117	2.2	35	64	0.0	38	71	0.0	42	77	0.0	63	115	0.0	83	154	0.0	49	90	52	96
1913	3.8	62	117	2.2	35	66	0.0	38	73	0.0	42	79	0.0	63	118	0.0	83	158	0.0	49	93	52	98
1852	3.9	60	117	2.2	35	68	0.0	38	74	0.0	42	81	0.0	63	122	0.0	83	162	0.0	49	95	52	101
1794	4.0	59	117	2.3	35	69	0.0	38	76	0.0	42	83	0.0	63	125	0.0	83	166	0.0	49	97	52	103
1739	4.1	58	117	2.3	35	71	0.0	38	78	0.0	42	85	0.0	63	128	0.0	83	170	0.0	49	100	52	106
1686	4.2	56	117	2.3	35	73	0.0	38	80	0.0	42	87	0.0	63	131	0.0	83	174	0.0	49	102	52	108
1635	4.3	55	117	2.3	35	75	0.0	38	82	0.0	42	89	0.0	63	134	0.0	83	178	0.0	49	105	52	111
1587	4.4	54	117	2.4	35	76	0.0	38	84	0.0	42	92	0.0	63	137	0.0	83	183	0.0	49	107	52	114
1540	4.5	52	117	2.4	35	78	0.0	38	86	0.0	42	94	0.0	63	140	0.0	83	187	0.0	49	110	52	116
1495	4.6	51	117	2.4	35	80	0.0	38	88	0.0	42	96	0.0	63	143	0.0	83	191	0.0	49	112	52	119
1452	4.7	50	117	2.4	35	82	0.0	38	90	0.0	42	98	0.0	63	146	0.0	83	195	0.0	49	114	52	121
1411	4.8	49	117	2.5	35	83	0.0	38	92	0.0	42	100	0.0	63	149	0.0	83	199	0.0	49	117	52	124
1370	4.9	48	117	2.5	35	85	0.0	38	93	0.0	42	102	0.0	63	153	0.0	83	203	0.0	49	119	52	126
1332	5.0	47	117	2.5	35	87	0.0	38	95	0.0	42	104	0.0	63	156	0.0	83	207	0.0	49	122	52	129
1294	5.1	46	117	2.5	35	88	0.0	38	97	0.0	42	106	0.0	63	159	0.0	83	212	0.0	49	124	52	132
1258	5.2	45	117	2.6	35	90	0.0	38	99	0.0	42	108	0.0	63	162	0.0	83	216	0.0	49	127	52	134
1222	5.3	45	117	2.6	35	92	0.0	38	101	0.0	42	110	0.0	63	165	0.0	83	220	0.0	49	129	52	137
1188	5.4	44	117	2.6	35	94	0.0	38	103	0.0	42	112	0.0	63	168	0.0	83	224	0.0	49	131	52	139
1154	5.5	43	117	2.7	35	95	0.0	38	105	0.0	42	114	0.0	63	171	0.0	83	228	0.0	49	134	52	142
1122	5.6	42	117	2.7	35	97	0.0	38	107	0.0	42	116	0.0	63	174	0.0	83	232	0.0	49	136	52	144
1090	5.7	42	117	2.7	35	99	0.0	38	109	0.0	42	118	0.0	63	177	0.0	83	236	0.0	49	139	52	147
1058	5.8	41	117	2.7	35	100	0.0	38	110	0.0	42	120	0.0	63	180	0.0	83	240	0.0	49	141	52	150
1028	5.9	40	117	2.8	35	102	0.0	38	112	0.0	42	123	0.0	63	184	0.0	83	245	0.0	49	144	52	152
999	6.0	39	117	2.8	35	104	0.0	38	114	0.0	42	125	0.0	63	187	0.0	83	249	0.0	49	146	52	155
971	6.1	39	117	2.8	35	106	0.0	38	116	0.0	42	127	0.0	63	190	0.0	83	253	0.0	49	148	52	157
944	6.2	38	117	2.9	35	107	0.0	38	118	0.0	42	129	0.0	63	193	0.0	83	257	0.0	49	151	52	160
917	6.3	38	117	2.9	35	109	0.0	38	120	0.0	42	131	0.0	63	196	0.0	83	261	0.0	49	153	52	162
891	6.4	37	117	2.9	35	111	0.0	38	122	0.0	42	133	0.0	63	199	0.0	83	265	0.0	49	156	52	165
866	6.5	37	118	3.0	39	124	2.0	38	124	0.0	42	135	0.0	63	202	0.0	83	269	0.0	49	158	52	168
842	6.6	37	120	3.0	39	126	2.0	38	126	0.0	42	137	0.0	63	205	0.0	83	274	0.0	49	160	52	170
818	6.7	37	122	3.0	39	128	2.0	38	128	0.0	42	139	0.0	63	208	0.0	83	278	0.0	49	163	52	173
794	6.8	37	124	3.1	39	130	2.1	38	129	0.0	42	141	0.0	63	212	0.0	83	282	0.0	49	165	52	175
771	6.9	37	126	3.1	39	132	2.1	38	131	0.0	42	143	0.0	63	215	0.0	83	286	0.0	49	168	52	178
748	7.0	37	128	3.2	39	134	2.2	38	133	0.0	42	145	0.0	63	218	0.0	83	290	0.0	49	170	52	180
726	7.1	37	130	3.2	39	136	2.2	38	135	0.0	42	147	0.0	63	221	0.0	83	294	0.0	49	173	52	183
703	7.2	37	133	3.3	39	139	2.3	38	137	0.0	42	149	0.0	63	224	0.0	83	298	0.0	49	175	52	186
681	7.3	37	135	3.3	39	141	2.3	38	139	0.0	42	152	0.0	63	227	0.0	83	303	0.0	49	177	52	188
658	7.4	38	137	3.4	39	143	2.4	38	141	0.0	42	154	0.0	63	230	0.0	83	307	0.0	49	180	52	191
635	7.5	38	139	3.4	39	145	2.4	38	143	0.0	42	156	0.0	63	233	0.0	83	311	0.0	49	182	52	193
612	7.6	38	141	3.5	39	148	2.5	38	145	0.0	42	158	0.0	63	236	0.0	83	315	0.0	49	185	52	196
587	7.7	38	143	3.5	39	150	2.5	38	147	0.0	42	160	0.0	63	239	0.0	83	319	0.0	49	187	52	198
560	7.8	38	146	3.6	39	152	2.6	38	148	0.0	42	162	0.0	63	243	0.0	83	323	0.0	49	190	52	201
529	7.9	38	148	3.7	40	155	2.7	38	150	0.0	42	164	0.0	63	246	0.0	88	346	2.1	49	192	52	204
465	8.0	38	152	4.0	40	159	3.0	42	166	2.0	42	166	0.0	63	269	0.0	90	359	3.0	49	194	52	206

NOTE:
Lt, Lr & w VALUES IN FEET. LISTED RADIUS IS THE MINIMUM ALLOWABLE RADIUS FOR THE CORRESPONDING E, Lt, Lr, AND w VALUES.

SPECIFICATION REFERENCE

SPECIFICATION REFERENCE

TRANSITION CURVES - RURAL
45 MPH DESIGN SPEED
VIRGINIA DEPARTMENT OF TRANSPORTATION

DESIGN FACTORS FOR A DESIGN SPEED OF 45 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY =45		WIDTH= 18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT			WIDTH=72 FT			INTERCHANGE RAMPS WIDTH			
		DESIGN SOFTWARE EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)																					
		1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'			3 @ 12'			16 FT		18 FT	
RADIUS(FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	Lt	Lr
8000	NC	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0	0
4957	2.0	34	34	0.0	38	38	0.0	41	41	0.0	45	45	0.0	67	67	0.0	89	89	0.0	53	53	56	56
4702	2.1	34	35	0.0	38	39	0.0	41	43	0.0	45	47	0.0	67	70	0.0	89	94	0.0	53	56	56	59
4467	2.2	34	37	0.0	38	41	0.0	41	45	0.0	45	49	0.0	67	74	0.0	89	98	0.0	53	58	56	61
4254	2.3	34	39	0.0	38	43	0.0	41	47	0.0	45	52	0.0	67	77	0.0	89	103	0.0	53	61	56	64
4057	2.4	34	40	0.0	38	45	0.0	41	49	0.0	45	54	0.0	67	80	0.0	89	107	0.0	53	63	56	67
3876	2.5	34	42	0.0	38	47	0.0	41	51	0.0	45	56	0.0	67	84	0.0	89	112	0.0	53	66	56	70
3710	2.6	34	44	0.0	38	49	0.0	41	53	0.0	45	58	0.0	67	87	0.0	89	116	0.0	53	69	56	72
3554	2.7	34	45	0.0	38	50	0.0	41	55	0.0	45	60	0.0	67	90	0.0	89	120	0.0	53	71	56	75
3412	2.8	34	47	0.0	38	52	0.0	41	58	0.0	45	63	0.0	67	94	0.0	89	125	0.0	53	74	56	78
3278	2.9	34	49	0.0	38	54	0.0	41	60	0.0	45	65	0.0	67	97	0.0	89	129	0.0	53	77	56	81
3152	3.0	34	50	0.0	38	56	0.0	41	62	0.0	45	67	0.0	67	100	0.0	89	134	0.0	53	79	56	84
3035	3.1	34	52	0.0	38	58	0.0	41	64	0.0	45	69	0.0	67	104	0.0	89	138	0.0	53	82	56	86
2925	3.2	34	54	0.0	38	60	0.0	41	66	0.0	45	72	0.0	67	107	0.0	89	143	0.0	53	84	56	89
2866	3.3	34	55	0.0	38	62	0.0	41	68	0.0	45	74	0.0	67	110	0.0	89	147	0.0	53	87	56	92
2865	3.3	80	132	2.1	38	62	0.0	41	68	0.0	45	74	0.0	67	110	0.0	89	147	0.0	53	87	56	92
2822	3.3	80	132	2.1	38	62	0.0	41	68	0.0	45	74	0.0	67	110	0.0	89	147	0.0	53	87	56	92
2724	3.4	78	132	2.1	38	63	0.0	41	70	0.0	45	76	0.0	67	114	0.0	89	152	0.0	53	90	56	95
2631	3.5	76	132	2.1	38	65	0.0	41	72	0.0	45	78	0.0	67	117	0.0	89	156	0.0	53	92	56	97
2544	3.6	74	132	2.1	38	67	0.0	41	74	0.0	45	80	0.0	67	120	0.0	89	160	0.0	53	95	56	100
2461	3.7	72	132	2.2	38	69	0.0	41	76	0.0	45	83	0.0	67	124	0.0	89	165	0.0	53	98	56	103
2383	3.8	70	132	2.2	38	71	0.0	41	78	0.0	45	85	0.0	67	127	0.0	89	169	0.0	53	100	56	106
2308	3.9	68	132	2.2	38	73	0.0	41	80	0.0	45	87	0.0	67	130	0.0	89	174	0.0	53	103	56	108
2237	4.0	66	132	2.2	38	75	0.0	41	82	0.0	45	89	0.0	67	134	0.0	89	178	0.0	53	105	56	111
2169	4.1	65	132	2.2	38	76	0.0	41	84	0.0	45	92	0.0	67	137	0.0	89	183	0.0	53	108	56	114
2104	4.2	63	132	2.3	38	78	0.0	41	86	0.0	45	94	0.0	67	140	0.0	89	187	0.0	53	111	56	117
2041	4.3	62	132	2.3	38	80	0.0	41	88	0.0	45	96	0.0	67	144	0.0	89	192	0.0	53	113	56	120
1982	4.4	60	132	2.3	38	82	0.0	41	90	0.0	45	98	0.0	67	147	0.0	89	196	0.0	53	116	56	122
1924	4.5	59	132	2.3	38	84	0.0	41	92	0.0	45	100	0.0	67	150	0.0	89	200	0.0	53	119	56	125
1870	4.6	58	132	2.4	38	86	0.0	41	94	0.0	45	103	0.0	67	154	0.0	89	205	0.0	53	121	56	128
1817	4.7	57	132	2.4	38	88	0.0	41	96	0.0	45	105	0.0	67	157	0.0	89	209	0.0	53	124	56	131
1766	4.8	55	132	2.4	38	89	0.0	41	98	0.0	45	107	0.0	67	160	0.0	89	214	0.0	53	126	56	133
1717	4.9	54	132	2.4	38	91	0.0	41	100	0.0	45	109	0.0	67	164	0.0	89	218	0.0	53	129	56	136
1669	5.0	53	132	2.4	38	93	0.0	41	102	0.0	45	112	0.0	67	167	0.0	89	223	0.0	53	132	56	139
1624	5.1	52	132	2.5	38	95	0.0	41	104	0.0	45	114	0.0	67	170	0.0	89	227	0.0	53	134	56	142
1579	5.2	51	132	2.5	38	97	0.0	41	106	0.0	45	116	0.0	67	174	0.0	89	232	0.0	53	137	56	144
1536	5.3	50	132	2.5	38	99	0.0	41	108	0.0	45	118	0.0	67	177	0.0	89	236	0.0	53	140	56	147
1495	5.4	49	132	2.5	38	100	0.0	41	110	0.0	45	120	0.0	67	180	0.0	89	240	0.0	53	142	56	150
1454	5.5	48	132	2.6	38	102	0.0	41	113	0.0	45	123	0.0	67	184	0.0	89	245	0.0	53	145	56	153
1415	5.6	48	132	2.6	38	104	0.0	41	115	0.0	45	125	0.0	67	187	0.0	89	249	0.0	53	147	56	156
1376	5.7	47	132	2.6	38	106	0.0	41	117	0.0	45	127	0.0	67	190	0.0	89	254	0.0	53	150	56	158
1339	5.8	46	132	2.6	38	108	0.0	41	119	0.0	45	129	0.0	67	194	0.0	89	258	0.0	53	153	56	161
1302	5.9	45	132	2.7	38	110	0.0	41	121	0.0	45	132	0.0	67	197	0.0	89	263	0.0	53	155	56	164
1266	6.0	44	132	2.7	38	112	0.0	41	123	0.0	45	134	0.0	67	200	0.0	89	267	0.0	53	158	56	167
1232	6.1	44	132	2.7	38	113	0.0	41	125	0.0	45	136	0.0	67	204	0.0	89	272	0.0	53	160	56	169
1199	6.2	43	132	2.8	38	115	0.0	41	127	0.0	45	138	0.0	67	207	0.0	89	276	0.0	53	163	56	172
1166	6.3	42	132	2.8	38	117	0.0	41	129	0.0	45	140	0.0	67	210	0.0	89	280	0.0	53	166	56	175
1135	6.4	42	132	2.8	38	119	0.0	41	131	0.0	45	143	0.0	67	214	0.0	89	285	0.0	53	168	56	178
1104	6.5	41	132	2.8	38	121	0.0	41	133	0.0	45	145	0.0	67	217	0.0	89	289	0.0	53	171	56	180
1073	6.6	40	132	2.9	38	123	0.0	41	135	0.0	45	147	0.0	67	220	0.0	89	294	0.0	53	174	56	183
1044	6.7	40	132	2.9	38	125	0.0	41	137	0.0	45	149	0.0	67	224	0.0	89	298	0.0	53	176	56	186
1015	6.8	39	132	2.9	38	126	0.0	41	139	0.0	45	152	0.0	67	227	0.0	89	303	0.0	53	179	56	189
986	6.9	40	135	3.0	41	141	2.0	41	141	0.0	45	154	0.0	67	230	0.0	89	307	0.0	53	181	56	192
957	7.0	40	137	3.0	41	143	2.0	41	143	0.0	45	156	0.0	67	234	0.0	89	312	0.0	53	184	56	194
929	7.1	40	139	3.1	42	146	2.1	41	145	0.0	45	158	0.0	67	237	0.0	89	316	0.0	53	187	56	197
902	7.2	40	141	3.1	42	148	2.1	41	147	0.0	45	160	0.0	67	240	0.0	89	320	0.0	53	189	56	200
874	7.3	40	143	3.1	42	150	2.1	41	149	0.0	45	163	0.0	67	244	0.0	89	325	0.0	53	192	56	203
845	7.4	40	146	3.2	42	153	2.2	41	151	0.0	45	165	0.0	67	247	0.0	89	329	0.0	53	195	56	205
817	7.5	40	148	3.2	42	155	2.2	41	153	0.0	45	167	0.0	67	250	0.0	89	334	0.0	53	197	56	208
787	7.6	40	150	3.3	42	157	2.3	41	155	0.0	45	169	0.0	67	254	0.0	89	338	0.0	53	200	56	211
756	7.7	40	152	3.3	42	159	2.3	41	157	0.0	45	172	0.0	67	257	0.0	89	343	0.0	53	202	56	214
723	7.8	40	155	3.4	42	162	2.4	41	159	0.0	45	174	0.0	67	260	0.0	89	347	0.0	53	205	56	216
683	7.9	40	158	3.5	42	165	2.5	41	161	0.0	45	176	0.0	67	264	0.0	89	352	0.0	53	208	56	219
602	8.0	41	161	3.7	43	169	2.7	41	163	0.0	45	178	0.0	67	267	0.0	95	377	2.1	53	210	56	222

NOTE:
Lt, Lr & w VALUES IN FEET. LISTED RADIUS IS THE MINIMUM ALLOWABLE RADIUS FOR THE CORRESPONDING E, Lt, Lr, AND w VALUES.

TRANSITION CURVES - RURAL
50 MPH DESIGN SPEED

VIRGINIA DEPARTMENT OF TRANSPORTATION

DESIGN FACTORS FOR A DESIGN SPEED OF 50 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY =50		WIDTH= 18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT			WIDTH=72 FT			INTERCHANGE RAMPS WIDTH			
		DESIGN SOFTWARE EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)																					
		1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'			3 @ 12'			16 FT		18 FT	
RADIUS(FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	Lt	Lr
8000	NC	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0	0
6013	2.0	36	36	0.0	40	40	0.0	44	44	0.0	48	48	0.0	72	72	0.0	96	96	0.0	57	57	60	60
5703	2.1	36	38	0.0	40	42	0.0	44	47	0.0	48	51	0.0	72	76	0.0	96	101	0.0	57	59	60	63
5420	2.2	36	40	0.0	40	44	0.0	44	49	0.0	48	53	0.0	72	80	0.0	96	106	0.0	57	62	60	66
5162	2.3	36	42	0.0	40	46	0.0	44	51	0.0	48	56	0.0	72	83	0.0	96	111	0.0	57	65	60	69
4926	2.4	36	44	0.0	40	48	0.0	44	53	0.0	48	58	0.0	72	87	0.0	96	116	0.0	57	68	60	72
4708	2.5	36	45	0.0	40	50	0.0	44	55	0.0	48	60	0.0	72	90	0.0	96	120	0.0	57	71	60	75
4507	2.6	36	47	0.0	40	52	0.0	44	58	0.0	48	63	0.0	72	94	0.0	96	125	0.0	57	73	60	78
4320	2.7	36	49	0.0	40	54	0.0	44	60	0.0	48	65	0.0	72	98	0.0	96	130	0.0	57	76	60	81
4146	2.8	36	51	0.0	40	56	0.0	44	62	0.0	48	68	0.0	72	101	0.0	96	135	0.0	57	79	60	84
3985	2.9	36	53	0.0	40	58	0.0	44	64	0.0	48	70	0.0	72	105	0.0	96	140	0.0	57	82	60	87
3834	3.0	36	54	0.0	40	60	0.0	44	66	0.0	48	72	0.0	72	108	0.0	96	144	0.0	57	85	60	90
3692	3.1	36	56	0.0	40	62	0.0	44	69	0.0	48	75	0.0	72	112	0.0	96	149	0.0	57	88	60	93
3560	3.2	36	58	0.0	40	64	0.0	44	71	0.0	48	77	0.0	72	116	0.0	96	154	0.0	57	90	60	96
3434	3.3	36	60	0.0	40	66	0.0	44	73	0.0	48	80	0.0	72	119	0.0	96	159	0.0	57	93	60	99
3316	3.4	36	62	0.0	40	68	0.0	44	75	0.0	48	82	0.0	72	123	0.0	96	164	0.0	57	96	60	102
3205	3.5	36	63	0.0	40	70	0.0	44	77	0.0	48	84	0.0	72	126	0.0	96	168	0.0	57	99	60	105
3099	3.6	36	65	0.0	40	72	0.0	44	80	0.0	48	87	0.0	72	130	0.0	96	173	0.0	57	102	60	108
2999	3.7	36	67	0.0	40	74	0.0	44	82	0.0	48	89	0.0	72	134	0.0	96	178	0.0	57	104	60	111
2904	3.8	36	69	0.0	40	76	0.0	44	84	0.0	48	92	0.0	72	137	0.0	96	183	0.0	57	107	60	114
2866	3.9	36	71	0.0	40	78	0.0	44	86	0.0	48	94	0.0	72	141	0.0	96	188	0.0	57	110	60	117
2865	3.9	76	147	2.2	40	78	0.0	44	86	0.0	48	94	0.0	72	141	0.0	96	188	0.0	57	110	60	117
2814	3.9	76	147	2.2	40	78	0.0	44	86	0.0	48	94	0.0	72	141	0.0	96	188	0.0	57	110	60	117
2728	4.0	74	147	2.2	40	80	0.0	44	88	0.0	48	96	0.0	72	144	0.0	96	192	0.0	57	113	60	120
2646	4.1	72	147	2.2	40	82	0.0	44	91	0.0	48	99	0.0	72	148	0.0	96	197	0.0	57	116	60	123
2568	4.2	70	147	2.2	40	84	0.0	44	93	0.0	48	101	0.0	72	152	0.0	96	202	0.0	57	118	60	126
2493	4.3	69	147	2.2	40	86	0.0	44	95	0.0	48	104	0.0	72	155	0.0	96	207	0.0	57	121	60	129
2422	4.4	67	147	2.3	40	88	0.0	44	97	0.0	48	106	0.0	72	159	0.0	96	212	0.0	57	124	60	132
2353	4.5	66	147	2.3	40	90	0.0	44	99	0.0	48	108	0.0	72	162	0.0	96	216	0.0	57	127	60	135
2287	4.6	64	147	2.3	40	92	0.0	44	102	0.0	48	111	0.0	72	166	0.0	96	221	0.0	57	130	60	138
2224	4.7	63	147	2.3	40	94	0.0	44	104	0.0	48	113	0.0	72	170	0.0	96	226	0.0	57	132	60	141
2163	4.8	62	147	2.4	40	96	0.0	44	106	0.0	48	116	0.0	72	173	0.0	96	231	0.0	57	135	60	144
2104	4.9	60	147	2.4	40	98	0.0	44	108	0.0	48	118	0.0	72	177	0.0	96	236	0.0	57	138	60	147
2047	5.0	59	147	2.4	40	100	0.0	44	110	0.0	48	120	0.0	72	180	0.0	96	240	0.0	57	141	60	150
1992	5.1	58	147	2.4	40	102	0.0	44	113	0.0	48	123	0.0	72	184	0.0	96	245	0.0	57	144	60	153
1939	5.2	57	147	2.4	40	104	0.0	44	115	0.0	48	125	0.0	72	188	0.0	96	250	0.0	57	146	60	156
1888	5.3	56	147	2.5	40	106	0.0	44	117	0.0	48	128	0.0	72	191	0.0	96	255	0.0	57	149	60	159
1838	5.4	55	147	2.5	40	108	0.0	44	119	0.0	48	130	0.0	72	195	0.0	96	260	0.0	57	152	60	162
1790	5.5	54	147	2.5	40	110	0.0	44	121	0.0	48	132	0.0	72	198	0.0	96	264	0.0	57	155	60	165
1743	5.6	53	147	2.5	40	112	0.0	44	124	0.0	48	135	0.0	72	202	0.0	96	269	0.0	57	158	60	168
1698	5.7	52	147	2.6	40	114	0.0	44	126	0.0	48	137	0.0	72	206	0.0	96	274	0.0	57	160	60	171
1653	5.8	51	147	2.6	40	116	0.0	44	128	0.0	48	140	0.0	72	209	0.0	96	279	0.0	57	163	60	174
1610	5.9	50	147	2.6	40	118	0.0	44	130	0.0	48	142	0.0	72	213	0.0	96	284	0.0	57	166	60	177
1568	6.0	49	147	2.6	40	120	0.0	44	132	0.0	48	144	0.0	72	216	0.0	96	288	0.0	57	169	60	180
1527	6.1	49	147	2.6	40	122	0.0	44	135	0.0	48	147	0.0	72	220	0.0	96	293	0.0	57	172	60	183
1487	6.2	48	147	2.7	40	124	0.0	44	137	0.0	48	149	0.0	72	224	0.0	96	298	0.0	57	175	60	186
1448	6.3	47	147	2.7	40	126	0.0	44	139	0.0	48	152	0.0	72	227	0.0	96	303	0.0	57	177	60	189
1410	6.4	46	147	2.7	40	128	0.0	44	141	0.0	48	154	0.0	72	231	0.0	96	308	0.0	57	180	60	192
1372	6.5	46	147	2.8	40	130	0.0	44	143	0.0	48	156	0.0	72	234	0.0	96	312	0.0	57	183	60	195
1336	6.6	45	147	2.8	40	132	0.0	44	146	0.0	48	159	0.0	72	238	0.0	96	317	0.0	57	186	60	198
1300	6.7	44	147	2.8	40	134	0.0	44	148	0.0	48	161	0.0	72	242	0.0	96	322	0.0	57	189	60	201
1265	6.8	44	147	2.8	40	136	0.0	44	150	0.0	48	164	0.0	72	245	0.0	96	327	0.0	57	191	60	204
1230	6.9	43	147	2.9	40	138	0.0	44	152	0.0	48	166	0.0	72	249	0.0	96	332	0.0	57	194	60	207
1196	7.0	42	147	2.9	40	140	0.0	44	154	0.0	48	168	0.0	72	252	0.0	96	336	0.0	57	197	60	210
1162	7.1	42	149	2.9	40	142	0.0	44	157	0.0	48	171	0.0	72	256	0.0	96	341	0.0	57	200	60	213
1128	7.2	43	152	3.0	45	159	2.0	44	159	0.0	48	173	0.0	72	260	0.0	96	346	0.0	57	203	60	216
1094	7.3	43	154	3.0	45	161	2.0	44	161	0.0	48	176	0.0	72	263	0.0	96	351	0.0	57	205	60	219
1059	7.4	43	156	3.0	45	163	2.0	44	163	0.0	48	178	0.0	72	267	0.0	96	356	0.0	57	208	60	222
1024	7.5	43	159	3.1	45	166	2.1	44	165	0.0	48	180	0.0	72	270	0.0	96	360	0.0	57	211	60	225
988	7.6	43	161	3.1	45	168	2.1	44	168	0.0	48	183	0.0	72	274	0.0	96	365	0.0	57	214	60	228
950	7.7	43	164	3.2	45	171	2.2	44	170	0.0	48	185	0.0	72	278	0.0	96	370	0.0	57	217	60	231
908	7.8	43	166	3.2	45	174	2.2	44	172	0.0	48	188	0.0	72	281	0.0	96	375	0.0	57	219	60	234
860	7.9	43	169	3.3	45	177	2.3	44	174	0.0	48	190	0.0	72	285	0.0	96	380	0.0	57	222	60	237
760	8.0	43	172	3.5	45	180	2.5	44	176	0.0	48	192	0.0	72	288	0.0	96	384	0.0	57	225	60	240

NOTE:
Lt, Lr & w VALUES IN FEET. LISTED RADIUS IS THE MINIMUM ALLOWABLE RADIUS FOR THE CORRESPONDING E, Lt, Lr, AND w VALUES.

SPECIFICATION REFERENCE

SPECIFICATION REFERENCE

TRANSITION CURVES - RURAL
55 MPH DESIGN SPEED

VIRGINIA DEPARTMENT OF TRANSPORTATION

DESIGN FACTORS FOR A DESIGN SPEED OF 55 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY =55		WIDTH= 18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT			WIDTH=72 FT			INTERCHANGE RAMPS WIDTH			
		DESIGN SOFTWARE EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)																					
		1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'			3 @ 12'			16 FT		18 FT	
RADIUS(FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	Lt	Lr
10000	NC	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0	0
7190	2.0	39	39	0.0	43	43	0.0	47	47	0.0	52	52	0.0	77	77	0.0	103	103	0.0	60	60	64	64
6821	2.1	39	41	0.0	43	45	0.0	47	50	0.0	52	54	0.0	77	81	0.0	103	108	0.0	60	63	64	67
6485	2.2	39	43	0.0	43	47	0.0	47	52	0.0	52	57	0.0	77	85	0.0	103	113	0.0	60	66	64	70
6179	2.3	39	45	0.0	43	49	0.0	47	54	0.0	52	59	0.0	77	89	0.0	103	118	0.0	60	69	64	73
5897	2.4	39	46	0.0	43	52	0.0	47	57	0.0	52	62	0.0	77	92	0.0	103	123	0.0	60	72	64	76
5638	2.5	39	48	0.0	43	54	0.0	47	59	0.0	52	64	0.0	77	96	0.0	103	128	0.0	60	75	64	79
5399	2.6	39	50	0.0	43	56	0.0	47	61	0.0	52	67	0.0	77	100	0.0	103	133	0.0	60	78	64	83
5177	2.7	39	52	0.0	43	58	0.0	47	64	0.0	52	69	0.0	77	104	0.0	103	138	0.0	60	80	64	86
4972	2.8	39	54	0.0	43	60	0.0	47	66	0.0	52	72	0.0	77	108	0.0	103	143	0.0	60	83	64	89
4779	2.9	39	56	0.0	43	62	0.0	47	68	0.0	52	75	0.0	77	112	0.0	103	149	0.0	60	86	64	92
4600	3.0	39	58	0.0	43	64	0.0	47	71	0.0	52	77	0.0	77	115	0.0	103	154	0.0	60	89	64	95
4432	3.1	39	60	0.0	43	66	0.0	47	73	0.0	52	80	0.0	77	119	0.0	103	159	0.0	60	92	64	98
4274	3.2	39	62	0.0	43	69	0.0	47	75	0.0	52	82	0.0	77	123	0.0	103	164	0.0	60	95	64	102
4125	3.3	39	64	0.0	43	71	0.0	47	78	0.0	52	85	0.0	77	127	0.0	103	169	0.0	60	98	64	105
3986	3.4	39	66	0.0	43	73	0.0	47	80	0.0	52	87	0.0	77	131	0.0	103	174	0.0	60	101	64	108
3853	3.5	39	68	0.0	43	75	0.0	47	82	0.0	52	90	0.0	77	135	0.0	103	179	0.0	60	104	64	111
3728	3.6	39	69	0.0	43	77	0.0	47	85	0.0	52	92	0.0	77	138	0.0	103	184	0.0	60	107	64	114
3610	3.7	39	71	0.0	43	79	0.0	47	87	0.0	52	95	0.0	77	142	0.0	103	189	0.0	60	110	64	117
3498	3.8	39	73	0.0	43	81	0.0	47	89	0.0	52	98	0.0	77	146	0.0	103	195	0.0	60	113	64	120
3391	3.9	39	75	0.0	43	83	0.0	47	92	0.0	52	100	0.0	77	150	0.0	103	200	0.0	60	116	64	124
3289	4.0	39	77	0.0	43	86	0.0	47	94	0.0	52	103	0.0	77	154	0.0	103	205	0.0	60	119	64	127
3192	4.1	39	79	0.0	43	88	0.0	47	96	0.0	52	105	0.0	77	158	0.0	103	210	0.0	60	122	64	130
3100	4.2	39	81	0.0	43	90	0.0	47	99	0.0	52	108	0.0	77	161	0.0	103	215	0.0	60	125	64	133
3011	4.3	39	83	0.0	43	92	0.0	47	101	0.0	52	110	0.0	77	165	0.0	103	220	0.0	60	128	64	136
2927	4.4	39	85	0.0	43	94	0.0	47	103	0.0	52	113	0.0	77	169	0.0	103	225	0.0	60	131	64	139
2866	4.5	39	87	0.0	43	96	0.0	47	106	0.0	52	115	0.0	77	173	0.0	103	230	0.0	60	134	64	143
2865	4.5	72	161	2.2	43	96	0.0	47	106	0.0	52	115	0.0	77	173	0.0	103	230	0.0	60	134	64	143
2846	4.5	72	161	2.3	43	96	0.0	47	106	0.0	52	115	0.0	77	173	0.0	103	230	0.0	60	134	64	143
2768	4.6	70	161	2.3	43	98	0.0	47	108	0.0	52	118	0.0	77	177	0.0	103	235	0.0	60	137	64	146
2693	4.7	69	161	2.3	43	100	0.0	47	110	0.0	52	120	0.0	77	180	0.0	103	240	0.0	60	140	64	149
2621	4.8	68	161	2.3	43	103	0.0	47	113	0.0	52	123	0.0	77	184	0.0	103	246	0.0	60	143	64	152
2552	4.9	66	161	2.3	43	105	0.0	47	115	0.0	52	126	0.0	77	188	0.0	103	251	0.0	60	146	64	155
2486	5.0	65	161	2.3	43	107	0.0	47	118	0.0	52	128	0.0	77	192	0.0	103	256	0.0	60	149	64	158
2421	5.1	64	161	2.4	43	109	0.0	47	120	0.0	52	131	0.0	77	196	0.0	103	261	0.0	60	152	64	162
2359	5.2	62	161	2.4	43	111	0.0	47	122	0.0	52	133	0.0	77	200	0.0	103	266	0.0	60	155	64	165
2299	5.3	61	161	2.4	43	113	0.0	47	125	0.0	52	136	0.0	77	203	0.0	103	271	0.0	60	158	64	168
2241	5.4	60	161	2.4	43	115	0.0	47	127	0.0	52	138	0.0	77	207	0.0	103	276	0.0	60	160	64	171
2185	5.5	59	161	2.5	43	118	0.0	47	129	0.0	52	141	0.0	77	211	0.0	103	281	0.0	60	163	64	174
2130	5.6	58	161	2.5	43	120	0.0	47	132	0.0	52	143	0.0	77	215	0.0	103	286	0.0	60	166	64	177
2077	5.7	57	161	2.5	43	122	0.0	47	134	0.0	52	146	0.0	77	219	0.0	103	292	0.0	60	169	64	180
2026	5.8	56	161	2.5	43	124	0.0	47	136	0.0	52	149	0.0	77	223	0.0	103	297	0.0	60	172	64	184
1976	5.9	55	161	2.5	43	126	0.0	47	139	0.0	52	151	0.0	77	226	0.0	103	302	0.0	60	175	64	187
1927	6.0	54	161	2.6	43	128	0.0	47	141	0.0	52	154	0.0	77	230	0.0	103	307	0.0	60	178	64	190
1880	6.1	53	161	2.6	43	130	0.0	47	143	0.0	52	156	0.0	77	234	0.0	103	312	0.0	60	181	64	193
1833	6.2	52	161	2.6	43	132	0.0	47	146	0.0	52	159	0.0	77	238	0.0	103	317	0.0	60	184	64	196
1788	6.3	52	161	2.6	43	135	0.0	47	148	0.0	52	161	0.0	77	242	0.0	103	322	0.0	60	187	64	199
1743	6.4	51	161	2.6	43	137	0.0	47	150	0.0	52	164	0.0	77	246	0.0	103	327	0.0	60	190	64	203
1700	6.5	50	161	2.7	43	139	0.0	47	153	0.0	52	166	0.0	77	249	0.0	103	332	0.0	60	193	64	206
1657	6.6	49	161	2.7	43	141	0.0	47	155	0.0	52	169	0.0	77	253	0.0	103	338	0.0	60	196	64	209
1615	6.7	49	161	2.7	43	143	0.0	47	157	0.0	52	172	0.0	77	257	0.0	103	343	0.0	60	199	64	212
1573	6.8	48	161	2.7	43	145	0.0	47	160	0.0	52	174	0.0	77	261	0.0	103	348	0.0	60	202	64	215
1532	6.9	47	161	2.8	43	147	0.0	47	162	0.0	52	177	0.0	77	265	0.0	103	353	0.0	60	205	64	218
1491	7.0	46	161	2.8	43	149	0.0	47	164	0.0	52	179	0.0	77	269	0.0	103	358	0.0	60	208	64	222
1450	7.1	46	161	2.8	43	152	0.0	47	167	0.0	52	182	0.0	77	272	0.0	103	363	0.0	60	211	64	225
1409	7.2	45	161	2.9	43	154	0.0	47	169	0.0	52	184	0.0	77	276	0.0	103	368	0.0	60	214	64	228
1369	7.3	45	163	2.9	43	156	0.0	47	171	0.0	52	187	0.0	77	280	0.0	103	373	0.0	60	217	64	231
1327	7.4	45	165	2.9	43	158	0.0	47	174	0.0	52	189	0.0	77	284	0.0	103	378	0.0	60	220	64	234
1285	7.5	45	168	3.0	47	176	2.0	47	176	0.0	52	192	0.0	77	288	0.0	103	383	0.0	60	223	64	237
1241	7.6	45	170	3.0	47	178	2.0	47	178	0.0	52	195	0.0	77	292	0.0	103	389	0.0	60	226	64	240
1195	7.7	45	173	3.0	48	181	2.0	47	181	0.0	52	197	0.0	77	295	0.0	103	394	0.0	60	229	64	244
1145	7.8	46	176	3.1	48	184	2.1	47	183	0.0	52	200	0.0	77	299	0.0	103	399	0.0	60	232	64	247
1085	7.9	46	179	3.2	48	187	2.2	47	185	0.0	52	202	0.0	77	303	0.0	103	404	0.0	60	235	64	250
964	8.0	46	182	3.3	48	190	2.3	47	188	0.0	52	205	0.0	77	307	0.0	103	409	0.0	60	238	64	253

NOTE:
Lt, Lr & w VALUES IN FEET. LISTED RADIUS IS THE MINIMUM ALLOWABLE RADIUS FOR THE CORRESPONDING E, Lt, Lr, AND w VALUES.

TRANSITION CURVES - RURAL
60 MPH DESIGN SPEED

VIRGINIA DEPARTMENT OF TRANSPORTATION

DESIGN FACTORS FOR A DESIGN SPEED OF 60 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY =60		WIDTH= 18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT			WIDTH=72 FT			INTERCHANGE RAMPS WIDTH			
		DESIGN SOFTWARE EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)																					
		1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'			3 @ 12'			16 FT		18 FT	
RADIUS(FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	Lt	Lr
12000	NC	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0	0
8480	2.0	40	40	0.0	45	45	0.0	49	49	0.0	54	54	0.0	80	80	0.0	107	107	0.0	63	63	67	67
8048	2.1	40	42	0.0	45	47	0.0	49	52	0.0	54	56	0.0	80	84	0.0	107	112	0.0	63	66	67	70
7654	2.2	40	44	0.0	45	49	0.0	49	54	0.0	54	59	0.0	80	88	0.0	107	118	0.0	63	70	67	74
7294	2.3	40	46	0.0	45	52	0.0	49	57	0.0	54	62	0.0	80	92	0.0	107	123	0.0	63	73	67	77
6965	2.4	40	48	0.0	45	54	0.0	49	59	0.0	54	64	0.0	80	96	0.0	107	128	0.0	63	76	67	80
6661	2.5	40	50	0.0	45	56	0.0	49	62	0.0	54	67	0.0	80	100	0.0	107	134	0.0	63	79	67	84
6381	2.6	40	52	0.0	45	58	0.0	49	64	0.0	54	70	0.0	80	104	0.0	107	139	0.0	63	82	67	87
6121	2.7	40	54	0.0	45	60	0.0	49	66	0.0	54	72	0.0	80	108	0.0	107	144	0.0	63	85	67	90
5879	2.8	40	56	0.0	45	63	0.0	49	69	0.0	54	75	0.0	80	112	0.0	107	150	0.0	63	88	67	94
5654	2.9	40	58	0.0	45	65	0.0	49	71	0.0	54	78	0.0	80	116	0.0	107	155	0.0	63	91	67	97
5444	3.0	40	60	0.0	45	67	0.0	49	74	0.0	54	80	0.0	80	120	0.0	107	160	0.0	63	95	67	100
5247	3.1	40	62	0.0	45	69	0.0	49	76	0.0	54	83	0.0	80	124	0.0	107	166	0.0	63	98	67	104
5063	3.2	40	64	0.0	45	72	0.0	49	79	0.0	54	86	0.0	80	128	0.0	107	171	0.0	63	101	67	107
4889	3.3	40	66	0.0	45	74	0.0	49	81	0.0	54	88	0.0	80	132	0.0	107	176	0.0	63	104	67	110
4725	3.4	40	68	0.0	45	76	0.0	49	84	0.0	54	91	0.0	80	136	0.0	107	182	0.0	63	107	67	114
4571	3.5	40	70	0.0	45	78	0.0	49	86	0.0	54	94	0.0	80	140	0.0	107	187	0.0	63	110	67	117
4424	3.6	40	72	0.0	45	80	0.0	49	88	0.0	54	96	0.0	80	144	0.0	107	192	0.0	63	113	67	120
4286	3.7	40	74	0.0	45	83	0.0	49	91	0.0	54	99	0.0	80	148	0.0	107	198	0.0	63	117	67	124
4155	3.8	40	76	0.0	45	85	0.0	49	93	0.0	54	102	0.0	80	152	0.0	107	203	0.0	63	120	67	127
4030	3.9	40	78	0.0	45	87	0.0	49	96	0.0	54	104	0.0	80	156	0.0	107	208	0.0	63	123	67	130
3911	4.0	40	80	0.0	45	89	0.0	49	98	0.0	54	107	0.0	80	160	0.0	107	214	0.0	63	126	67	134
3798	4.1	40	82	0.0	45	92	0.0	49	101	0.0	54	110	0.0	80	164	0.0	107	219	0.0	63	129	67	137
3690	4.2	40	84	0.0	45	94	0.0	49	103	0.0	54	112	0.0	80	168	0.0	107	224	0.0	63	132	67	140
3587	4.3	40	86	0.0	45	96	0.0	49	106	0.0	54	115	0.0	80	172	0.0	107	230	0.0	63	135	67	144
3488	4.4	40	88	0.0	45	98	0.0	49	108	0.0	54	118	0.0	80	176	0.0	107	235	0.0	63	139	67	147
3394	4.5	40	90	0.0	45	100	0.0	49	110	0.0	54	120	0.0	80	176	0.0	107	240	0.0	63	142	67	150
3303	4.6	40	92	0.0	45	103	0.0	49	113	0.0	54	123	0.0	80	184	0.0	107	246	0.0	63	145	67	154
3216	4.7	40	94	0.0	45	105	0.0	49	115	0.0	54	126	0.0	80	188	0.0	107	251	0.0	63	148	67	157
3133	4.8	40	96	0.0	45	107	0.0	49	118	0.0	54	128	0.0	80	192	0.0	107	256	0.0	63	151	67	160
3053	4.9	40	98	0.0	45	109	0.0	49	120	0.0	54	131	0.0	80	196	0.0	107	262	0.0	63	154	67	164
2975	5.0	40	100	0.0	45	112	0.0	49	123	0.0	54	134	0.0	80	200	0.0	107	267	0.0	63	157	67	167
2901	5.1	40	102	0.0	45	114	0.0	49	125	0.0	54	136	0.0	80	204	0.0	107	272	0.0	63	160	67	170
2866	5.2	40	104	0.0	45	116	0.0	49	128	0.0	54	139	0.0	80	208	0.0	107	278	0.0	63	164	67	174
2865	5.2	68	176	2.3	45	116	0.0	49	128	0.0	54	139	0.0	80	208	0.0	107	278	0.0	63	164	67	174
2829	5.2	68	176	2.4	45	116	0.0	49	128	0.0	54	139	0.0	80	208	0.0	107	278	0.0	63	164	67	174
2759	5.3	67	176	2.4	45	118	0.0	49	130	0.0	54	142	0.0	80	212	0.0	107	283	0.0	63	167	67	177
2692	5.4	66	176	2.4	45	120	0.0	49	132	0.0	54	144	0.0	80	216	0.0	107	288	0.0	63	170	67	180
2627	5.5	64	176	2.4	45	123	0.0	49	135	0.0	54	147	0.0	80	220	0.0	107	294	0.0	63	173	67	184
2565	5.6	63	176	2.4	45	125	0.0	49	137	0.0	54	150	0.0	80	224	0.0	107	299	0.0	63	176	67	187
2504	5.7	62	176	2.4	45	127	0.0	49	140	0.0	54	152	0.0	80	228	0.0	107	304	0.0	63	179	67	190
2445	5.8	61	176	2.5	45	129	0.0	49	142	0.0	54	155	0.0	80	232	0.0	107	310	0.0	63	182	67	194
2387	5.9	60	176	2.5	45	132	0.0	49	145	0.0	54	158	0.0	80	236	0.0	107	315	0.0	63	186	67	197
2332	6.0	59	176	2.5	45	134	0.0	49	147	0.0	54	160	0.0	80	240	0.0	107	320	0.0	63	189	67	200
2277	6.1	58	176	2.5	45	136	0.0	49	150	0.0	54	163	0.0	80	244	0.0	107	326	0.0	63	192	67	204
2225	6.2	57	176	2.5	45	138	0.0	49	152	0.0	54	166	0.0	80	248	0.0	107	331	0.0	63	195	67	207
2173	6.3	56	176	2.6	45	140	0.0	49	154	0.0	54	168	0.0	80	252	0.0	107	336	0.0	63	198	67	210
2122	6.4	55	176	2.6	45	143	0.0	49	157	0.0	54	171	0.0	80	256	0.0	107	342	0.0	63	201	67	214
2072	6.5	55	176	2.6	45	145	0.0	49	159	0.0	54	174	0.0	80	260	0.0	107	347	0.0	63	204	67	217
2022	6.6	54	176	2.6	45	147	0.0	49	162	0.0	54	176	0.0	80	264	0.0	107	352	0.0	63	208	67	220
1974	6.7	53	176	2.6	45	149	0.0	49	164	0.0	54	179	0.0	80	268	0.0	107	358	0.0	63	211	67	224
1925	6.8	52	176	2.7	45	152	0.0	49	167	0.0	54	182	0.0	80	272	0.0	107	363	0.0	63	214	67	227
1877	6.9	52	176	2.7	45	154	0.0	49	169	0.0	54	184	0.0	80	276	0.0	107	368	0.0	63	217	67	230
1830	7.0	51	176	2.7	45	156	0.0	49	172	0.0	54	187	0.0	80	280	0.0	107	374	0.0	63	220	67	234
1782	7.1	50	176	2.7	45	158	0.0	49	174	0.0	54	190	0.0	80	284	0.0	107	379	0.0	63	223	67	237
1735	7.2	49	176	2.8	45	160	0.0	49	176	0.0	54	192	0.0	80	288	0.0	107	384	0.0	63	226	67	240
1687	7.3	49	176	2.8	45	163	0.0	49	179	0.0	54	195	0.0	80	292	0.0	107	390	0.0	63	230	67	244
1638	7.4	48	176	2.8	45	165	0.0	49	181	0.0	54	198	0.0	80	296	0.0	107	395	0.0	63	233	67	247
1588	7.5	47	176	2.9	45	167	0.0	49	184	0.0	54	200	0.0	80	300	0.0	107	400	0.0	63	236	67	250
1537	7.6	47	177	2.9	45	169	0.0	49	186	0.0	54	203	0.0	80	304	0.0	107	406	0.0	63	239	67	254
1482	7.7	47	179	2.9	45	172	0.0	49	189	0.0	54	206	0.0	80	308	0.0	107	411	0.0	63	242	67	257
1422	7.8	47	182	3.0	49	191	2.0	49	191	0.0	54	208	0.0	80	312	0.0	107	416	0.0	63	245	67	260
1350	7.9	47	185	3.0	49	194	2.0	49	194	0.0	54	211	0.0	80	316	0.0	107	422	0.0	63	248	67	264
1204	8.0	48	189	3.2	50	198	2.2	49	196	0.0	54	214	0.0	80	320	0.0	107	427	0.0	63	251	67	267

NOTE:
Lt, Lr & w VALUES IN FEET. LISTED RADIUS IS THE MINIMUM ALLOWABLE RADIUS FOR THE CORRESPONDING E, Lt, Lr, AND w VALUES.

SPECIFICATION REFERENCE

SPECIFICATION REFERENCE

TRANSITION CURVES - RURAL
65 MPH DESIGN SPEED

VIRGINIA DEPARTMENT OF TRANSPORTATION

DESIGN FACTORS FOR A DESIGN SPEED OF 65 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY =65		WIDTH= 18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT			WIDTH=72 FT			INTERCHANGE RAMPS			
		DESIGN SOFTWARE EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)																		WIDTH			
		1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'			3 @ 12'			16 FT		18 FT	
	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	Lt	Lr
14000	NC	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0	0
9566	2.0	42	42	0.0	47	47	0.0	52	52	0.0	56	56	0.0	84	84	0.0	112	112	0.0	66	66	70	70
9083	2.1	42	44	0.0	47	49	0.0	52	54	0.0	56	59	0.0	84	88	0.0	112	118	0.0	66	69	70	73
8643	2.2	42	47	0.0	47	52	0.0	52	57	0.0	56	62	0.0	84	93	0.0	112	123	0.0	66	72	70	77
8242	2.3	42	49	0.0	47	54	0.0	52	59	0.0	56	65	0.0	84	97	0.0	112	129	0.0	66	76	70	80
7873	2.4	42	51	0.0	47	56	0.0	52	62	0.0	56	67	0.0	84	101	0.0	112	134	0.0	66	79	70	84
7534	2.5	42	53	0.0	47	59	0.0	52	64	0.0	56	70	0.0	84	105	0.0	112	140	0.0	66	82	70	87
7221	2.6	42	55	0.0	47	61	0.0	52	67	0.0	56	73	0.0	84	109	0.0	112	146	0.0	66	85	70	90
6931	2.7	42	57	0.0	47	63	0.0	52	70	0.0	56	76	0.0	84	114	0.0	112	151	0.0	66	89	70	94
6662	2.8	42	59	0.0	47	66	0.0	52	72	0.0	56	79	0.0	84	118	0.0	112	157	0.0	66	92	70	97
6411	2.9	42	61	0.0	47	68	0.0	52	75	0.0	56	81	0.0	84	122	0.0	112	162	0.0	66	95	70	101
6176	3.0	42	63	0.0	47	70	0.0	52	77	0.0	56	84	0.0	84	126	0.0	112	168	0.0	66	98	70	104
5957	3.1	42	65	0.0	47	73	0.0	52	80	0.0	56	87	0.0	84	130	0.0	112	174	0.0	66	102	70	108
5751	3.2	42	67	0.0	47	75	0.0	52	82	0.0	56	90	0.0	84	134	0.0	112	179	0.0	66	105	70	111
5557	3.3	42	70	0.0	47	77	0.0	52	85	0.0	56	93	0.0	84	139	0.0	112	185	0.0	66	108	70	115
5375	3.4	42	72	0.0	47	80	0.0	52	87	0.0	56	95	0.0	84	143	0.0	112	190	0.0	66	112	70	118
5203	3.5	42	74	0.0	47	82	0.0	52	90	0.0	56	98	0.0	84	147	0.0	112	196	0.0	66	115	70	122
5040	3.6	42	76	0.0	47	84	0.0	52	93	0.0	56	101	0.0	84	151	0.0	112	201	0.0	66	118	70	125
4886	3.7	42	78	0.0	47	87	0.0	52	95	0.0	56	104	0.0	84	155	0.0	112	207	0.0	66	121	70	129
4740	3.8	42	80	0.0	47	89	0.0	52	98	0.0	56	107	0.0	84	160	0.0	112	213	0.0	66	125	70	132
4601	3.9	42	82	0.0	47	91	0.0	52	100	0.0	56	109	0.0	84	164	0.0	112	218	0.0	66	128	70	135
4469	4.0	42	84	0.0	47	94	0.0	52	103	0.0	56	112	0.0	84	168	0.0	112	224	0.0	66	131	70	139
4344	4.1	42	86	0.0	47	96	0.0	52	105	0.0	56	115	0.0	84	172	0.0	112	229	0.0	66	134	70	142
4224	4.2	42	88	0.0	47	98	0.0	52	108	0.0	56	118	0.0	84	176	0.0	112	235	0.0	66	138	70	146
4109	4.3	42	90	0.0	47	100	0.0	52	110	0.0	56	120	0.0	84	180	0.0	112	240	0.0	66	141	70	149
4000	4.4	42	93	0.0	47	103	0.0	52	113	0.0	56	123	0.0	84	185	0.0	112	246	0.0	66	144	70	153
3896	4.5	42	95	0.0	47	105	0.0	52	116	0.0	56	126	0.0	84	189	0.0	112	252	0.0	66	147	70	156
3795	4.6	42	97	0.0	47	107	0.0	52	118	0.0	56	129	0.0	84	193	0.0	112	257	0.0	66	151	70	160
3699	4.7	42	99	0.0	47	110	0.0	52	121	0.0	56	132	0.0	84	197	0.0	112	263	0.0	66	154	70	163
3607	4.8	42	101	0.0	47	112	0.0	52	123	0.0	56	134	0.0	84	201	0.0	112	268	0.0	66	157	70	167
3518	4.9	42	103	0.0	47	114	0.0	52	126	0.0	56	137	0.0	84	206	0.0	112	274	0.0	66	160	70	170
3433	5.0	42	105	0.0	47	117	0.0	52	128	0.0	56	140	0.0	84	210	0.0	112	280	0.0	66	164	70	174
3351	5.1	42	107	0.0	47	119	0.0	52	131	0.0	56	143	0.0	84	214	0.0	112	285	0.0	66	167	70	177
3272	5.2	42	109	0.0	47	121	0.0	52	134	0.0	56	146	0.0	84	218	0.0	112	291	0.0	66	170	70	180
3196	5.3	42	111	0.0	47	124	0.0	52	136	0.0	56	148	0.0	84	222	0.0	112	296	0.0	66	174	70	184
3122	5.4	42	114	0.0	47	126	0.0	52	139	0.0	56	151	0.0	84	227	0.0	112	302	0.0	66	177	70	187
3051	5.5	42	116	0.0	47	128	0.0	52	141	0.0	56	154	0.0	84	231	0.0	112	307	0.0	66	180	70	191
2982	5.6	42	118	0.0	47	131	0.0	52	144	0.0	56	157	0.0	84	235	0.0	112	313	0.0	66	183	70	194
2916	5.7	42	120	0.0	47	133	0.0	52	146	0.0	56	160	0.0	84	239	0.0	112	319	0.0	66	187	70	198
2866	5.8	42	122	0.0	47	135	0.0	52	149	0.0	56	162	0.0	84	243	0.0	112	324	0.0	66	190	70	201
2865	5.8	66	191	2.4	47	135	0.0	52	149	0.0	56	162	0.0	84	243	0.0	112	324	0.0	66	190	70	201
2852	5.8	66	191	2.4	47	135	0.0	52	149	0.0	56	162	0.0	84	243	0.0	112	324	0.0	66	190	70	201
2789	5.9	65	191	2.5	47	138	0.0	52	151	0.0	56	165	0.0	84	247	0.0	112	330	0.0	66	193	70	205
2729	6.0	64	191	2.5	47	140	0.0	52	154	0.0	56	168	0.0	84	252	0.0	112	335	0.0	66	196	70	208
2670	6.1	63	191	2.5	47	142	0.0	52	157	0.0	56	171	0.0	84	256	0.0	112	341	0.0	66	200	70	212
2613	6.2	62	191	2.5	47	145	0.0	52	159	0.0	56	174	0.0	84	260	0.0	112	347	0.0	66	203	70	215
2558	6.3	61	191	2.5	47	147	0.0	52	162	0.0	56	176	0.0	84	264	0.0	112	352	0.0	66	206	70	219
2504	6.4	60	191	2.5	47	149	0.0	52	164	0.0	56	179	0.0	84	268	0.0	112	358	0.0	66	209	70	222
2451	6.5	59	191	2.6	47	152	0.0	52	167	0.0	56	182	0.0	84	273	0.0	112	363	0.0	66	213	70	225
2398	6.6	58	191	2.6	47	154	0.0	52	169	0.0	56	185	0.0	84	277	0.0	112	369	0.0	66	216	70	229
2346	6.7	58	191	2.6	47	156	0.0	52	172	0.0	56	187	0.0	84	281	0.0	112	374	0.0	66	219	70	232
2294	6.8	57	191	2.6	47	159	0.0	52	174	0.0	56	190	0.0	84	285	0.0	112	380	0.0	66	223	70	236
2242	6.9	56	191	2.6	47	161	0.0	52	177	0.0	56	193	0.0	84	289	0.0	112	386	0.0	66	226	70	239
2191	7.0	55	191	2.7	47	163	0.0	52	180	0.0	56	196	0.0	84	294	0.0	112	391	0.0	66	229	70	243
2139	7.1	54	191	2.7	47	166	0.0	52	182	0.0	56	199	0.0	84	298	0.0	112	397	0.0	66	232	70	246
2087	7.2	54	191	2.7	47	168	0.0	52	185	0.0	56	201	0.0	84	302	0.0	112	402	0.0	66	236	70	250
2034	7.3	53	191	2.7	47	170	0.0	52	187	0.0	56	204	0.0	84	306	0.0	112	408	0.0	66	239	70	253
1980	7.4	52	191	2.8	47	173	0.0	52	190	0.0	56	207	0.0	84	310	0.0	112	414	0.0	66	242	70	257
1924	7.5	51	191	2.8	47	175	0.0	52	192	0.0	56	210	0.0	84	314	0.0	112	419	0.0	66	245	70	260
1867	7.6	51	191	2.8	47	177	0.0	52	195	0.0	56	213	0.0	84	319	0.0	112	425	0.0	66	249	70	264
1805	7.7	50	191	2.9	47	180	0.0	52	197	0.0	56	215	0.0	84	323	0.0	112	430	0.0	66	252	70	267
1737	7.8	49	191	2.9	47	182	0.0	52	200	0.0	56	218	0.0	84	327	0.0	112	436	0.0	66	255	70	270
1656	7.9	49	192	2.9	47	184	0.0	52	203	0.0	56	221	0.0	84	331	0.0	112	441	0.0	66	258	70	274
1488	8.0	50	197	3.1	52	206	2.1	52	205	0.0	56	224	0.0	84	335	0.0	112	447	0.0	66	262	70	277

NOTE:
Lt, Lr & w VALUES IN FEET. LISTED RADIUS IS THE MINIMUM ALLOWABLE RADIUS FOR THE CORRESPONDING E, Lt, Lr, AND w VALUES.

TRANSITION CURVES - RURAL
70 MPH DESIGN SPEED

VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE

DESIGN FACTORS FOR A DESIGN SPEED OF 70 MPH (RURAL) USING E= 8% MAX.

DESIGN VELOCITY =70		WIDTH= 18 FT			WIDTH=20 FT			WIDTH=22 FT			WIDTH=24 FT			WIDTH=48 FT			WIDTH=72 FT			INTERCHANGE RAMPS WIDTH			
		DESIGN SOFTWARE EQUIVALENTS (NUMBER OF LANES AT LANE WIDTH)																					
		1 @ 9'			1 @ 10'			1 @ 11'			1 @ 12'			2 @ 12'			3 @ 12'			16 FT		18 FT	
RADIUS(FT)	E(%)	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	w	Lt	Lr	Lt	Lr
17000	NC	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0	0
10731	2.0	45	45	0.0	50	50	0.0	55	55	0.0	60	60	0.0	90	90	0.0	120	120	0.0	72	72	75	75
10194	2.1	45	48	0.0	50	53	0.0	55	58	0.0	60	63	0.0	90	95	0.0	120	126	0.0	72	75	75	79
9706	2.2	45	50	0.0	50	55	0.0	55	61	0.0	60	66	0.0	90	99	0.0	120	132	0.0	72	79	75	83
9260	2.3	45	52	0.0	50	58	0.0	55	64	0.0	60	69	0.0	90	104	0.0	120	138	0.0	72	82	75	87
8851	2.4	45	54	0.0	50	60	0.0	55	66	0.0	60	72	0.0	90	108	0.0	120	144	0.0	72	86	75	90
8474	2.5	45	57	0.0	50	63	0.0	55	69	0.0	60	75	0.0	90	113	0.0	120	150	0.0	72	89	75	94
8127	2.6	45	59	0.0	50	65	0.0	55	72	0.0	60	78	0.0	90	117	0.0	120	156	0.0	72	93	75	98
7805	2.7	45	61	0.0	50	68	0.0	55	75	0.0	60	81	0.0	90	122	0.0	120	162	0.0	72	96	75	102
7506	2.8	45	63	0.0	50	70	0.0	55	77	0.0	60	84	0.0	90	126	0.0	120	168	0.0	72	100	75	105
7227	2.9	45	66	0.0	50	73	0.0	55	80	0.0	60	87	0.0	90	131	0.0	120	174	0.0	72	104	75	109
6967	3.0	45	68	0.0	50	75	0.0	55	83	0.0	60	90	0.0	90	135	0.0	120	180	0.0	72	107	75	113
6724	3.1	45	70	0.0	50	78	0.0	55	86	0.0	60	93	0.0	90	140	0.0	120	186	0.0	72	111	75	117
6495	3.2	45	72	0.0	50	80	0.0	55	88	0.0	60	96	0.0	90	144	0.0	120	192	0.0	72	114	75	120
6281	3.3	45	75	0.0	50	83	0.0	55	91	0.0	60	99	0.0	90	149	0.0	120	198	0.0	72	118	75	124
6079	3.4	45	77	0.0	50	85	0.0	55	94	0.0	60	102	0.0	90	153	0.0	120	204	0.0	72	121	75	128
5888	3.5	45	79	0.0	50	88	0.0	55	97	0.0	60	105	0.0	90	158	0.0	120	210	0.0	72	125	75	132
5708	3.6	45	81	0.0	50	90	0.0	55	99	0.0	60	108	0.0	90	162	0.0	120	216	0.0	72	128	75	135
5537	3.7	45	84	0.0	50	93	0.0	55	102	0.0	60	111	0.0	90	167	0.0	120	222	0.0	72	132	75	139
5376	3.8	45	86	0.0	50	95	0.0	55	105	0.0	60	114	0.0	90	171	0.0	120	228	0.0	72	136	75	143
5222	3.9	45	88	0.0	50	98	0.0	55	108	0.0	60	117	0.0	90	176	0.0	120	234	0.0	72	139	75	147
5076	4.0	45	90	0.0	50	100	0.0	55	110	0.0	60	120	0.0	90	180	0.0	120	240	0.0	72	143	75	150
4937	4.1	45	93	0.0	50	103	0.0	55	113	0.0	60	123	0.0	90	185	0.0	120	246	0.0	72	146	75	154
4805	4.2	45	95	0.0	50	105	0.0	55	116	0.0	60	126	0.0	90	189	0.0	120	252	0.0	72	150	75	158
4679	4.3	45	97	0.0	50	108	0.0	55	119	0.0	60	129	0.0	90	194	0.0	120	258	0.0	72	153	75	162
4558	4.4	45	99	0.0	50	110	0.0	55	121	0.0	60	132	0.0	90	198	0.0	120	264	0.0	72	157	75	165
4443	4.5	45	102	0.0	50	113	0.0	55	124	0.0	60	135	0.0	90	203	0.0	120	270	0.0	72	160	75	169
4332	4.6	45	104	0.0	50	115	0.0	55	127	0.0	60	138	0.0	90	207	0.0	120	276	0.0	72	164	75	173
4226	4.7	45	106	0.0	50	118	0.0	55	130	0.0	60	141	0.0	90	212	0.0	120	282	0.0	72	168	75	177
4125	4.8	45	108	0.0	50	120	0.0	55	132	0.0	60	144	0.0	90	216	0.0	120	288	0.0	72	171	75	180
4027	4.9	45	111	0.0	50	123	0.0	55	135	0.0	60	147	0.0	90	221	0.0	120	294	0.0	72	175	75	184
3933	5.0	45	113	0.0	50	125	0.0	55	138	0.0	60	150	0.0	90	225	0.0	120	300	0.0	72	178	75	188
3843	5.1	45	115	0.0	50	128	0.0	55	141	0.0	60	153	0.0	90	230	0.0	120	306	0.0	72	182	75	192
3756	5.2	45	117	0.0	50	130	0.0	55	143	0.0	60	156	0.0	90	234	0.0	120	312	0.0	72	185	75	195
3673	5.3	45	120	0.0	50	133	0.0	55	146	0.0	60	159	0.0	90	239	0.0	120	318	0.0	72	189	75	199
3592	5.4	45	122	0.0	50	135	0.0	55	149	0.0	60	162	0.0	90	243	0.0	120	324	0.0	72	192	75	203
3514	5.5	45	124	0.0	50	138	0.0	55	152	0.0	60	165	0.0	90	248	0.0	120	330	0.0	72	196	75	207
3439	5.6	45	126	0.0	50	140	0.0	55	154	0.0	60	168	0.0	90	252	0.0	120	336	0.0	72	200	75	210
3366	5.7	45	129	0.0	50	143	0.0	55	157	0.0	60	171	0.0	90	257	0.0	120	342	0.0	72	203	75	214
3296	5.8	45	131	0.0	50	145	0.0	55	160	0.0	60	174	0.0	90	261	0.0	120	348	0.0	72	207	75	218
3228	5.9	45	133	0.0	50	148	0.0	55	163	0.0	60	177	0.0	90	266	0.0	120	354	0.0	72	210	75	222
3163	6.0	45	135	0.0	50	150	0.0	55	165	0.0	60	180	0.0	90	270	0.0	120	360	0.0	72	214	75	225
3099	6.1	45	138	0.0	50	153	0.0	55	168	0.0	60	183	0.0	90	275	0.0	120	366	0.0	72	217	75	229
3037	6.2	45	140	0.0	50	155	0.0	55	171	0.0	60	186	0.0	90	279	0.0	120	372	0.0	72	221	75	233
2977	6.3	45	142	0.0	50	158	0.0	55	174	0.0	60	189	0.0	90	284	0.0	120	378	0.0	72	224	75	237
2919	6.4	45	144	0.0	50	160	0.0	55	176	0.0	60	192	0.0	90	288	0.0	120	384	0.0	72	228	75	240
2866	6.5	45	147	0.0	50	163	0.0	55	179	0.0	60	195	0.0	90	293	0.0	120	390	0.0	72	232	75	244
2865	6.5	64	205	2.5	50	163	0.0	55	179	0.0	60	195	0.0	90	293	0.0	120	390	0.0	72	232	75	244
2862	6.5	64	205	2.5	50	163	0.0	55	179	0.0	60	195	0.0	90	293	0.0	120	390	0.0	72	232	75	244
2807	6.6	63	205	2.5	50	165	0.0	55	182	0.0	60	198	0.0	90	297	0.0	120	396	0.0	72	235	75	248
2753	6.7	62	205	2.6	50	168	0.0	55	185	0.0	60	201	0.0	90	302	0.0	120	402	0.0	72	239	75	252
2699	6.8	61	205	2.6	50	170	0.0	55	187	0.0	60	204	0.0	90	306	0.0	120	408	0.0	72	242	75	255
2645	6.9	60	205	2.6	50	173	0.0	55	190	0.0	60	207	0.0	90	311	0.0	120	414	0.0	72	246	75	259
2590	7.0	59	205	2.6	50	175	0.0	55	193	0.0	60	210	0.0	90	315	0.0	120	420	0.0	72	249	75	263
2535	7.1	58	205	2.6	50	178	0.0	55	196	0.0	60	213	0.0	90	320	0.0	120	426	0.0	72	253	75	267
2480	7.2	57	205	2.7	50	180	0.0	55	198	0.0	60	216	0.0	90	324	0.0	120	432	0.0	72	256	75	270
2423	7.3	57	205	2.7	50	183	0.0	55	201	0.0	60	219	0.0	90	329	0.0	120	438	0.0	72	260	75	274
2365	7.4	56	205	2.7	50	185	0.0	55	204	0.0	60	222	0.0	90	333	0.0	120	444	0.0	72	264	75	278
2305	7.5	55	205	2.7	50	188	0.0	55	207	0.0	60	225	0.0	90	338	0.0	120	450	0.0	72	267	75	282
2242	7.6	54	205	2.7	50	190	0.0	55	209	0.0	60	228	0.0	90	342	0.0	120	456	0.0	72	271	75	285
2175	7.7	54	205	2.8	50	193	0.0	55	212	0.0	60	231	0.0	90	347	0.0	120	462	0.0	72	274	75	289
2100	7.8	53	205	2.8	50	195	0.0	55	215	0.0	60	234	0.0	90	351	0.0	120	468	0.0	72	278	75	293
2010	7.9	53	207	2.9	50	198	0.0	55	218	0.0	60	237	0.0	90	356	0.0	120	474	0.0	72	281	75	297
1821	8.0	53	210	3.0	55	220	2.0	55	220	0.0	60	240	0.0	90	360	0.0	120	480	0.0	72	285	75	300

NOTE:
Lt, Lr & w VALUES IN FEET. LISTED RADIUS IS THE MINIMUM ALLOWABLE RADIUS FOR THE CORRESPONDING E, Lt, Lr, AND w VALUES.