NORTH CAROLINA
Department of Transportation

Superelevation Lunch and Learn

Research, Standards, and Innovation Team
Roadway Design Unit

September 16, 2025

Connecting people, products and places safely and efficiently with customer focus, accountability and environmental sensitivity to enhance the economy and vitality of North Carolina

Applying Appropriate Superelevation

Focus Areas:

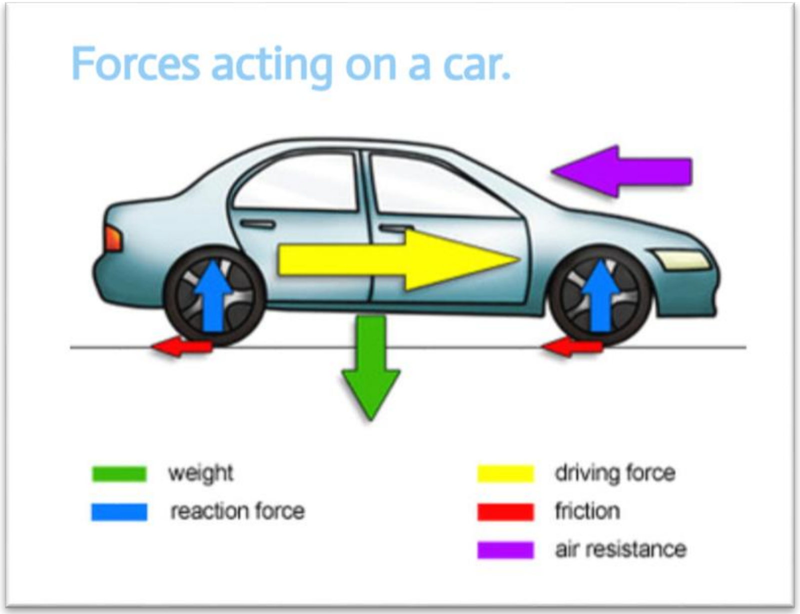
1. Typical Applications/Guidance
2. Driver Expectation
3. Superelevation and Rollover at Ramp Ties
4. Temporary Detours

Typical Applications & Driver Expectations

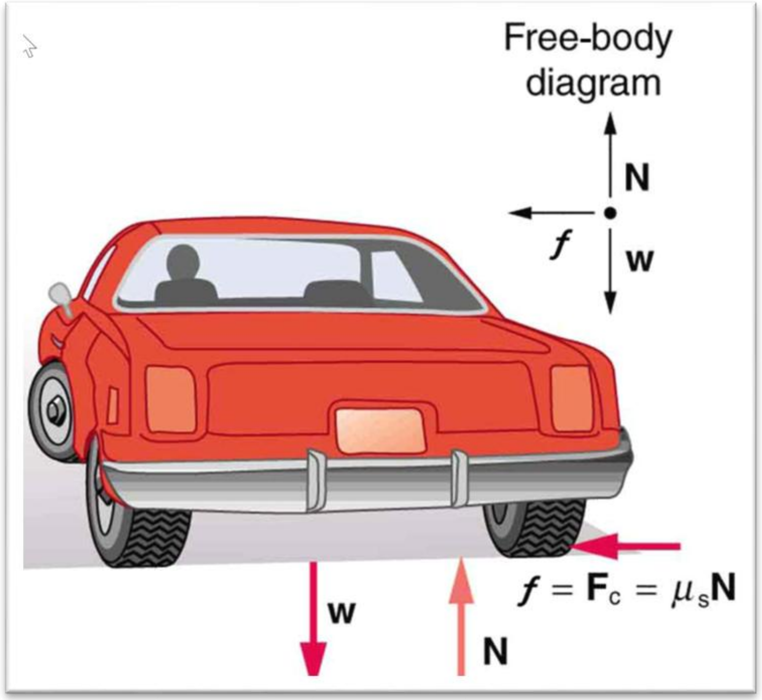
Why Apply Superelevation?

Friction Forces acting between the car tires and road surface are reduced with the application of superelevation, or banking, of the road.

Traveling Straight:



Traveling in a flat curve:



Why Apply Superelevation?

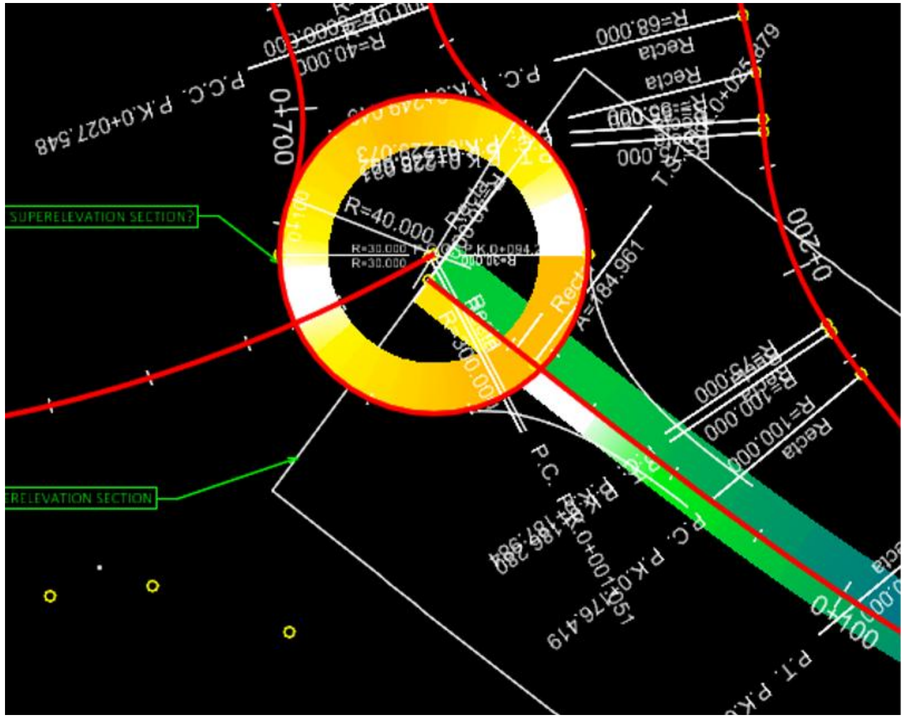
What happens when we do not design adequately for the design speed, curvature, design vehicle and driver expectations?

The same thing that happens when drivers choose to go too fast for the speeds we design for.....

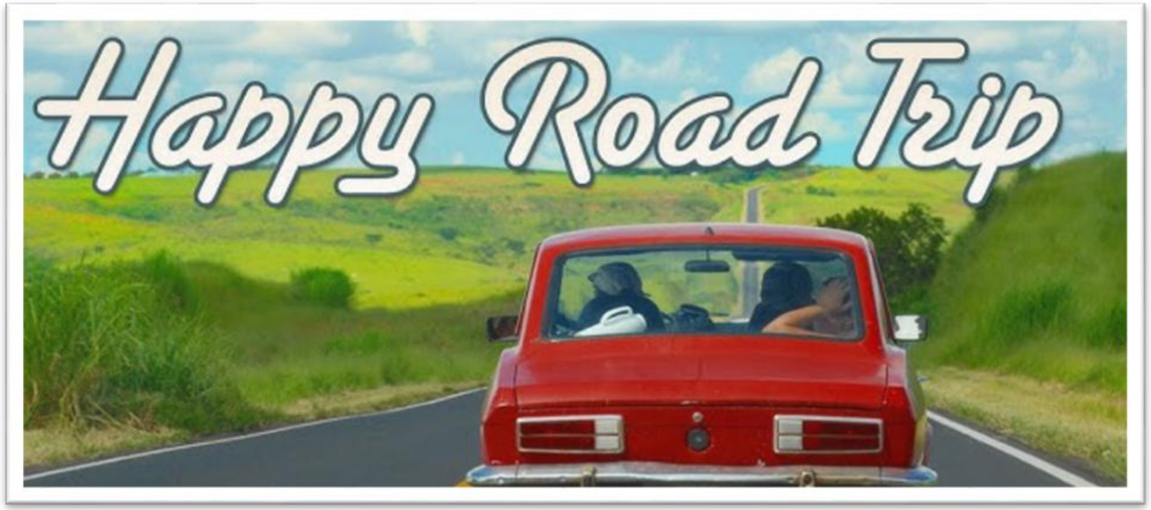
Our responsibility is to design and sign for the speeds that are posted and typical, which drivers expect on our relatively consistent highway system.

What Is Driver Expectation And Why Does It Matter?

Driver make many decisions every few seconds, and the number of decisions they make depends on what they see and experience around them constantly.



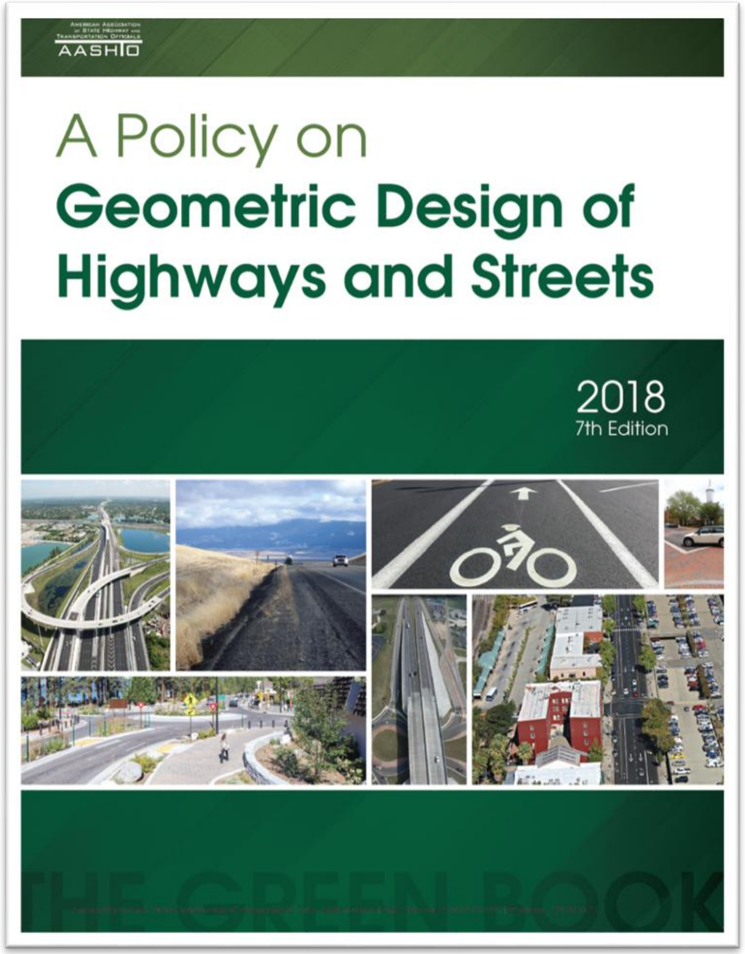
What Is Driver Expectation And Why Does It Matter?

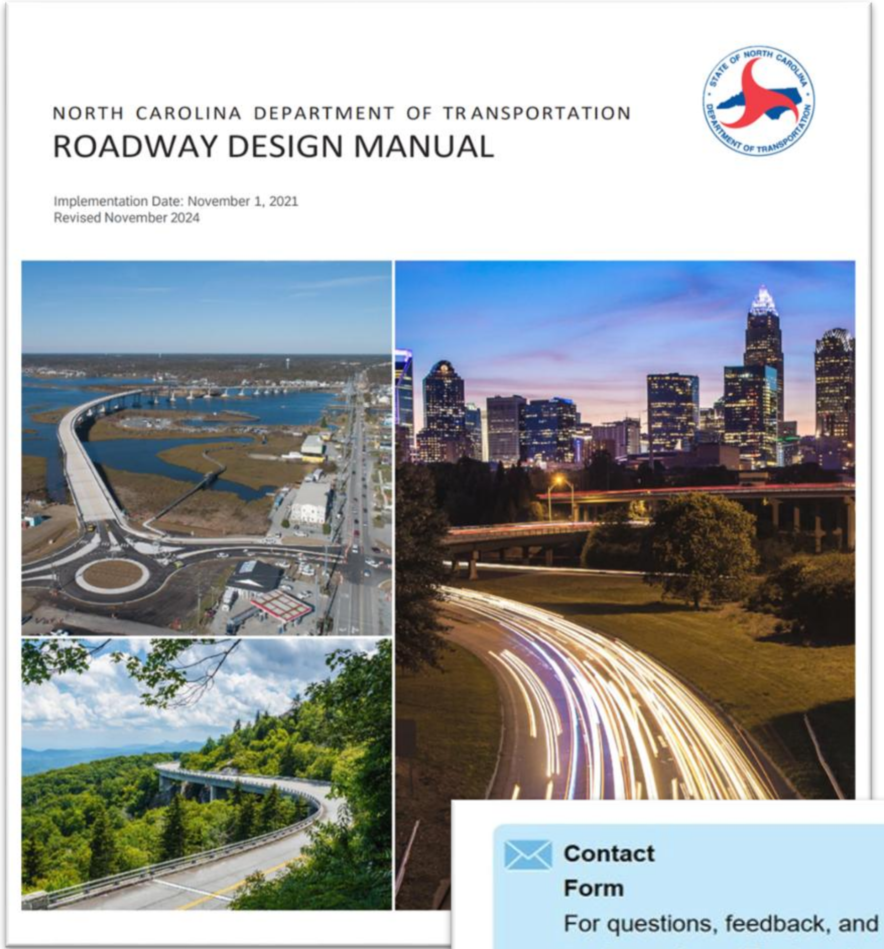


Consistency = Comfort

Unexpected Situations Create Discomfort

Guidance





Contact Form

For questions, feedback, and to sign up for notifications to the *Roadway Design Manual.*

Superelevation Guidance

Roadway Design Manual (May 2025 Update)

Table 3-5 Superelevation Guidelines

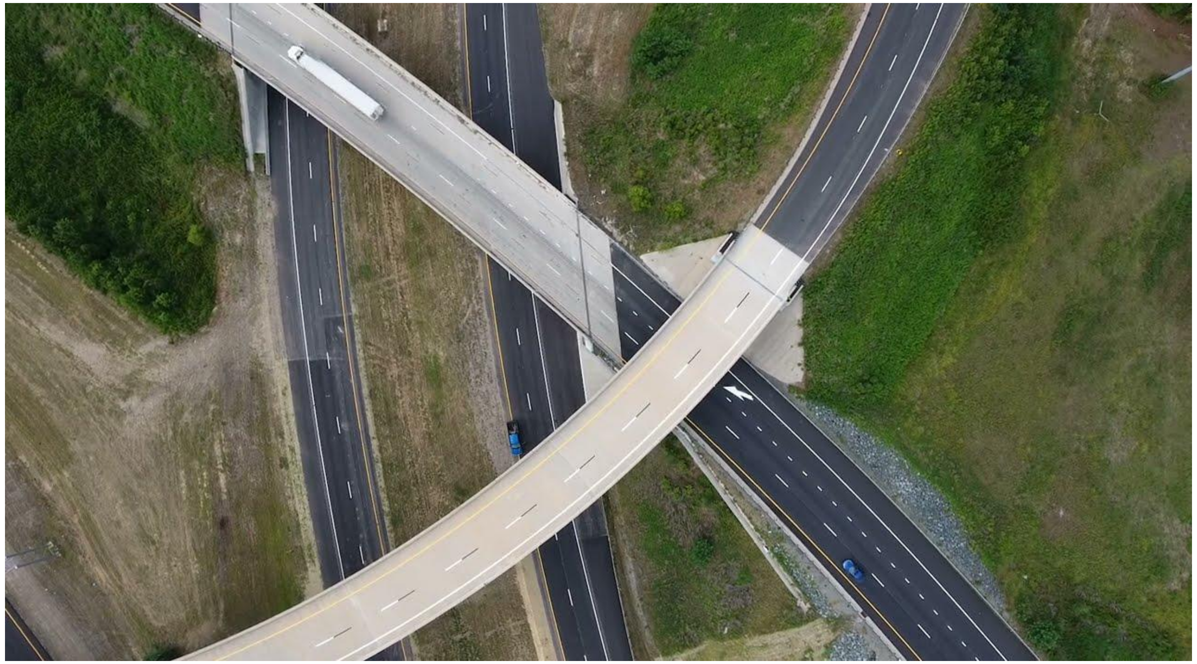
Classification	Location & Condition	Superelevation[1, 4, 5] Table to be Used
Interstates & Freeways	• Statewide	.08 or .10 [2]
Ramps & Loops	• Statewide	.08
Rural Arterials & Collectors	• Statewide	.08
Urban Arterials & Collectors with greater than 50 mph design speed	• Statewide	.06
Urban Collectors with 50 mph or less design speed	• Statewide	.04
Local Roads	• Statewide	.04 or .06 [3]
Curb and Gutter facilities	• Statewide	.04

Notes:

1. Refer to GB Chapter 3 Section 3.3.5 for particular design superelevation tables the designer should use.
2. Do not use in locations susceptible to icy conditions.
3. Choose superelevation table that fits characteristics of area.
4. For cored slab and box beam bridges, do not exceed a .04 superelevation.
5. For alignments with bridges, design the curve radius so that superelevation on the bridge does not exceed .06.

Flyover Superelevation

- Use .06 maximum superelevation for the entire curve if there is a proposed bridge on the curve.
- Apply .06 super on the .06 max super chart (GB Table 3-9) as a minimum for designs with limited right of way and semi-direct connections where high-speed designs are not expected.
- Design with the largest practicable radius while providing .06 maximum superelevation to allow for the highest possible design speed.
- Coordinate and Document

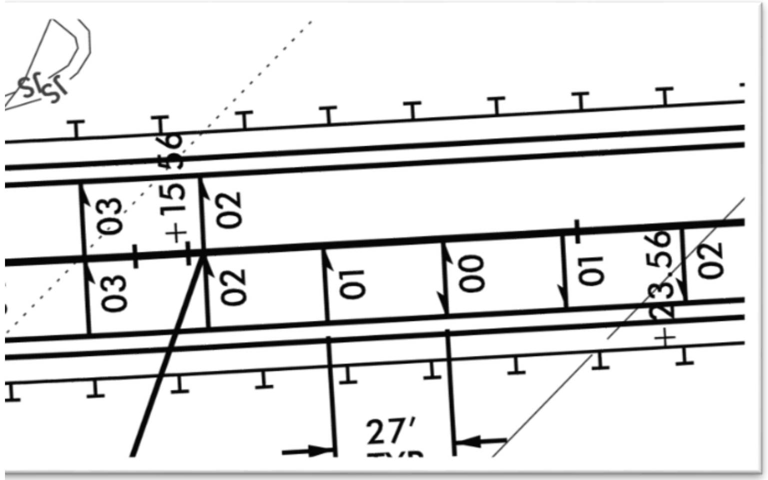


Applying Superelevation to a Road

Superelevation and roadway curvature are dependent on each other for achieving design speed.

Table 3-9. Minimum Radii for Design Superelevation Rates, Design Speeds, and e_{max} = 6%

U.S. Customary														
e (%)	V_d = 15 mph	V_d = 20 mph	V_d = 25 mph	V_d = 30 mph	V_d = 35 mph	V_d = 40 mph	V_d = 45 mph	V_d = 50 mph	V_d = 55 mph	V_d = 60 mph	V_d = 65 mph	V_d = 70 mph	V_d = 75 mph	V_d = 80 mph
	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)
NC	868	1580	2290	3130	4100	5230	6480	7870	9410	11100	12600	14100	15700	17400
RC	614	1120	1630	2240	2950	3770	4680	5700	6820	8060	9130	10300	11500	12900
2.2	543	991	1450	2000	2630	3370	4190	5100	6110	7230	8200	9240	10400	11600
2.4	482	884	1300	1790	2360	3030	3770	4600	5520	6540	7430	8380	9420	10600
2.6	430	791	1170	1610	2130	2740	3420	4170	5020	5950	6770	7660	8620	9670
2.8	384	709	1050	1460	1930	2490	3110	3800	4580	5440	6200	7030	7930	8910
3.0	341	635	944	1320	1760	2270	2840	3480	4200	4990	5710	6490	7330	8260
3.2	300	566	850	1200	1600	2080	2600	3200	3860	4600	5280	6010	6810	7680



A design speed is achieved when appropriate superelevation is provided to mitigate the centrifugal forces created by roadway curvature

2019 Green Book Errata

2018 GB

Table 3-16a. Superelevation Runoff L_r (ft) for Horizontal Curves (Continued)

U.S. Customary																												
e (%)	V_d = 15 mph		V_d = 20 mph		V_d = 25 mph		V_d = 30 mph		V_d = 35 mph		V_d = 40 mph		Vd = 45 mph		Vd = 50 mph		V_d = 55 mph		V_d = 60 mph		V_d = 65 mph		V_d = 70 mph		V_d = 75 mph		V_d = 80 mph	
	Number of Lanes Rotated. Note that 1 lane rotated is typical for a 2-lane highway, 2 lanes rotated is typical for a 4-lane highway, etc. (See Table 3-15.)																											
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)
7.0	108	162	114	170	120	180	127	191	135	203	145	217	156	233	168	252	179	268	187	280	195	293	210	315	221	332	240	360
7.2	111	166	117	175	123	185	131	196	139	209	149	223	160	240	173	259	184	276	192	288	201	301	216	324	227	341	247	370
7.4	114	171	120	180	127	190	135	202	143	215	153	230	164	247	178	266	189	283	197	296	207	310	222	333	234	351	254	381
7.6	117	175	123	185	130	195	138	207	147	221	157	236	169	253	182	274	194	291	203	304	212	318	228	342	240	360	261	391
7.8	120	180	126	190	134	201	142	213	151	226	161	242	173	260	187	281	199	299	208	312	218	327	234	351	246	369	267	401
8.0	123	185	130	195	137	206	145	218	155	232	166	248	178	267	192	288	204	306	213	320	223	335	240	360	253	379	274	411

2019

GB Errata

Table 3-16a. Superelevation Runoff L_r (ft) for Horizontal Curves (Continued)

U.S. Customary																														
e (%)	V_d = 15 mph		V_d = 20 mph		V_d = 25 mph		V_d = 30 mph		V_d = 35 mph		V_d = 40 mph		V_d = 45 mph		V_d = 50 mph		V_d = 55 mph		V_d = 60 mph		V_d = 65 mph		V_d = 70 mph		V_d = 75 mph		V_d = 80 mph		V_d = 85 mph	
	Number of Lanes Rotated. Note that 1 lane rotated is typical for a 2-lane highway; 2 lanes rotated is typical for a 4-lane highway, etc. (See Table 3-15.)																													
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)	L_r (ft)
7.0	105	158	105	158	116	173	126	189	137	205	147	221	158	236	168	252	168	252	168	252	168	252	168	252	168	252	168	252	168	252
7.2	108	162	108	162	119	178	130	194	140	211	151	227	162	243	173	259	173	259	173	259	173	259	173	259	173	259	173	259	173	259
7.4	111	167	111	167	122	183	133	200	144	217	156	233	167	250	178	266	178	266	178	266	178	266	178	266	178	266	178	266	178	266
7.6	114	171	114	171	125	188	137	205	148	222	160	240	171	257	182	274	182	274	182	274	182	274	182	274	182	274	182	274	182	274
7.8	117	176	117	176	129	193	140	210	152	228	164	246	176	263	187	281	187	281	187	281	187	281	187	281	187	281	187	281	187	281
8.0	120	180	120	180	132	198	144	216	156	234	168	252	180	270	192	288	192	288	192	288	192	288	192	288	192	288	192	288	192	288
8.2	123	185	123	185	135	203	148	221	160	240	172	258	185	277	197	295	197	295	197	295	197	295	197	295	197	295	197	295	197	295

2019 Green Book Errata

2018 GB Section 3.3.8.2.1
Text includes updated maximum relative gradient values
(Not changed by Errata)

Runoff Length Formula:

U.S. Customary

$$L_r = \frac{(wn_1)\,e_d}{\Delta}(b_w)$$

where:

L_r = minimum length of superelevation runoff, ft

w = width of one traffic lane, ft (typically 12 ft)

n_1 = number of lanes rotated

e_d = design superelevation rate, percent

b_w = adjustment factor for number of lanes rotated

Δ = maximum relative gradient, percent

3.3.8.2 Tangent-to-Curve Transition

3.3.8.2.1 Minimum Length of Superelevation Runoff

The length of superelevation runoff is typically computed based on the relative difference in gradient between the axis of rotation and the edge of pavement. The axis of rotation is generally represented by the alignment centerline for undivided roadways; however, other pavement reference lines can be used. These lines and the rationale for their use is discussed in Section 3.3.8.6, "Methods of Attaining Superelevation."

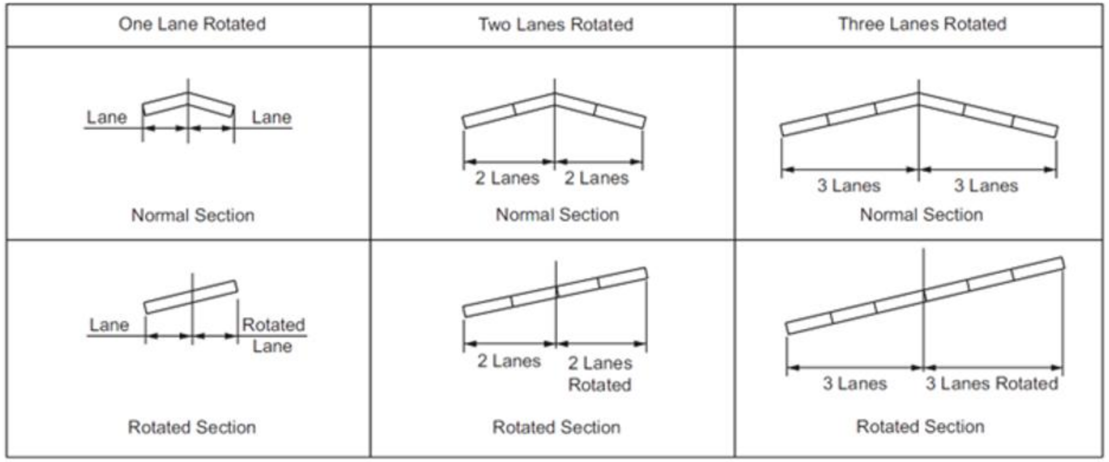
For optimal comfort and to avoid an abrupt appearance, the desirable maximum gradient for design speeds of 50 mph [80 km/h] and higher is 0.50 percent, or a longitudinal slope of 1:200. Greater relative slopes are appropriate for low-speed design: 1:175 for 40 mph [70 km/h], 1:150 for 30 mph [50 km/h], and 1:125 for 20 mph [30 km/h] design speeds. Design values may be interpolated for design speeds of 25, 35, and 45 mph [40 and 60 km/h].

Maximum Relative Gradient values used in the formula did not follow the 2018 guidance in the text

$$L_r = \frac{(wn_1)\, e_d}{\Delta}(b_w)$$

Table 3-15. Adjustment Factor for Number of Lanes Rotated

U.S. Customary			Metric		
Number of Lanes Rotated, n_1	Adjustment Factor,* b_w	Length Increase Relative to One-Lane Rotated, $(= n_1\, b_w)$	Number of Lanes Rotated, n_1	Adjustment Factor,* b_w	Length Increase Relative to One Lane Rotated, $(= n_1\, b_w)$
1	1.00	1.0	1	1.00	1.0
1.5	0.83	1.25	1.5	0.83	1.25
2	0.75	1.5	2	0.75	1.5
2.5	0.70	1.75	2.5	0.70	1.75
3	0.67	2.0	3	0.67	2.0
3.5	0.64	2.25	3.5	0.64	2.25



* $b_w = [1 + 0.5\,(n_1 - 1)]/n_1$

Bw (Adjustment Factor)

n_1 -Number of lanes rotated is the width from grade point to the edge of travel lane divided by "typical" lane width (12')

A "0.5" lane is therefore 6ft

A 23' median adds 1 full lane width to the calculation if the grade point follows the center alignment

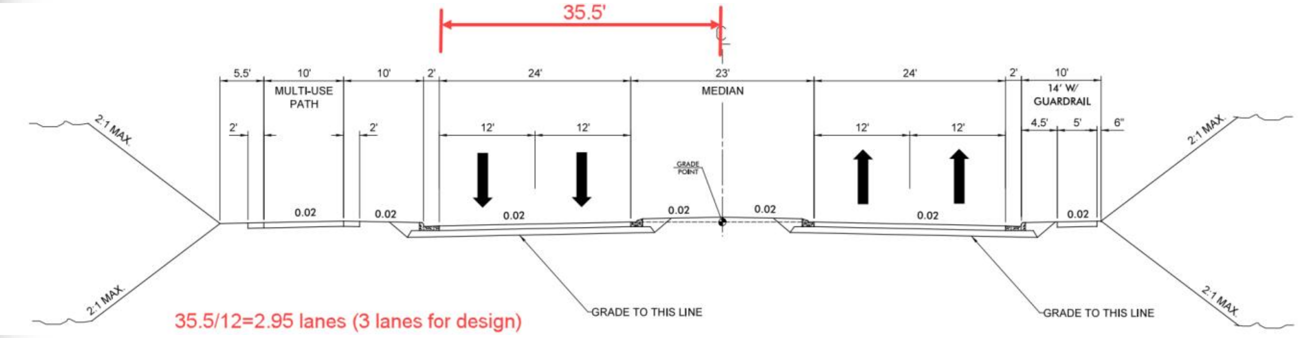
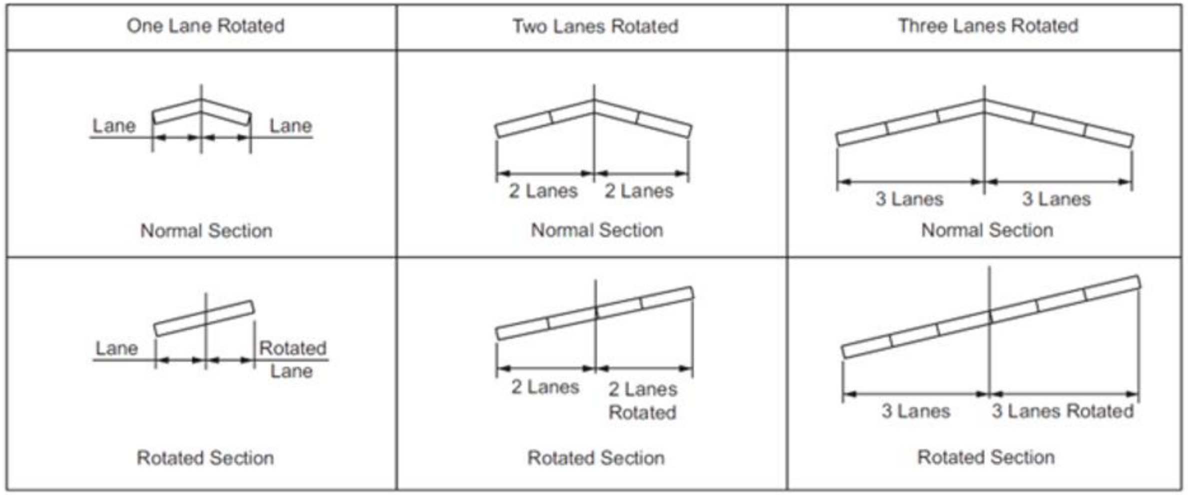


Table 3-15. Adjustment Factor for Number of Lanes Rotated

U.S. Customary			Metric		
Number of Lanes Rotated, n_1	Adjustment Factor,* b_w	Length Increase Relative to One-Lane Rotated, $(= n_1 b_w)$	Number of Lanes Rotated, n_1	Adjustment Factor,* b_w	Length Increase Relative to One Lane Rotated, $(= n_1 b_w)$
1	1.00	1.0	1	1.00	1.0
1.5	0.83	1.25	1.5	0.83	1.25
2	0.75	1.5	2	0.75	1.5
2.5	0.70	1.75	2.5	0.70	1.75
3	0.67	2.0	3	0.67	2.0
3.5	0.64	2.25	3.5	0.64	2.25



* $b_w = [1 + 0.5 (n_1 - 1)]/n_1$

$$L_r = \frac{(wn_1)\, e_d}{\Delta}(b_w)$$

e (%)	V_d = 70 mph, highway, etc.	
	1	2
	L_r (ft)	L_r (ft)
7.0	168	252
7.2	173	259
7.4	178	266
7.6	182	274
7.8	187	281
8.0	192	288

Example

L= (12)(2)(8)(.75) / .5 = 288

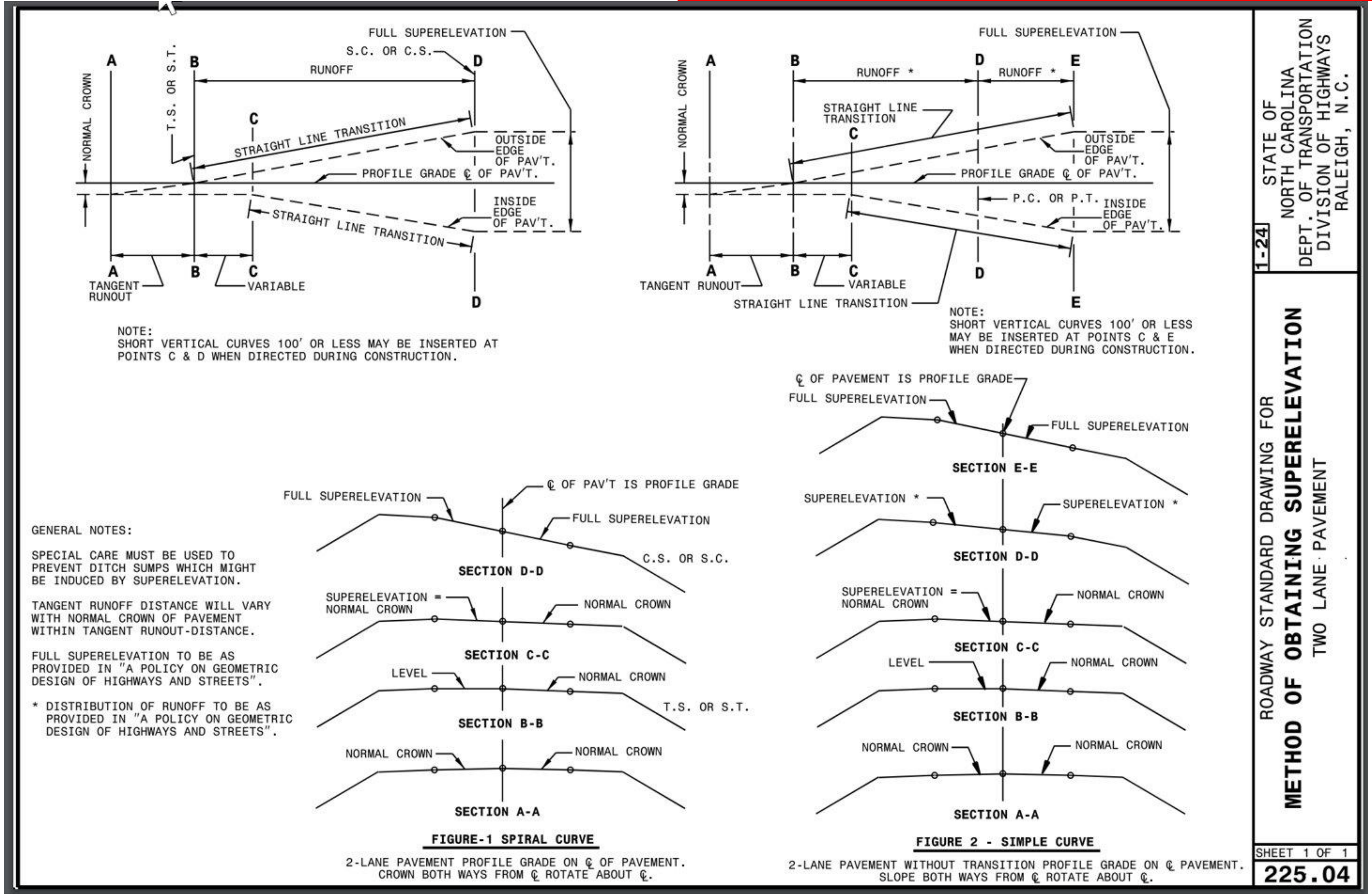
To make even increments and runoff length:

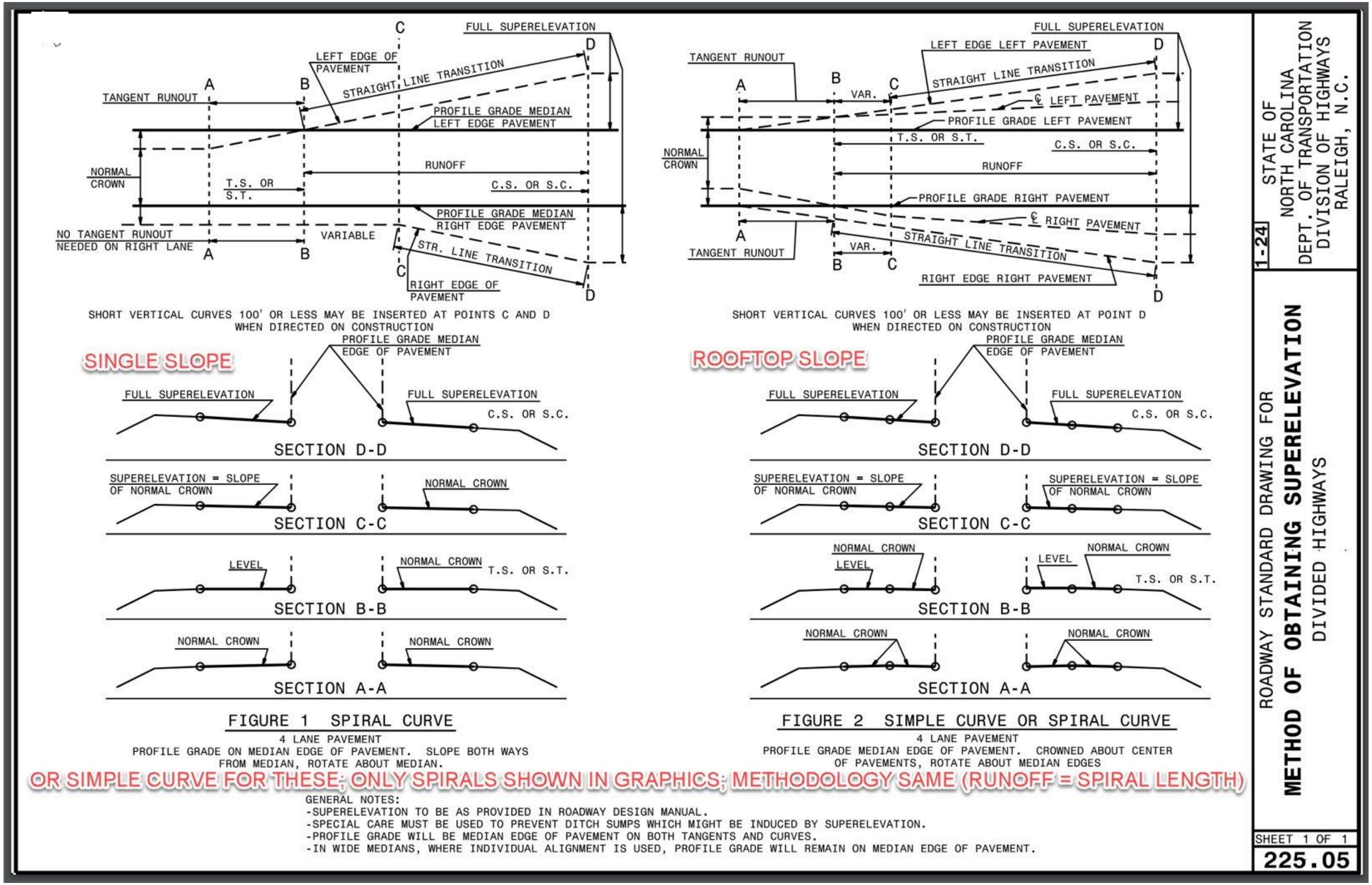
288/8=36' increment. If it were not a whole number, I would round to the nearest whole number and multiply by 8 for the proposed runoff length.

Note: Long increments increase hydroplaning potential when rotating through 00 super.

Spiral: Runoff = Length of Spiral

Simple Curve: Runoff (RO)
Applied 1/3 In, 2/3 Outside of Curve




FULL SUPERELEVATION
LEFT EDGE OF PAVEMENT
STRAIGHT LINE TRANSITION
TANGENT RUNOUT
PROFILE GRADE MEDIAN LEFT EDGE PAVEMENT
NORMAL CROWN
RUNOFF
T.S. OR S.T.
C.S. OR S.C.
PROFILE GRADE MEDIAN RIGHT EDGE PAVEMENT
NO TANGENT RUNOUT NEEDED ON RIGHT LANE
VARIABLE
STR. LINE TRANSITION
RIGHT EDGE OF PAVEMENT
SHORT VERTICAL CURVES 100' OR LESS MAY BE INSERTED AT POINTS C AND D WHEN DIRECTED ON CONSTRUCTION
SINGLE SLOPE
PROFILE GRADE MEDIAN EDGE OF PAVEMENT
SECTION D-D
SUPERELEVATION = SLOPE OF NORMAL CROWN
SECTION C-C
LEVEL
SECTION B-B
SECTION A-A
FIGURE 1 SPIRAL CURVE
4 LANE PAVEMENT
PROFILE GRADE ON MEDIAN EDGE OF PAVEMENT. SLOPE BOTH WAYS FROM MEDIAN, ROTATE ABOUT MEDIAN.
LEFT EDGE LEFT PAVEMENT
VAR.
℄ LEFT PAVEMENT
PROFILE GRADE LEFT PAVEMENT
PROFILE GRADE RIGHT PAVEMENT
℄ RIGHT PAVEMENT
RIGHT EDGE RIGHT PAVEMENT
SHORT VERTICAL CURVES 100' OR LESS MAY BE INSERTED AT POINT D WHEN DIRECTED ON CONSTRUCTION
ROOFTOP SLOPE
FIGURE 2 SIMPLE CURVE OR SPIRAL CURVE
4 LANE PAVEMENT
PROFILE GRADE MEDIAN EDGE OF PAVEMENT. CROWNED ABOUT CENTER OF PAVEMENTS, ROTATE ABOUT MEDIAN EDGES
OR SIMPLE CURVE FOR THESE; ONLY SPIRALS SHOWN IN GRAPHICS; METHODOLOGY SAME (RUNOFF = SPIRAL LENGTH)
GENERAL NOTES:
-SUPERELEVATION TO BE AS PROVIDED IN ROADWAY DESIGN MANUAL.
-SPECIAL CARE MUST BE USED TO PREVENT DITCH SUMPS WHICH MIGHT BE INDUCED BY SUPERELEVATION.
-PROFILE GRADE WILL BE MEDIAN EDGE OF PAVEMENT ON BOTH TANGENTS AND CURVES.
-IN WIDE MEDIANS, WHERE INDIVIDUAL ALIGNMENT IS USED, PROFILE GRADE WILL REMAIN ON MEDIAN EDGE OF PAVEMENT.
STATE OF NORTH CAROLINA
DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
RALEIGH, N.C.
1-24
ROADWAY STANDARD DRAWING FOR
METHOD OF OBTAINING SUPERELEVATION
DIVIDED HIGHWAYS
SHEET 1 OF 1
225.05

2018 AASHTO Green Book Simple Curve Superelevation Application

The Greenbook has moved away from a standard 2/3 (0.67) out – 1/3(0.33) in Runoff Application. However, it does indicate a majority of agencies still use it, and NC accepts this methodology as well.

U.S. Customary

$$\frac{e}{100} < \frac{2.15}{1 + p_{tangent}} \times \frac{v^2}{gR}$$

where:

e = superelevation at PC of horizontal curve

$p_{tangent}$ = proportion of the maximum superelevation attained at the PC of the horizontal curve

V = design speed, mph

g = gravitational constant, 32.2 ft/s^2

R = radius of horizontal curve, ft

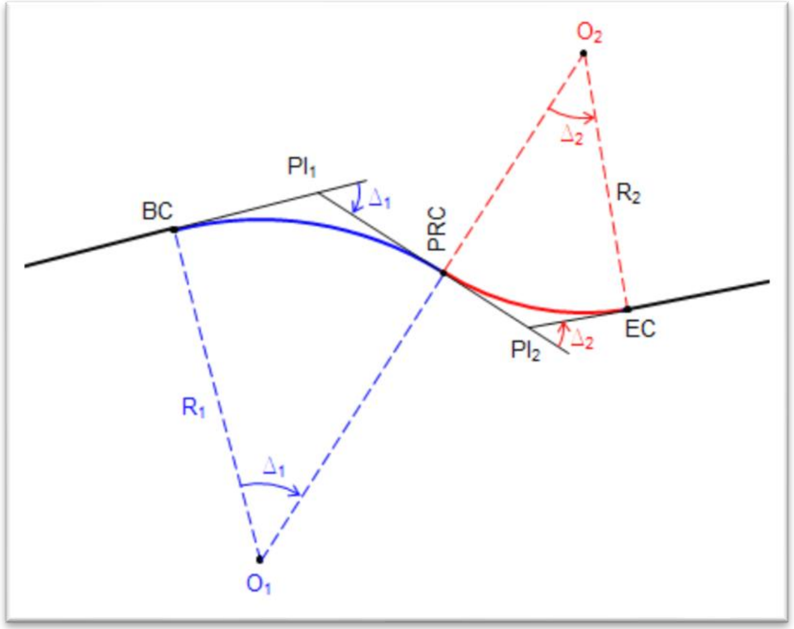
2/3 (0.67)

IF / THEN

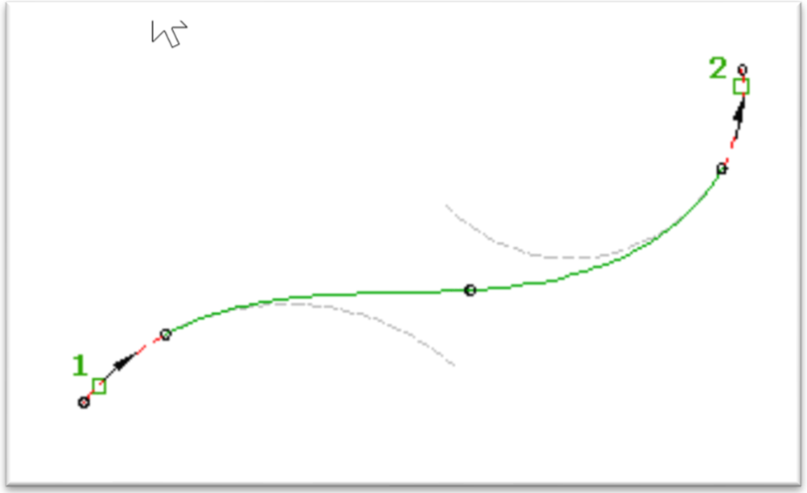
If the condition presented above is met, engineers can proceed with the superelevation transition as designed using the runoff proportion selected. If the condition presented above is not met, designers should reduce the proportion of the maximum superelevation attained at the PC of the horizontal curve, or introduce a spiral transition curve between the approach tangent and simple horizontal curve.

NCDOT Uses Spirals on High-Speed Facilities so we are 'okay' here.

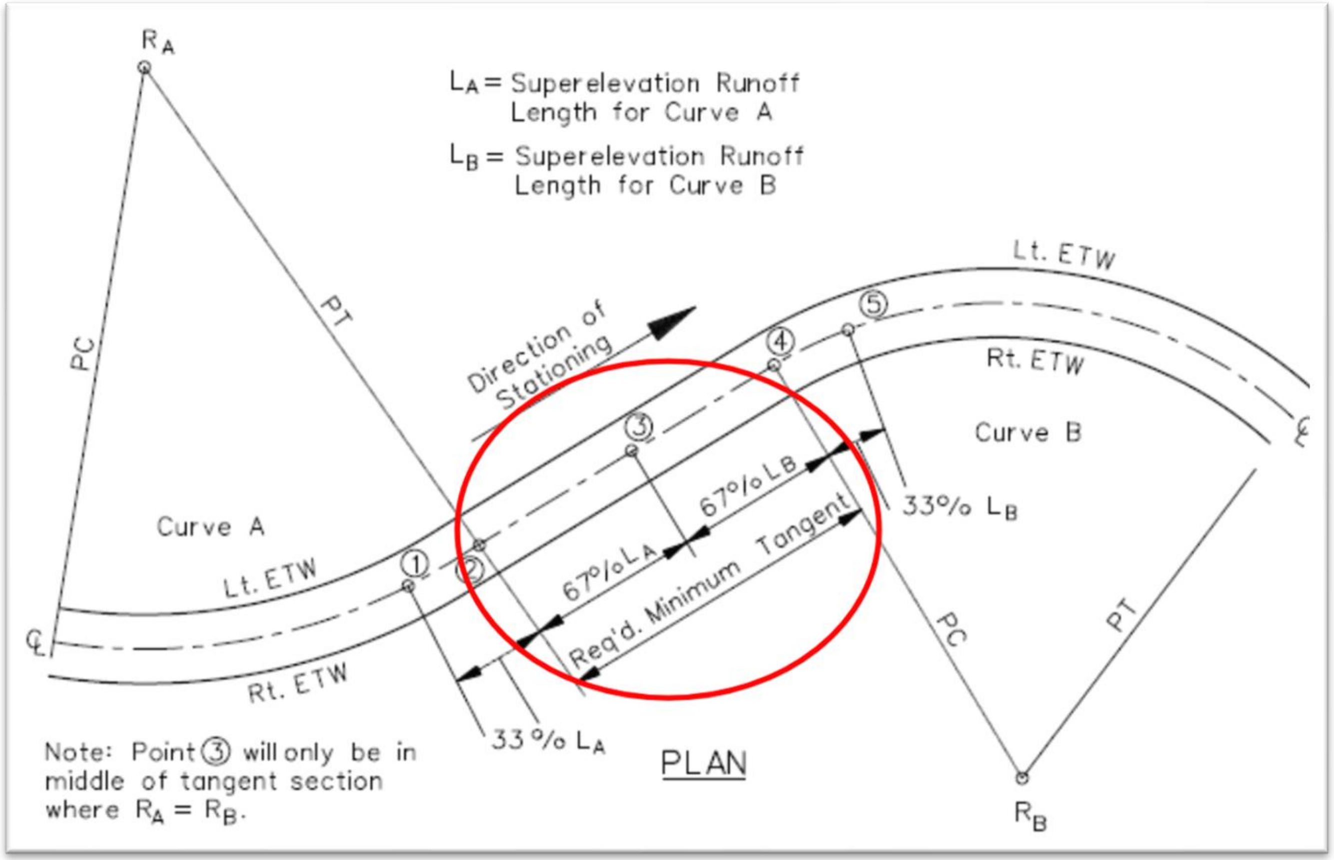
Reverse Curvature:



Spirals vs Curves



Simple Curves: (Indiana):

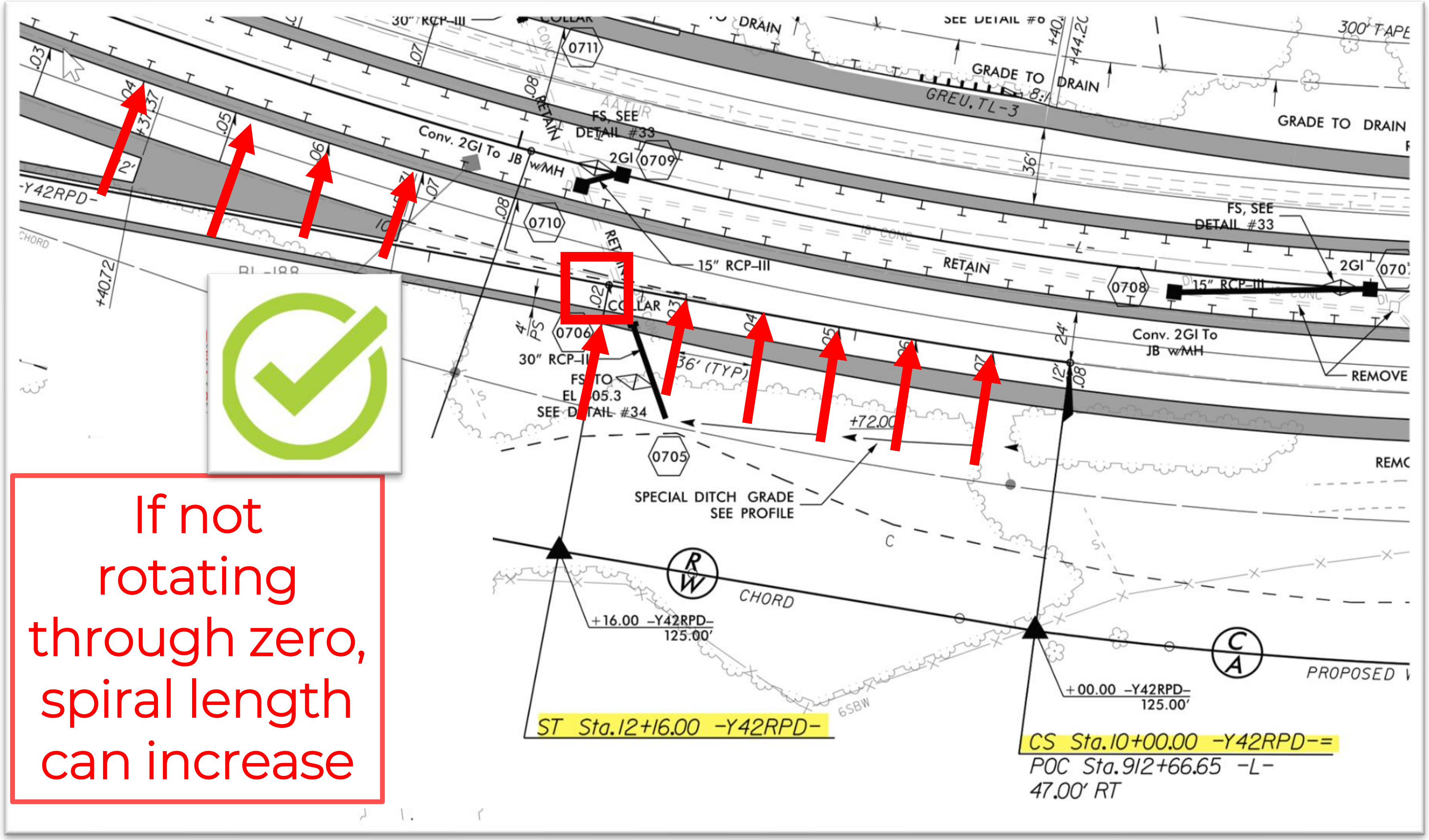


Ramp/Loop Superelevation Ties

Best Practices for Ramp/Loop Ties

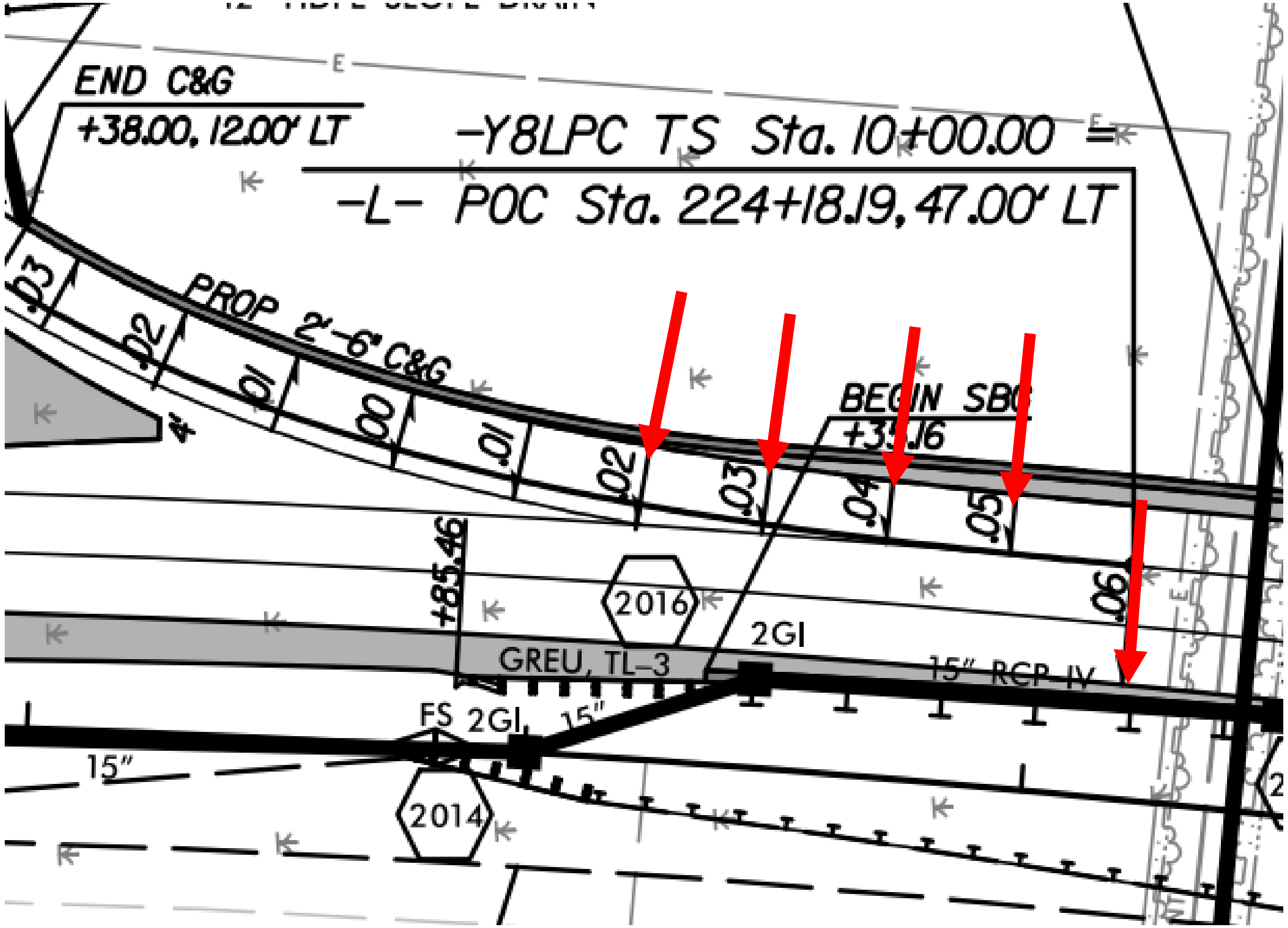
- Spiral out of Mainline Curvature (SC/CS)
- When not rotating through zero super, length of transition spiral can increase
- Use compound spirals when tying to the inside of the curve (low-side)
- When tying to the high-side of curves, hold super at gore before transitioning

Desirable Geometry and Super Transitions

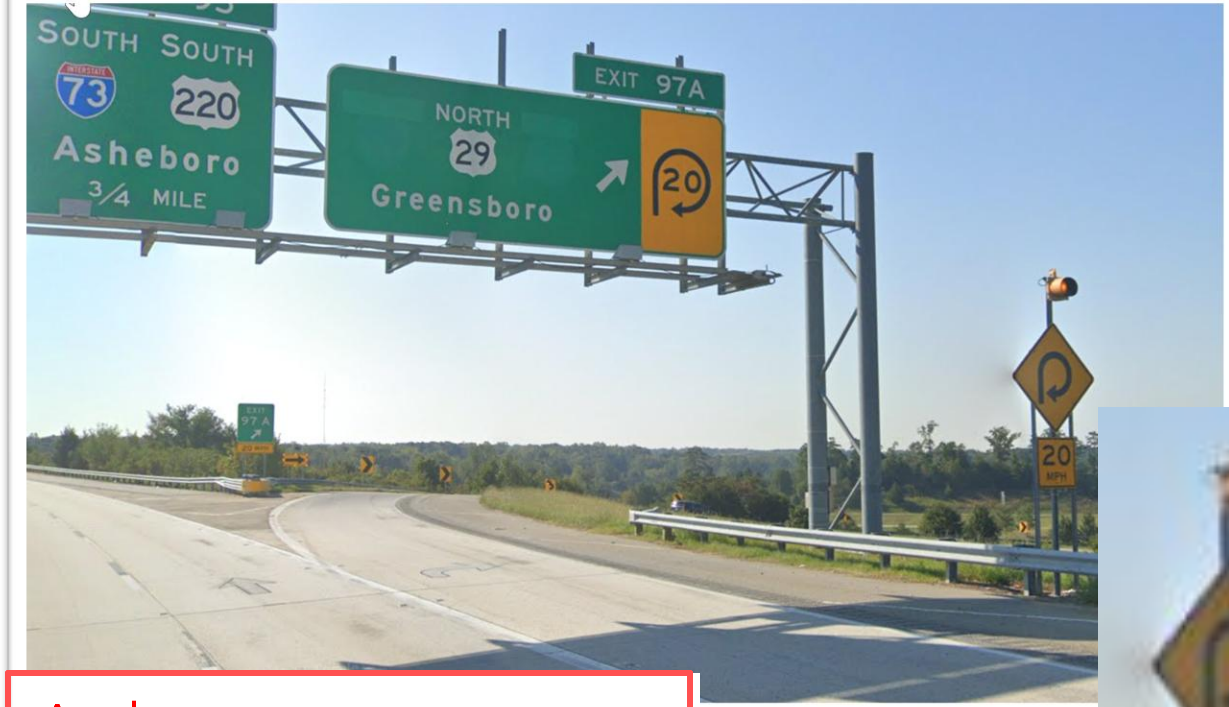


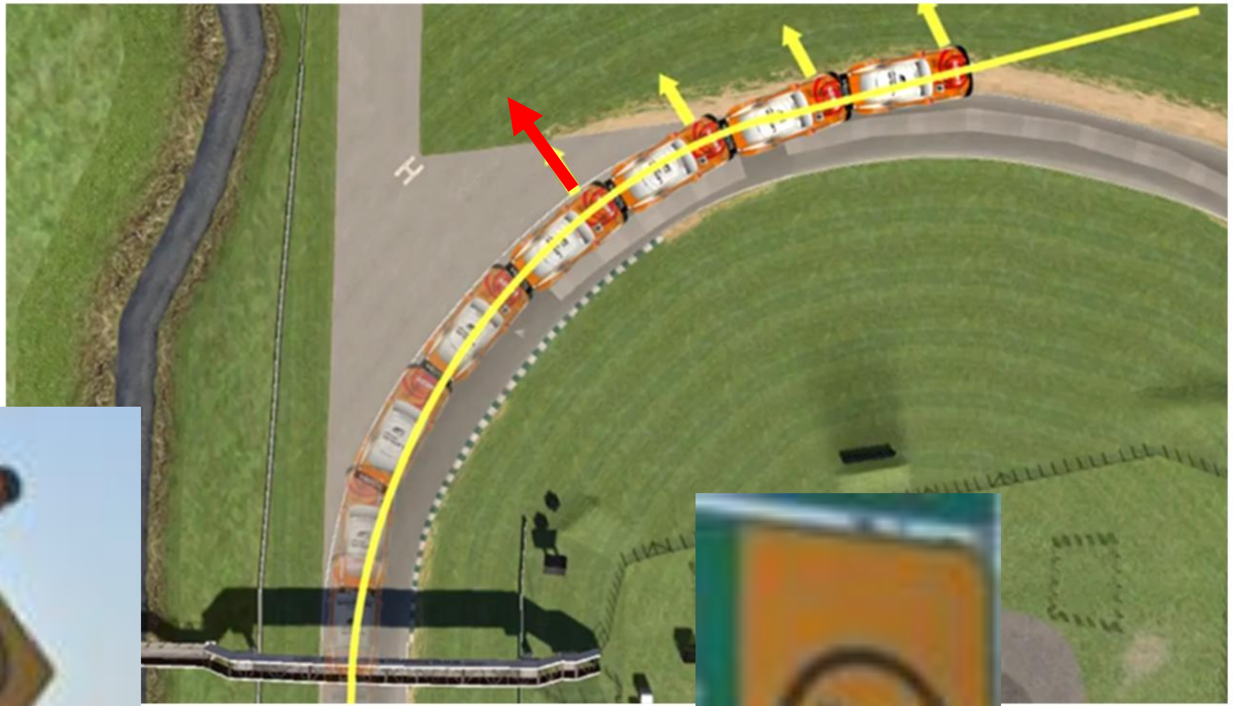
If not rotating through zero, spiral length can increase

Undesirable Geometry and Super Transitions



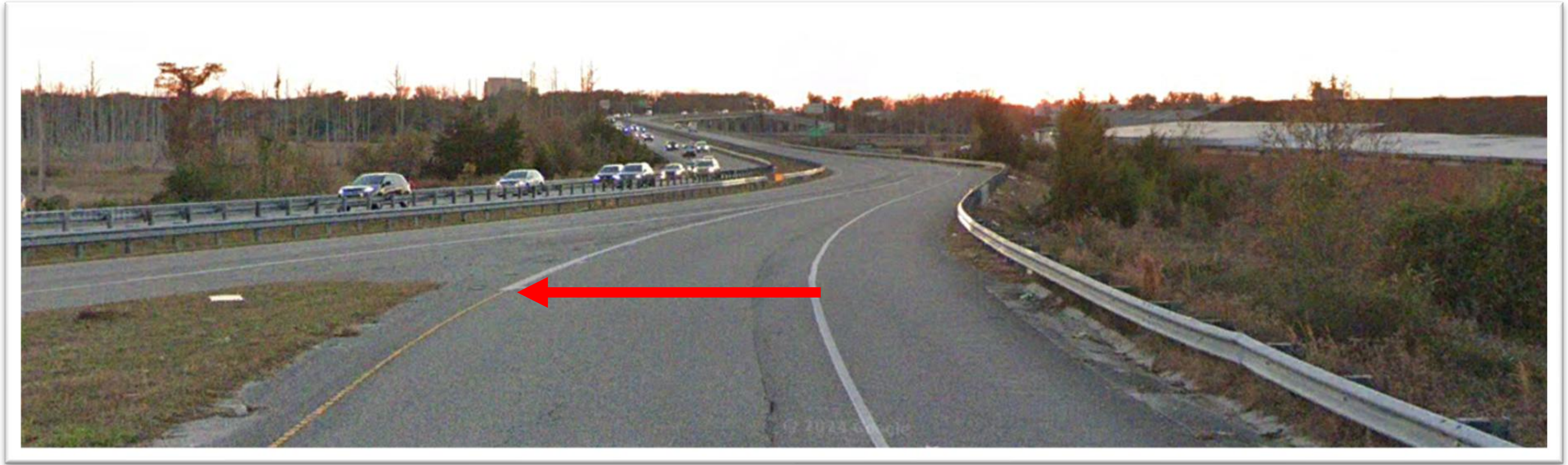
Undesirable Geometry and Super Transitions

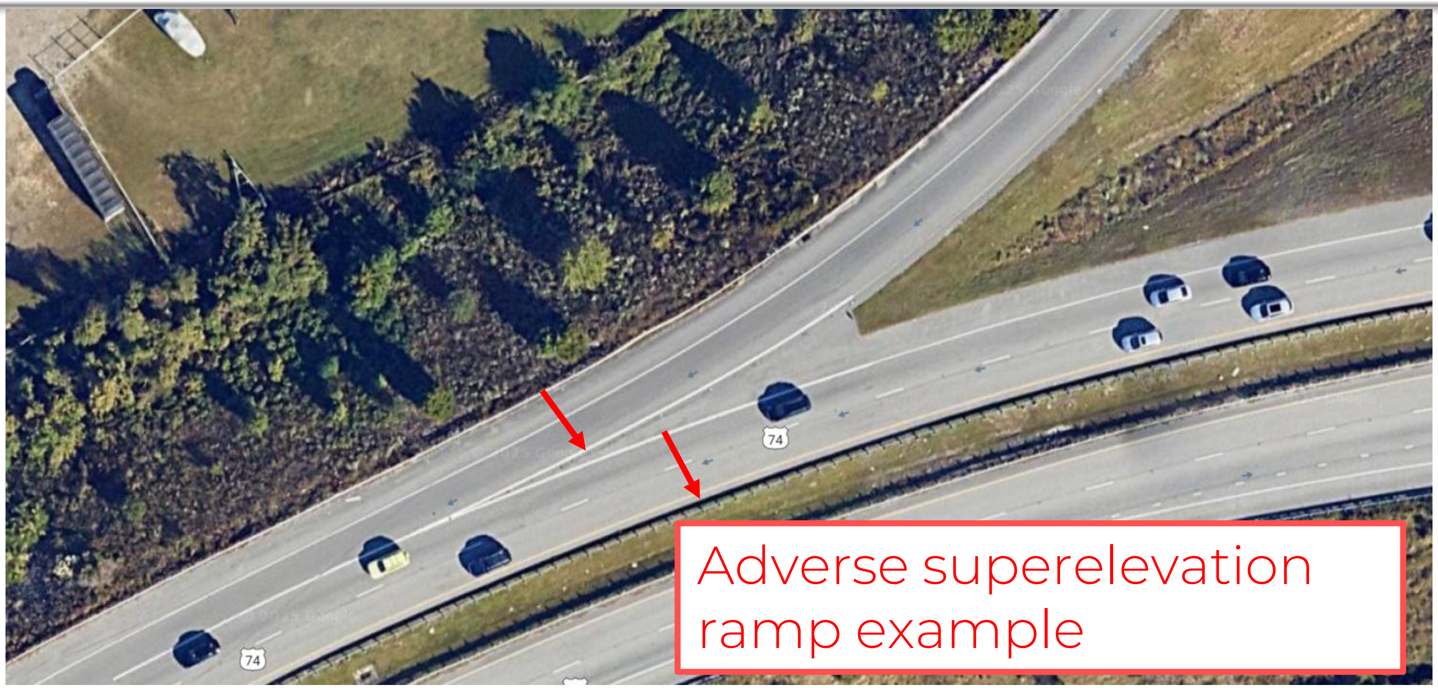




Adverse superelevation rotation

Undesirable Geometry and Super Transitions

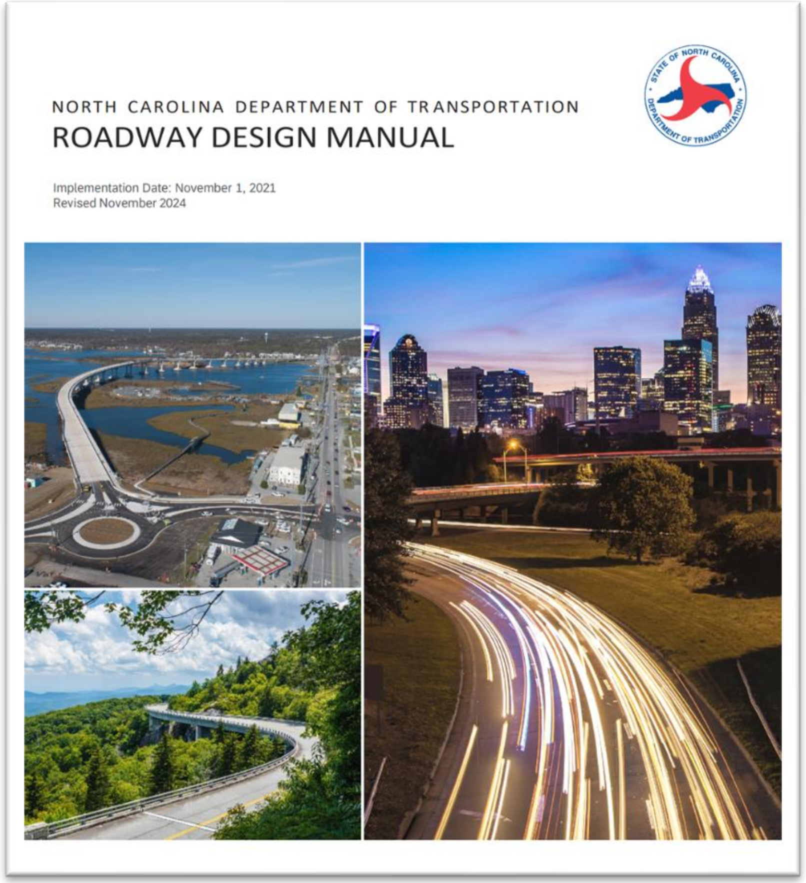


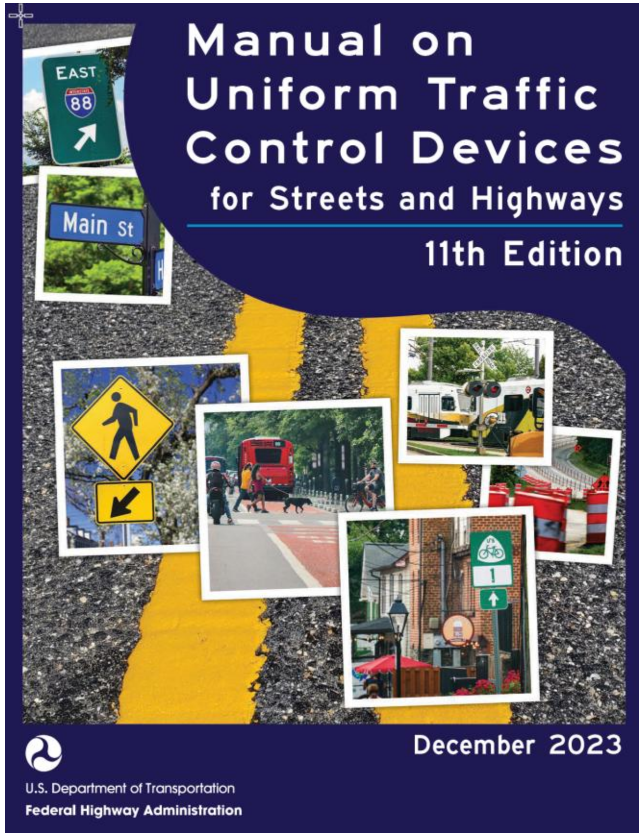


Adverse superelevation ramp example

On-Site Temporary Detour Design

Work Zone Traffic Control, Roadway Design, and Detours





Superelevation Guidance Update

- Detour design guidance update is under development
- Utilize Method 2 superelevation distribution for on-site temporary detours as a minimum criteria
- Supported by use in other states

AASHTO Greenbook 2018 Method 5 Superelevation Tables

Table 3-10. Minimum Radii for Design Superelevation Rates, Design Speeds, and e_{max} = 8%

U.S. Customary														
e (%)	V_d = 15 mph	V_d = 20 mph	V_d = 25 mph	V_d = 30 mph	V_d = 35 mph	V_d = 40 mph	V_d = 45 mph	V_d = 50 mph	V_d = 55 mph	V_d = 60 mph	V_d = 65 mph	V_d = 70 mph	V_d = 75 mph	V_d = 80 mph
	R (ft)	*R* (ft)	*R* (ft)	*R* (ft)	*R* (ft)	*R* (ft)	*R* (ft)	*R* (ft)	*R* (ft)	*R* (ft)	*R* (ft)	*R* (ft)	*R* (ft)	*R* (ft)
5.0	172	314	499	727	991	1310	1650	2040	2470	2960	3410	3910	4460	5050
5.2	154	284	457	676	929	1230	1560	1930	2350	2820	3250	3740	4260	4840
5.4	139	258	420	627	870	1160	1480	1830	2230	2680	3110	3570	4090	4640
5.6	126	236	387	582	813	1090	1390	1740	2120	2550	2970	3420	3920	4460
5.8	115	216	358	542	761	1030	1320	1650	2010	2430	2840	3280	3760	4290
6.0	105	199	332	506	713	965	1250	1560	1920	2320	2710	3150	3620	4140
6.2	97	184	308	472	669	909	1180	1480	1820	2210	2600	3020	3480	3990
6.4	89	170	287	442	628	857	1110	1400	1730	2110	2490	2910	3360	3850
6.6	82	157	267	413	590	808	1050	1330	1650	2010	2380	2790	3240	3720
6.8	76	146	248	386	553	761	990	1260	1560	1910	2280	2690	3120	3600
7.0	70	135	231	360	518	716	933	1190	1480	1820	2180	2580	3010	3480
7.2	64	125	214	336	485	672	878	1120	1400	1720	2070	2470	2900	3370
7.4	59	115	198	312	451	628	822	1060	1320	1630	1970	2350	2780	3250
7.6	54	105	182	287	417	583	765	980	1230	1530	1850	2230	2650	3120
7.8	48	94	164	261	380	533	701	901	1140	1410	1720	2090	2500	2970
8.0	38	76	134	214	314	444	587	758	960	1200	1480	1810	2210	2670

AASHTO Greenbook 2018 Method 2 Superelevation Tables

Table 3-13. Minimum Radii and Superelevation for Low-Speed Streets in Urban Areas

U.S. Customary							
e (%)	V_d = 15 mph	V_d = 20 mph	V_d = 25 mph	V_d = 30 mph	V_d = 35 mph	V_d = 40 mph	V_d = 45 mph
	R (ft)	*R* (ft)	*R* (ft)	*R* (ft)	*R* (ft)	*R* (ft)	*R* (ft)
−6.0	58	127	245	429	681	1067	1500
−5.0	56	121	231	400	628	970	1350
−4.0	54	116	219	375	583	889	1227
−3.0	52	111	208	353	544	821	1125
−2.8	51	110	206	349	537	808	1107
−2.6	51	109	204	345	530	796	1089
−2.4	51	108	202	341	524	784	1071
−2.2	50	108	200	337	517	773	1055
−2.0	50	107	198	333	510	762	1039
−1.5	49	105	194	324	495	736	1000
0	47	99	181	300	454	667	900
1.5	45	94	170	279	419	610	818
2.0	44	92	167	273	408	593	794
2.2	44	91	165	270	404	586	785
2.4	44	91	164	268	400	580	776
2.6	43	90	163	265	396	573	767
2.8	43	89	161	263	393	567	758
3.0	43	89	160	261	389	561	750
3.2	43	88	159	259	385	556	742
3.4	42	88	158	256	382	550	734
3.6	42	87	157	254	378	544	726
3.8	42	87	155	252	375	539	718
4.0	42	86	154	250	371	533	711
4.2	41	85	153	248	368	528	703
4.4	41	85	152	246	365	523	696
4.6	41	84	151	244	361	518	689
4.8	41	84	150	242	358	513	682
5.0	41	83	149	240	355	508	675
5.2	40	83	148	238	352	503	668

NCHRP Report 581 Exhibit 2-4

NCHRP 581: Design of Construction Work Zones on High-Speed Highways (2007) Exhibit 2-4. Minimum radii for superelevation rates and work zone design speed based on Method 2 superelevation distribution

U.S. Customary								
e (%)	Work zone design speed (mph)							
	40	45	50	55	60	65	70	75
	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)	R (ft)
-2.5	790	1080	1449	1921	2526	3314	4356	5769
-2.0	762	1038	1389	1833	2400	3130	4083	5357
-1.5	736	1000	1333	1754	2286	2965	3843	5000
1.5	610	818	1075	1391	1778	2253	2841	3571
2.0	593	794	1042	1344	1714	2167	2722	3409
2.1	589	789	1035	1336	1702	2150	2700	3378
2.2	586	785	1029	1327	1690	2134	2678	3348
2.3	583	780	1022	1318	1678	2118	2656	3319
2.4	580	776	1016	1310	1667	2102	2634	3289
2.5	577	771	1010	1301	1655	2086	2613	3261
2.6	573	767	1004	1293	1644	2071	2593	3233
2.7	570	763	998	1285	1633	2056	2572	3205
2.8	567	758	992	1276	1622	2041	2552	3178
2.9	564	754	986	1268	1611	2026	2532	3151
3.0	561	750	980	1260	1600	2012	2513	3125

Comparing Method 2 vs Method 5 Superelevation

Method 2

- Starts by utilizing side friction, then adds superelevation once f (friction) reaches its max
- Offers flexibility for tying detours into existing pavement with existing superelevation
- Minimizes the need for wedging
- Less comfortable but adequate

Method 5

$$0.01e + f = \frac{V^2}{15R}$$

- Uses both side friction and superelevation entering and throughout the curvature
- Requires longer detour lengths to provide the comfortable and balanced superelevation transitions associated with Method 5
- Involves more extensive construction and temporary wedging over existing pavement when longer detour lengths are not feasible

Guidance from other States on Method 2 Superelevation Distribution

Illinois DOT RDM

Design the horizontal curvature using the selected design speed for the work zone (Section 55-2.02) and AASHTO Method 2 for distributing superelevation and side friction to determine the radius and superelevation rate of the horizontal curve.

Montana DOT RDM

- In construction zones, the AASHTO Method 2 for distributing superelevation and side friction may be used to determine the radius and superelevation rate of any curve.
- Exhibit 10-5 provides the minimum horizontal curve radii for retaining normal crown, based on AASHTO Method 2, for detour connections to tangent PTW sections.

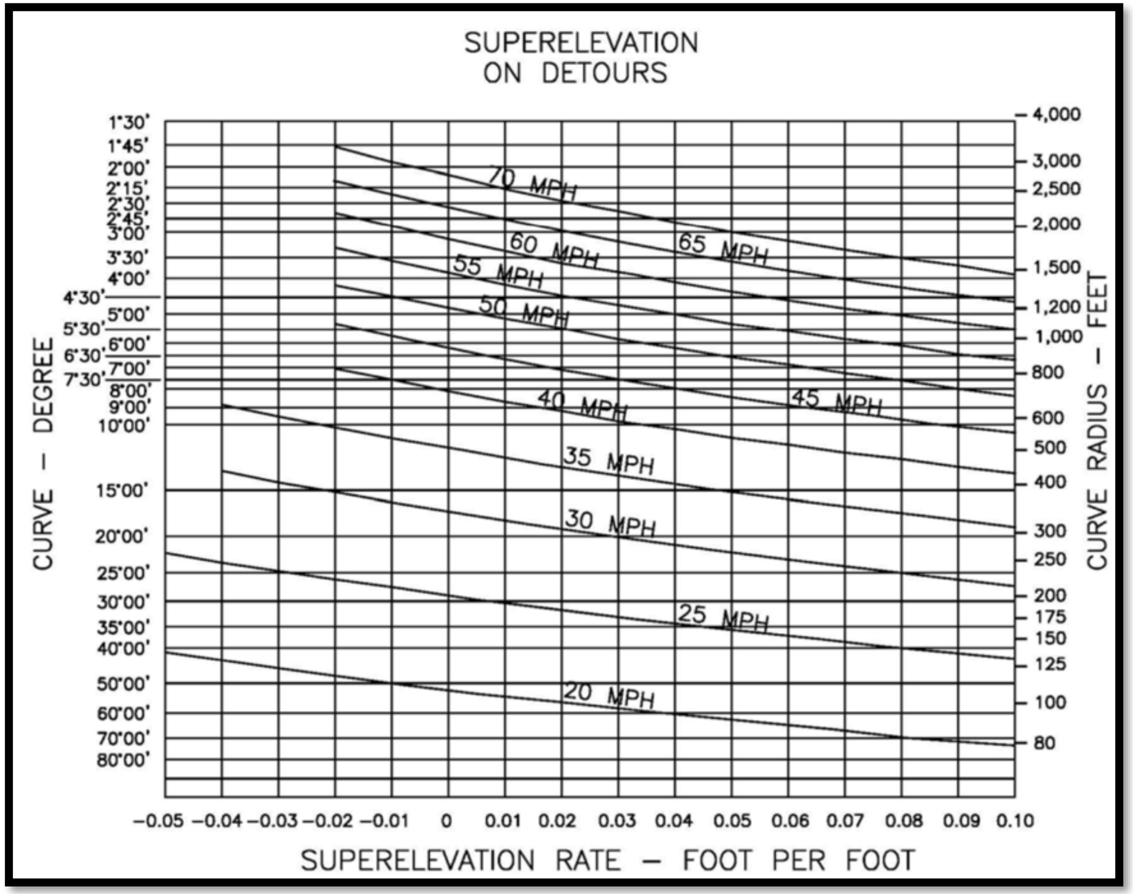
Montana DOT RDM

Design Speed, V (mph)	f_{max} (Open-Roadway Conditions)	Min Radii, R_{min} (for Normal Section) (e = -2%) (ft)	Min Radii, R_{min} (e = 8%) (ft)
20	0.27	110	80
25	0.23	200	140
30	0.20	340	220
35	0.18	520	320
40	0.16	770	450
45	0.15	1040	590
50	0.14	1390	760
55	0.13	1840	960
60	0.12	2400	1200
65	0.11	3130	1480
70	0.10	4090	1810

Indiana DOT RDM

Design the horizontal curvature using the selected construction-zone design speed. Use AASHTO Method 2 for distributing superelevation and side friction to determine the radius and superelevation rate of the horizontal curve. Minimum Radius for Horizontal Curve in Construction Zones, provides the minimum radius (including the radius for retention of the normal crown section) for a horizontal curve through a construction zone based on AASHTO Method 2.

Colorado DOT RDM



SUPERELEVATION RATE – FOOT PER FOOT

SPEED	FRICTION FACTOR
20	0.240
25	0.208
30	0.180
35	0.162
40	0.150
45	0.145
50	0.140
55	0.135
60	0.130
65	0.127
70	0.120

e= SUPERELEVATION
f= FRICTION FACTOR
V= SPEED– MILES PER HOUR
R= RADIUS IN FEET

$V = \sqrt{15(e+f)R}$

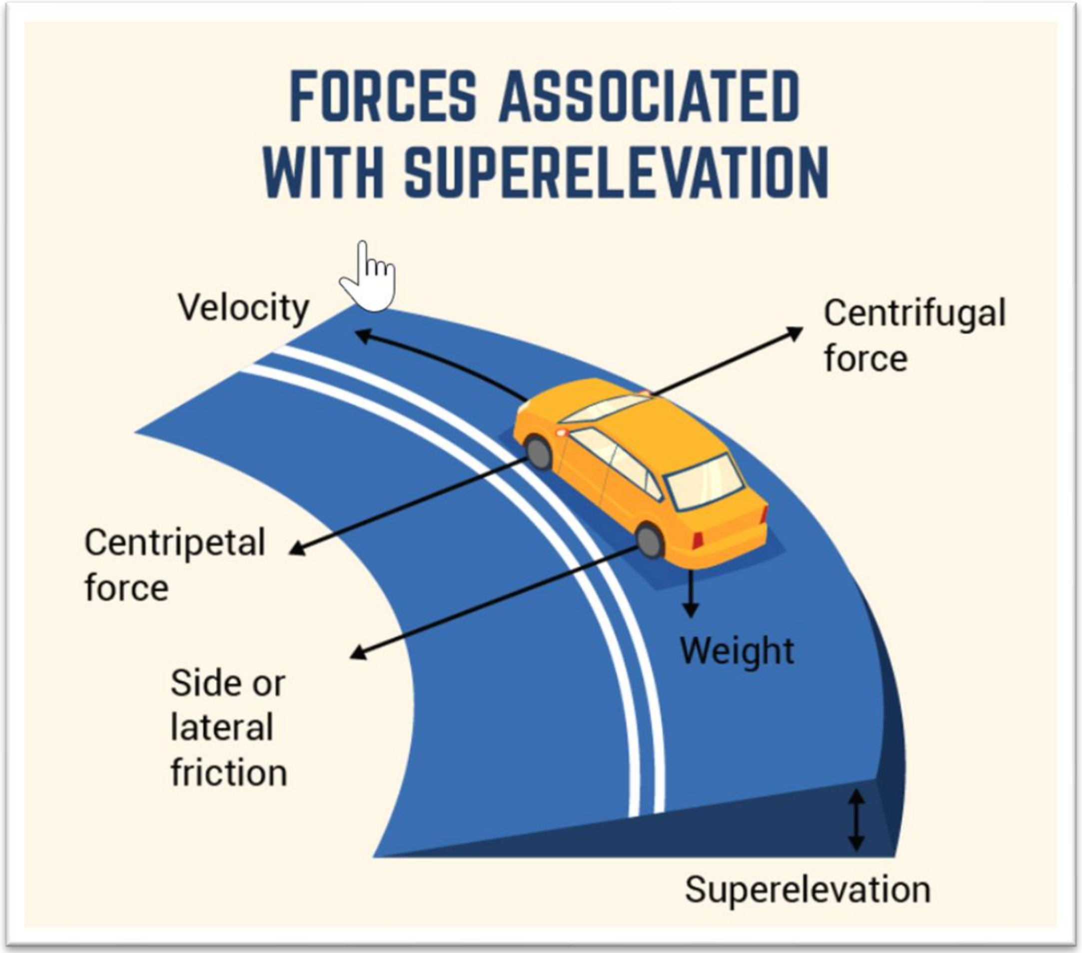
Figure 3-15 Superelevation on Detours

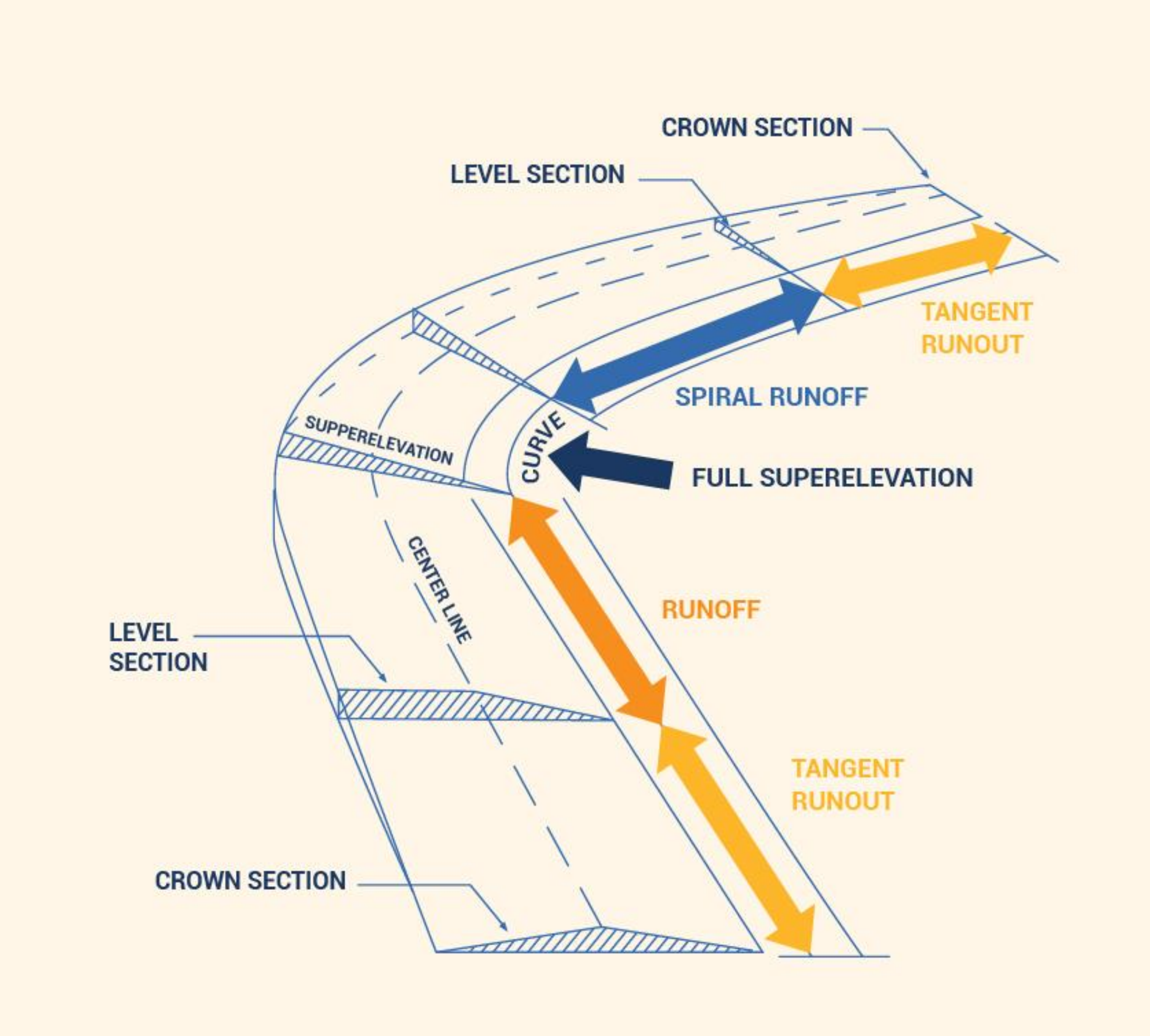
Wrapping Up

Today we discussed:

- Typical applications of superelevation
- Driver expectation
- Superelevation and rollover at ramp ties
- Temporary detours

Questions?


FORCES ASSOCIATED WITH SUPERELEVATION
Velocity
Centrifugal force
Centripetal force
Side or lateral friction
Weight
Superelevation


CROWN SECTION
LEVEL SECTION
TANGENT RUNOUT
SPIRAL RUNOFF
SUPPERELEVATION
CURVE
FULL SUPERELEVATION
CENTER LINE
RUNOFF
LEVEL SECTION
TANGENT RUNOUT
CROWN SECTION

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Thank you!