Design Meets Reality

Steve Allen

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Agenda

- Design Element Considerations
- Post Construction Issues
- Crash Statistics
- Proposed Concept
- Lessons Learned

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Location

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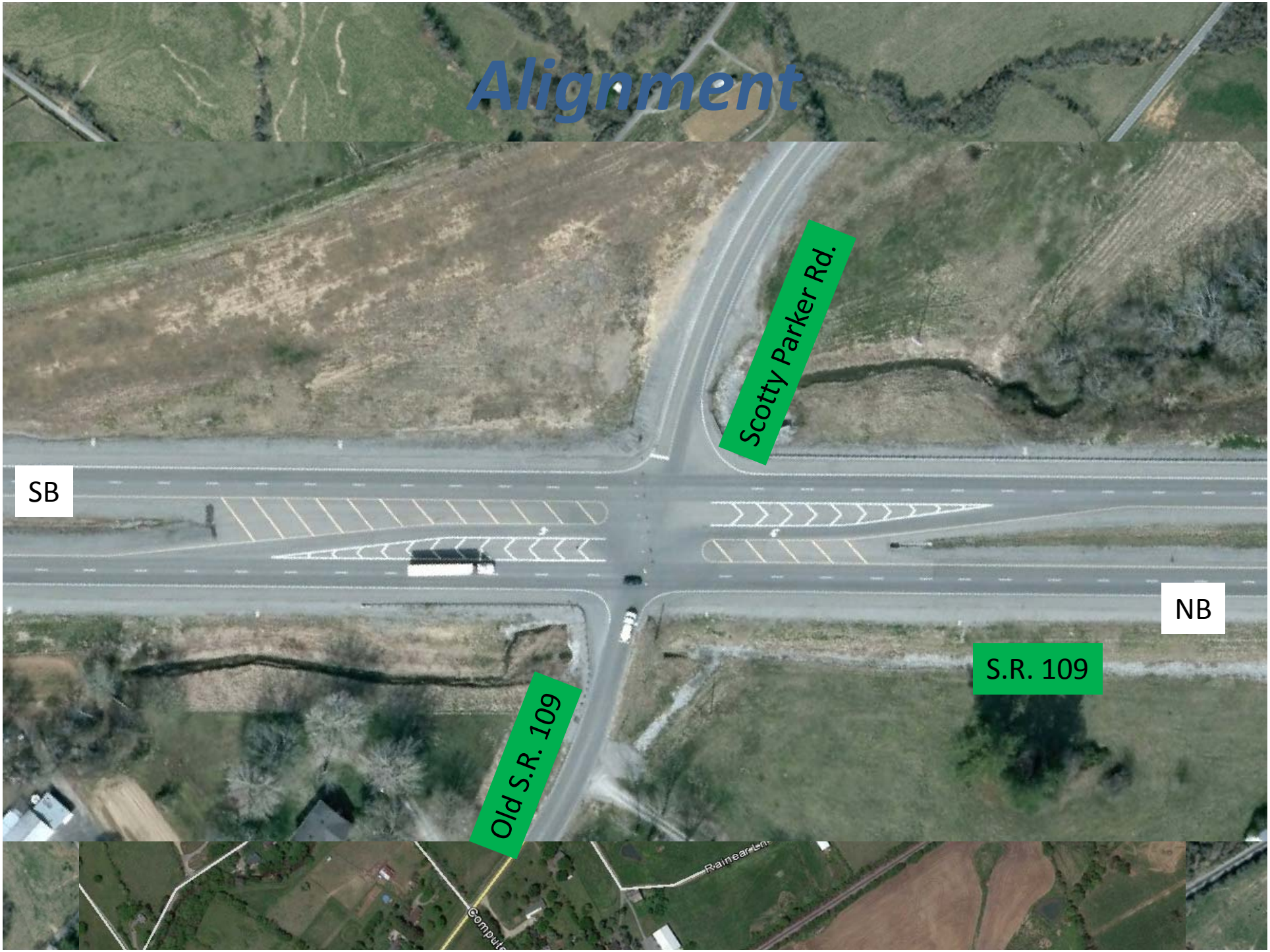
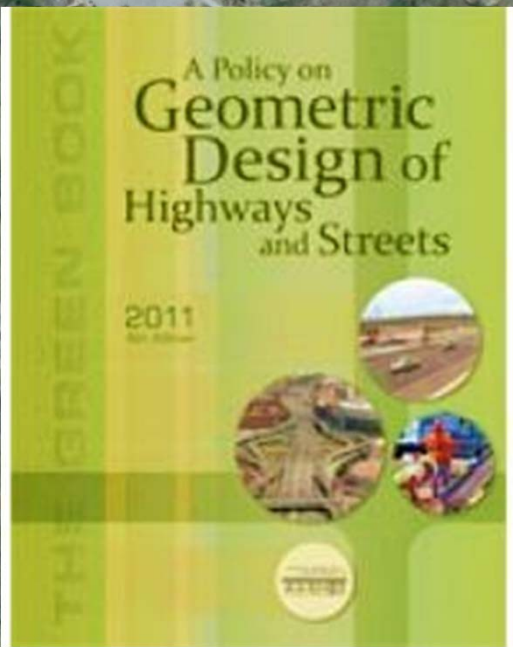
Alignment



13 Controlling Elements of Design

1. Design speed
2. Lane width
3. Shoulder width
4. Bridge width
5. Horizontal alignment
6. Superelevation
7. Vertical alignment
8. Grade
9. Stopping sight distance
10. Cross slope
11. Vertical clearance
12. Lateral offset to obstruction
13. Structural capacity



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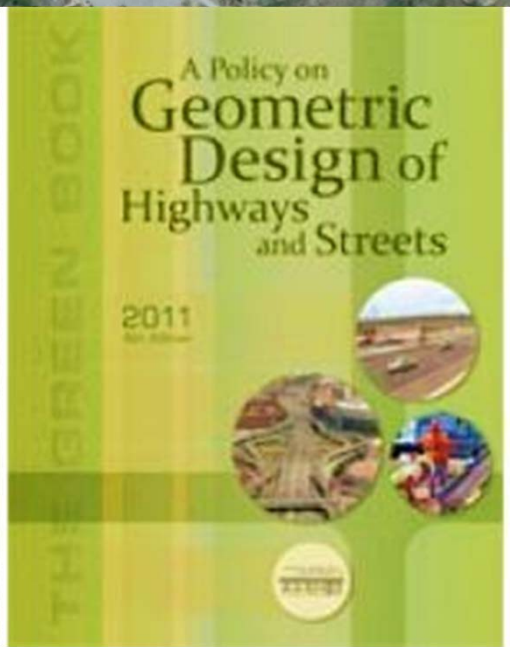

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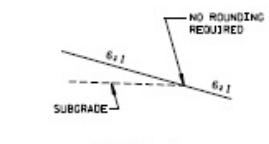
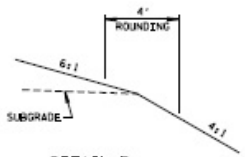
REV. 10-15-02a NEW SHEET.
REPLACES RD-TS-3A.



DETAIL A



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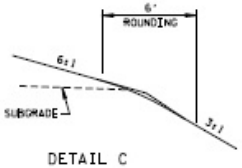

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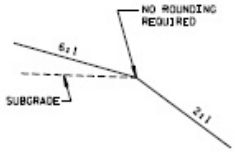
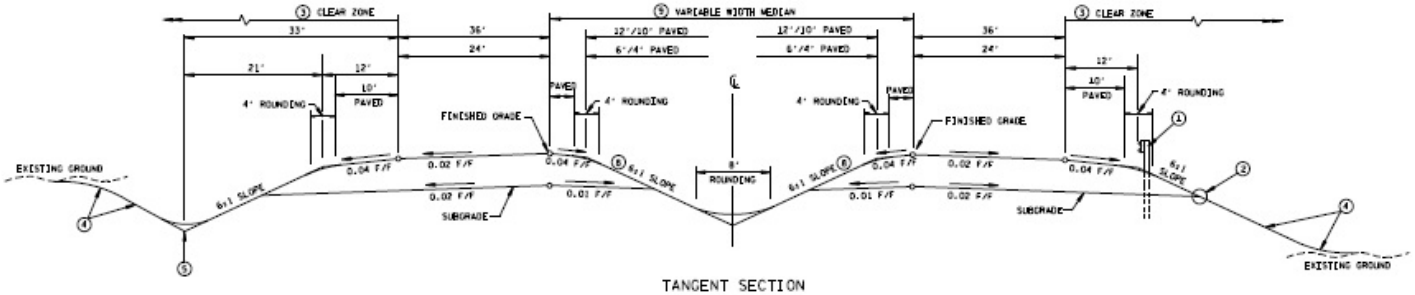
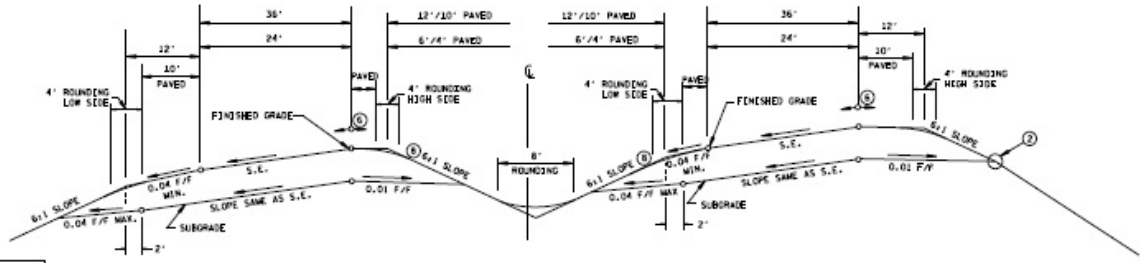


DETAIL D



TANGENT SECTION



SUPERELEVATED SECTION

TABLE I. RECOMMENDED RURAL DESIGN SPEEDS (SEE PAGE 448) ⑦	
TYPE OF TERRAIN	DESIGN SPEED (MPH)
LEVEL	70
ROLLING	60
MOUNTAINOUS	50

TABLE II. 4 AND 6 LANE ARTERIAL - DESIGN STANDARDS ⑩

DESIGN STANDARDS (FOR GIVEN DESIGN SPEED)		DESIGN SPEEDS (MPH)									
		30	35	40	45	50	55	60	65	70	
MINIMUM RADIUS (FT.) 0.04 MAX. S.E.		300	420	565	730	930	1190	1505	X	X	SEE PAGE 145
MINIMUM RADIUS (FT.) 0.06 MAX. S.E.		275	380	510	660	835	1065	1340	X	X	
MINIMUM RADIUS (FT.) 0.08 MAX. S.E.		250	350	465	600	760	965	1205	1485	1820	
MAXIMUM RURAL GRADES %	LEVEL TERRAIN	X	X	5	5	4	4	3	3	3	SEE PAGE 450
	ROLLING TERRAIN	X	X	6	6	5	5	4	4	4	
	MOUNTAINOUS TERRAIN	X	X	8	7	7	6	6	5	5	
MAXIMUM URBAN GRADES %	LEVEL TERRAIN	8	7	7	6	6	5	5	X	X	SEE PAGE 476
	ROLLING TERRAIN	9	8	8	7	7	6	6	X	X	
	MOUNTAINOUS TERRAIN	11	10	10	9	9	8	8	X	X	
MINIMUM STOPPING SIGHT DISTANCE (FT.)		200	250	305	360	425	495	570	645	730	SEE PAGE 449
MINIMUM "K" VALUE	CREST VERTICAL CURVE	19	29	44	61	84	114	151	193	247	SEE PAGE 274
	SAG VERTICAL CURVE	37	49	64	79	96	115	136	157	181	SEE PAGE 280
MINIMUM PASSING SIGHT DISTANCE (FT.)		1090	1280	1470	1625	1835	1985	2135	2285	2480	SEE PAGE 449
MINIMUM "K" VALUE FOR CREST VERTICAL CURVE		424	585	772	943	1203	1407	1628	1865	2197	SEE PAGE 276
SUPERELEVATION		SEE STANDARD DRAWINGS RD01-SE-2 AND RD01-SE-3.									

FOOTNOTES

① SEE DETAIL E FOR GUARDRAIL PLACEMENT AND GUARDRAIL STANDARD DRAWINGS (S-OR-SERIES).

② SEE DETAILS A, B, C, OR D FOR ROUNDING.

③ CLEAR ZONE WIDTH SHALL BE DETERMINED FROM STANDARD DRAWING RD01-S-12. SEE THE "ROADSIDE DESIGN GUIDE," AASHTO, 2002. FOR FURTHER INFORMATION ON CLEAR ZONES.

④ SEE STANDARD DRAWINGS RD01-S-11 AND RD01-S-11B FOR FILL AND CUT SLOPE TABLES, ROUNDING ON TOP OF CUT SLOPES AND TOE OF FILL SLOPES, AND SPECIAL HOOK CUT TREATMENT.

⑤ SEE STANDARD DRAWING RD01-S-11A FOR ROUNDING OF ROADSIDE DITCH SLOPES.

⑥ THE SLOPES OF THE SHOULDER AND ROADWAY PAVEMENT SHALL NOT EXCEED AN ALGEBRAIC DIFFERENCE OF 0.07 FOOT PER FOOT.

⑦ URBAN DESIGN SPEEDS ARE GENERALLY IN THE RANGE OF 30 TO 60 MILES PER HOUR (SEE PAGE 474).

⑧ 6:1 SLOPES ARE DESIRABLE. SLOPES RANGING BETWEEN 6:1 AND 4:1 MAY BE USED UNDER SPECIFIC ADVERSE CONDITIONS SUCH AS TO FACILITATE DRAINAGE OR TO ESTABLISH A LEFT TURN LANE.

⑨ 46 FEET MINIMUM, 64 FEET MINIMUM FOR A SIX LANE SECTION.

⑩ ALTHOUGH THE SELECTED DESIGN SPEED ESTABLISHES THE LIMITING VALUES OF CURVE RADIUS AND MINIMUM SIGHT DISTANCE THAT SHOULD BE USED IN DESIGN, THERE SHOULD BE NO RESTRICTION ON THE USE OF FLATTER HORIZONTAL CURVES OR GREATER SIGHT DISTANCES WHERE SUCH IMPROVEMENTS CAN BE PROVIDED AS A PART OF AN ECONOMICAL DESIGN (SEE PAGE 69).

GENERAL NOTES

Ⓐ SEE GUARDRAIL STANDARD DRAWINGS FOR TYPICAL GUARDRAIL PLACEMENT.

Ⓑ PAGE NUMBERS REFERRED TO ON THIS DRAWING ARE FROM "A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS," AASHTO, 2002, UNLESS OTHERWISE NOTED.

Ⓒ REFERENCE SHOULD ALSO BE MADE TO THE "ROADSIDE DESIGN GUIDE," AASHTO, 2002.

Ⓓ DESIRABLE RIGHT-OF-WAY IS SLOPE LINES PLUS FIFTEEN FEET TO TWENTY FEET.

Ⓔ ALL NEW AND REHABILITATED BRIDGES SHALL BE DESIGNED FOR MS-20 LOADING. THE MINIMUM CLEAR WIDTH FOR NEW AND REHABILITATED BRIDGES SHALL BE EQUAL TO THE FULL WIDTH OF THE APPROACH ROADWAY, CURB-TO-CURB OR FULL SHOULDER WIDTH AS APPLICABLE.

Ⓕ FOR EXISTING BRIDGES TO REMAIN IN PLACE, THEY SHOULD HAVE ADEQUATE STRUCTURAL STRENGTH AND A WIDTH AT LEAST EQUAL TO THE WIDTH OF THE TRAVELED WAY PLUS 2 FEET CLEARANCE ON EACH SIDE. BRIDGES SHOULD BE CONSIDERED FOR ULTIMATE WIDENING OR REPLACEMENT IF THEY DO NOT PROVIDE AT LEAST MS-20 LOADINGS. AS AN INTERIM MEASURE, NARROW BRIDGES SHOULD BE CONSIDERED FOR SPECIAL NARROW BRIDGE TREATMENTS SUCH AS SIGNING AND PAVEMENT MARKING.

Ⓖ FOR ADDITIONAL URBAN DESIGN GUIDANCE AND CRITERIA, SEE PAGES 473-506.

☐ MINOR REVISION -- FHWA APPROVAL NOT REQUIRED.

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

DESIGN STANDARDS 4 AND 6 LANE ARTERIAL HIGHWAYS WITH DEPRESSED MEDIANS

10-15-02 RD01-TS-3A

13 Controlling Elements of Design

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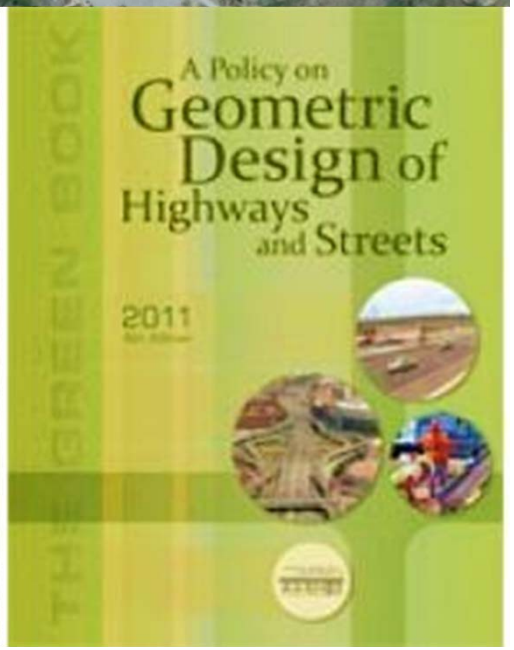

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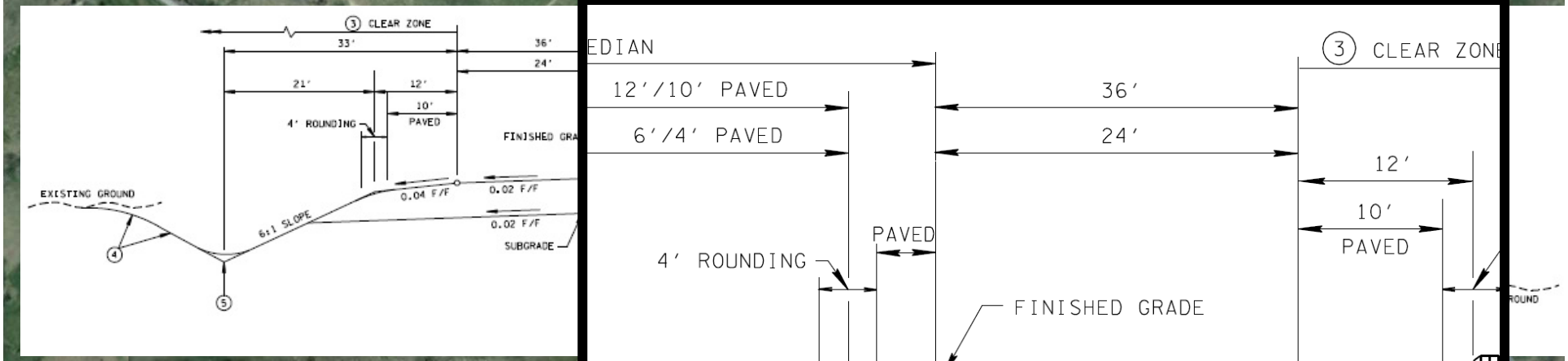
Lane Width and Shoulder Width



RDO1-TS-3A

13 Controlling Elements of Design

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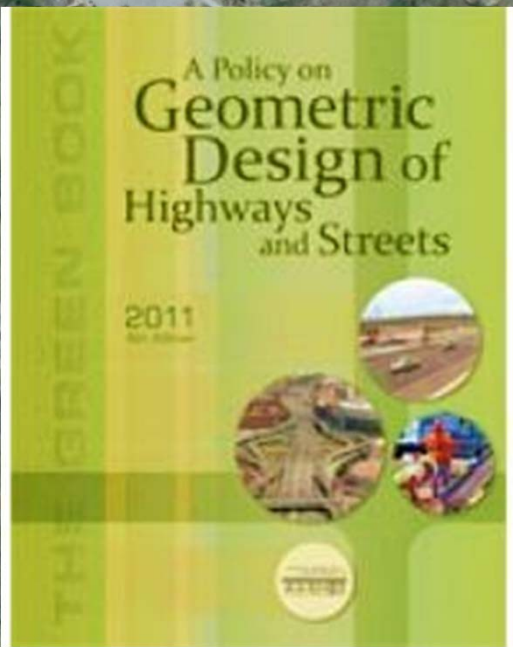

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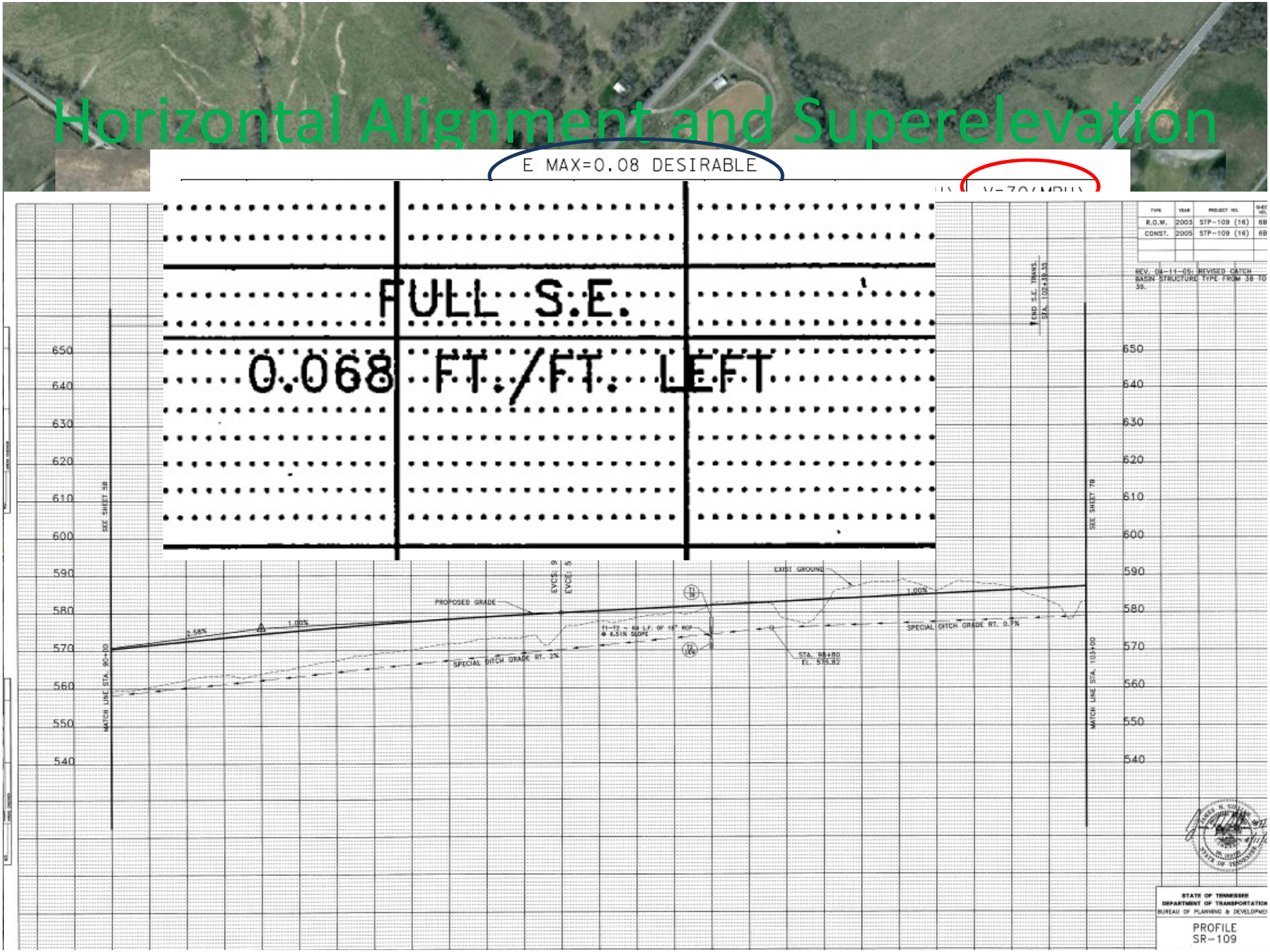
Horizontal Alignment and Superelevation



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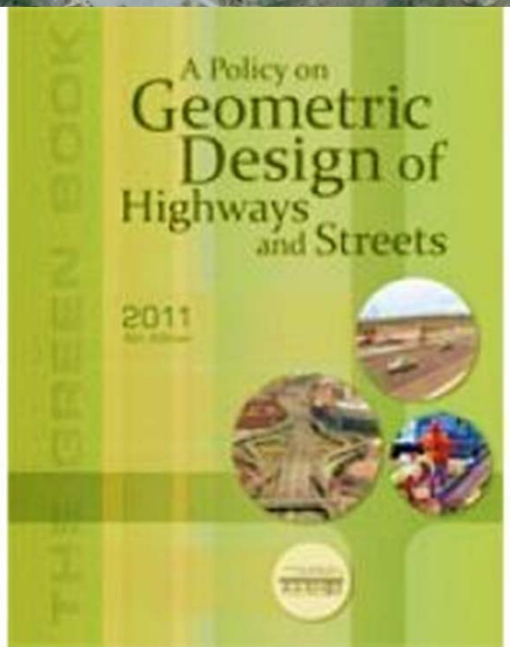

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Grade

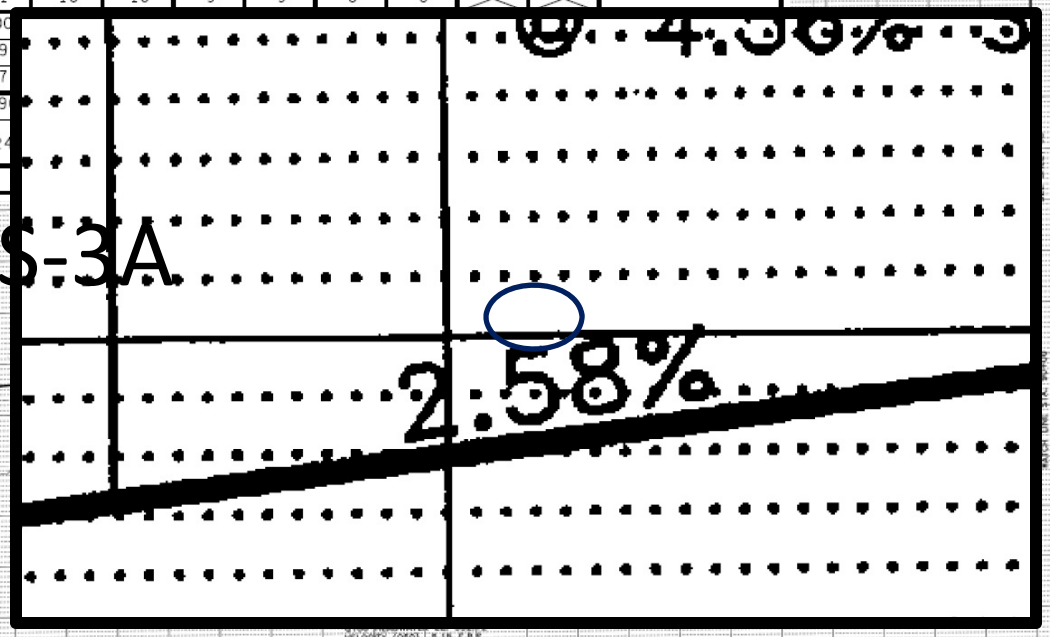
TABLE II. 4 AND 6 LANE ARTERIAL - DESIGN STANDARDS (10)

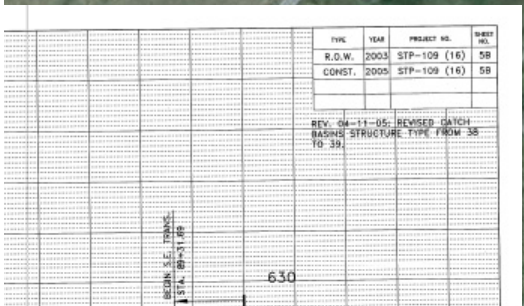
DESIGN STANDARDS (FOR GIVEN DESIGN SPEED)		DESIGN SPEED 30	35	40	45	50	55	60	65	70	
MINIMUM RADIUS (FT.) 0.04 MAX. S.E.		300	420	565	730	930	1150	1340			SEE PAGE 145
MINIMUM RADIUS (FT.) 0.06 MAX. S.E.		275	380	510	660	835	1065	1240	1485	1820	
MINIMUM RADIUS (FT.) 0.08 MAX. S.E.		250	350	465	600	760	965	1205			
LEVEL TERRAIN				5	5	4				3	SEE PAGE 450
ROLLING TERRAIN				6	6	5		4		4	
MOUNTAINOUS TERRAIN				8	7	7				5	
MAXIMUM URBAN GRADES %	LEVEL TERRAIN	8	7	7	6	6	5	5			SEE PAGE 476
	ROLLING TERRAIN	9	8	8	7	7	6	6			
	MOUNTAINOUS TERRAIN	11	10	10	9	9	8	8			
MINIMUM STOPPING SIGHT DISTANCE (FT.)		200									
MINIMUM "K" VALUE	CREST VERTICAL CURVE	19									
	SAG VERTICAL CURVE	37									
MINIMUM PASSING SIGHT DISTANCE (FT.)		109									
MINIMUM "K" VALUE FOR CREST VERTICAL CURVE		424									
SUPERELEVATION											

ROLLING TERRAIN

4

RDO1-TS-3A





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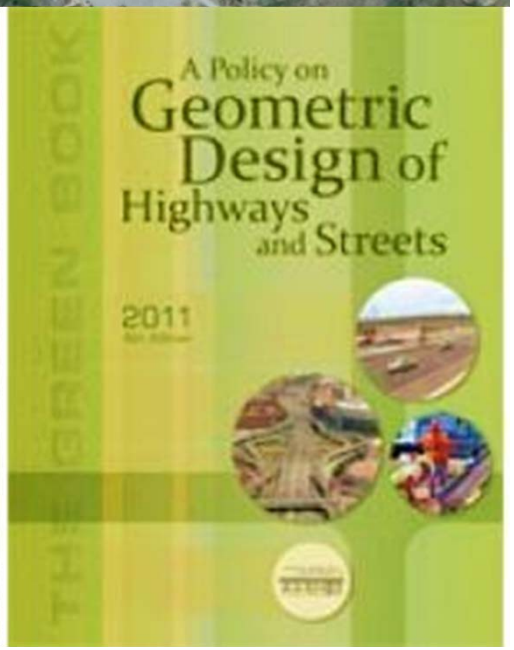

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Stopping Sight Distance

RDO1-TS-3A

MINIMUM STOPPING SIGHT DISTANCE (FT.)

TABLE II. 4 AND 6 LANE ARTERIAL - DESIGN STANDARDS (10)

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MINIMUM RADIUS (FT.) 0.06 MAX. S.E.		275	380	510	660	835	1065				SEE PAGE 145
MINIMUM RADIUS (FT.) 0.08 MAX. S.E.		250	350	465	600	760	965		1485	1820	
MAXIMUM RURAL GRADES %	LEVEL TERRAIN			5	5	4	4		3	3	SEE PAGE 450
	ROLLING TERRAIN			6	6	5	5		4	4	
	MOUNTAINOUS TERRAIN			8	7	7	6		5	5	
MAXIMUM URBAN	LEVEL TERRAIN	8	7	7	6	6	5				SEE PAGE 476
		9	8	8	7	7					
		11	10	10	9	9					
										730	SEE PAGE 449
MINIMUM "K" VALUE		19	29	44	61	84				247	SEE PAGE 274
	SAG VERTICAL CURVE	37	49	64	79	96	115	136	157	181	SEE PAGE 280
MINIMUM PASSING SIGHT DISTANCE (FT.)		1090	1280	1470	1625	1835	1985	2135	2285	2480	SEE PAGE 449
MINIMUM "K" VALUE FOR CREST VERTICAL CURVE		424	585	772	943	1203	1407	1628	1865	2197	SEE PAGE 276
SUPERELEVATION		SEE STANDARD DRAWINGS RDO1-SE-2 AND RDO1-SE-3.									

60

570

2,449’

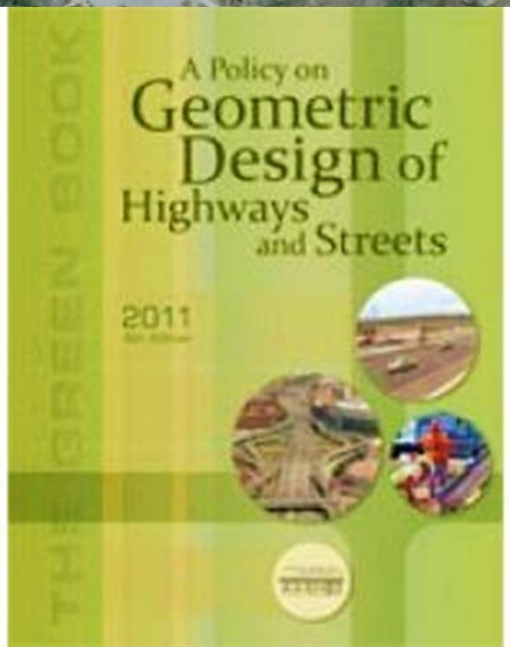
2,449’>570’

1,068’

1,068’>570’

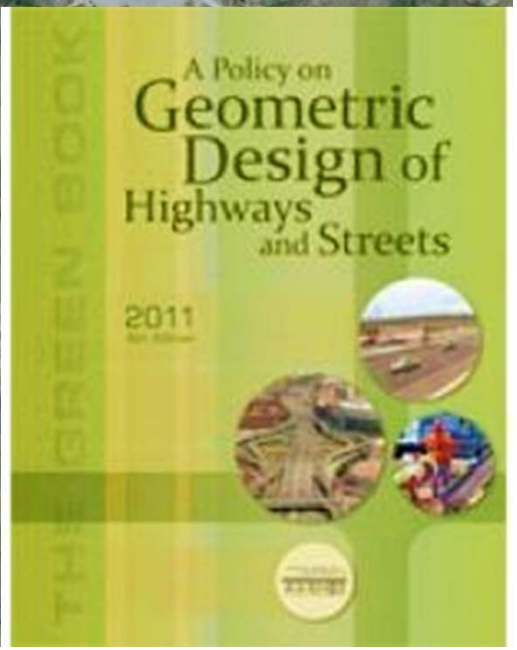
Other Design Elements

- Intersection sight distance
- Offset turn lane
- Turn lane storage



Other Design Elements

- Intersection sight distance
- Offset turn lane
- Turn lane storage



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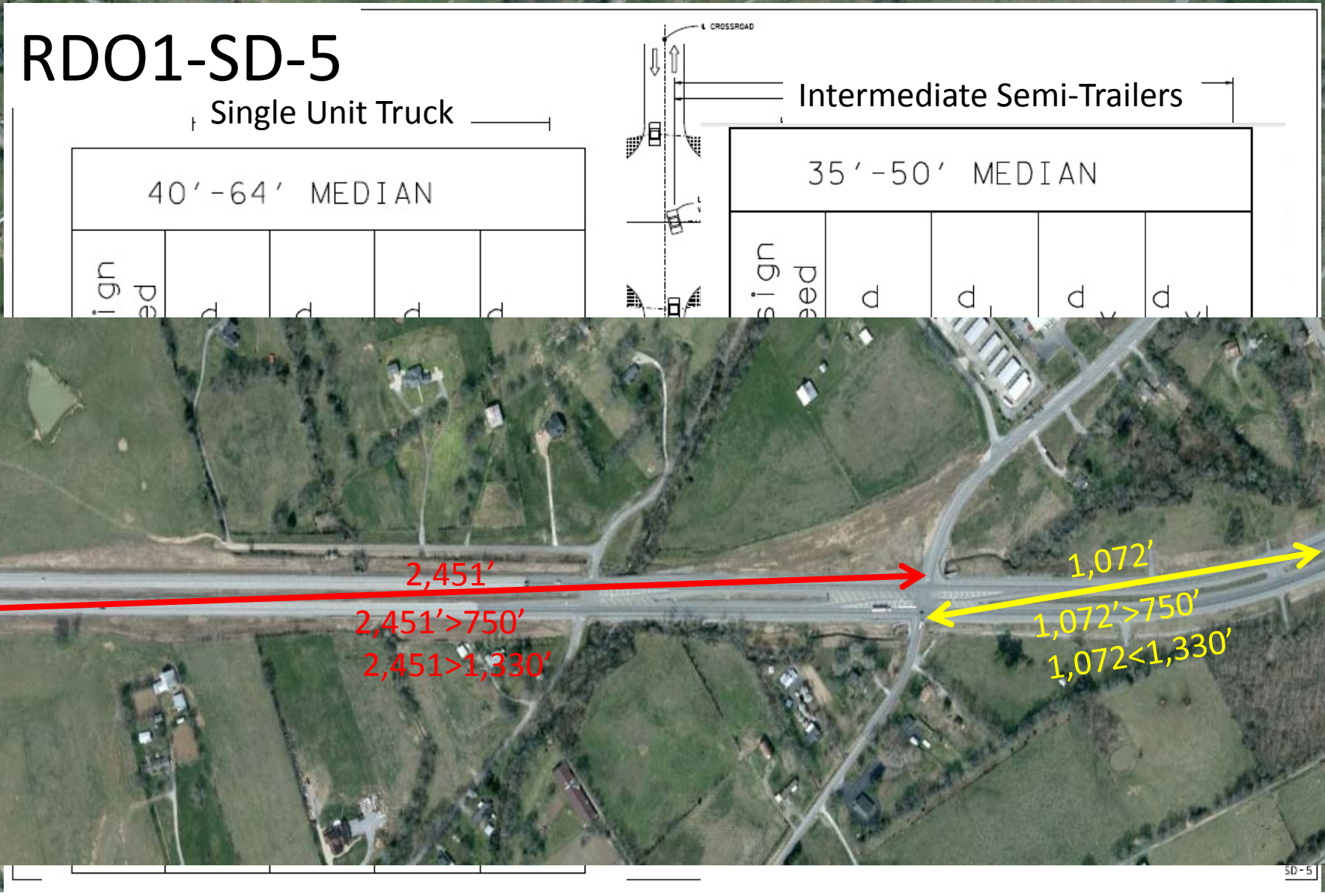
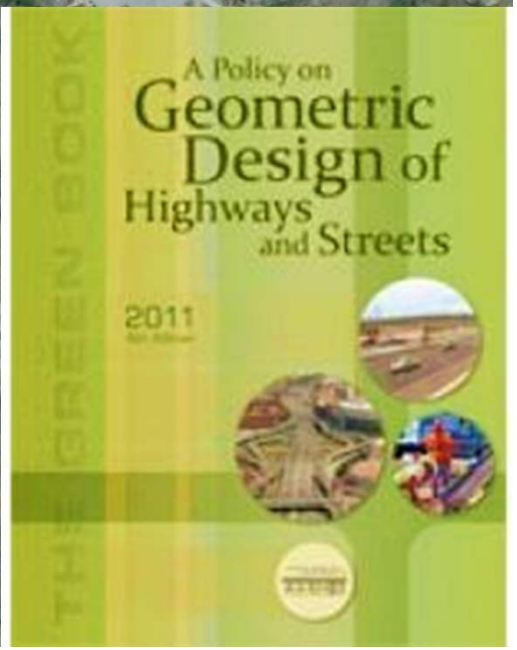
Intersection Sight Distance

RDO1-SD-5



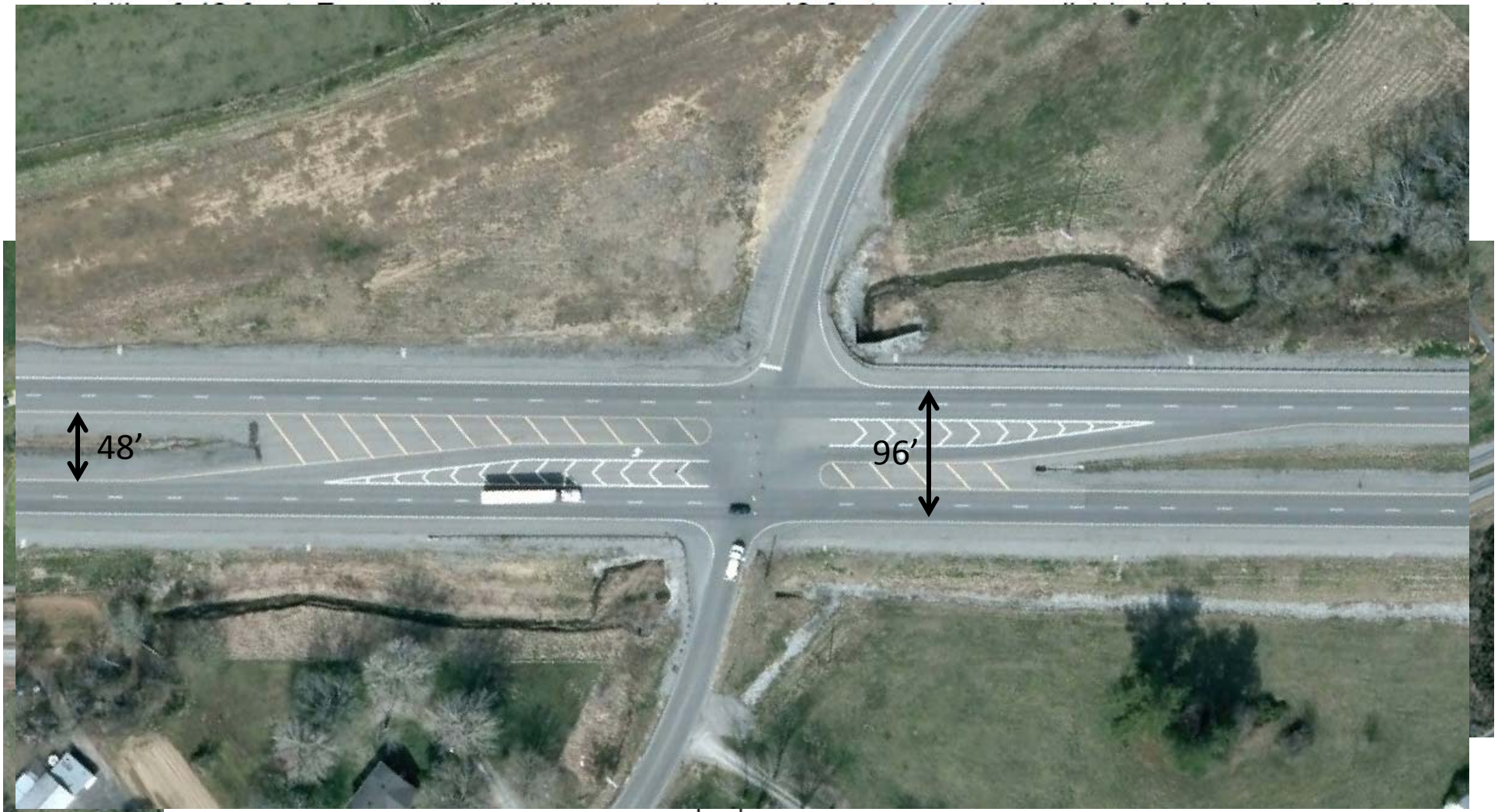
Other Design Elements

- Intersection sight distance
- Offset turn lane
- Turn lane storage



Offset Turn Lane Design

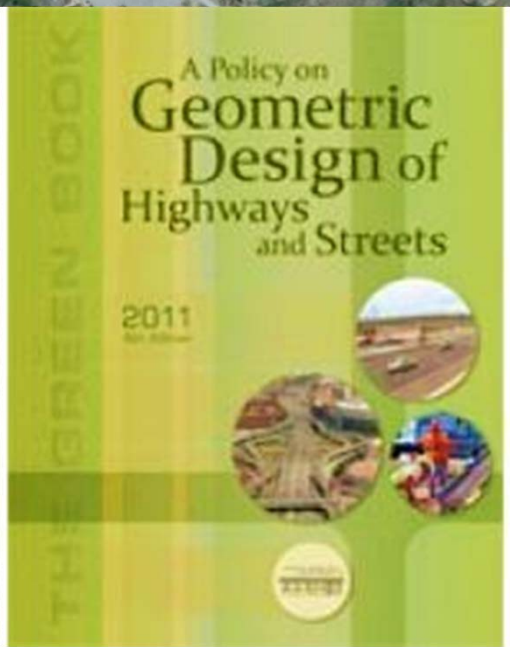
The following guidelines apply to four-lane divided highways with a maximum median



Preliminary Design

Other Design Elements

- Intersection sight distance
- Offset turn lane
- Turn lane storage



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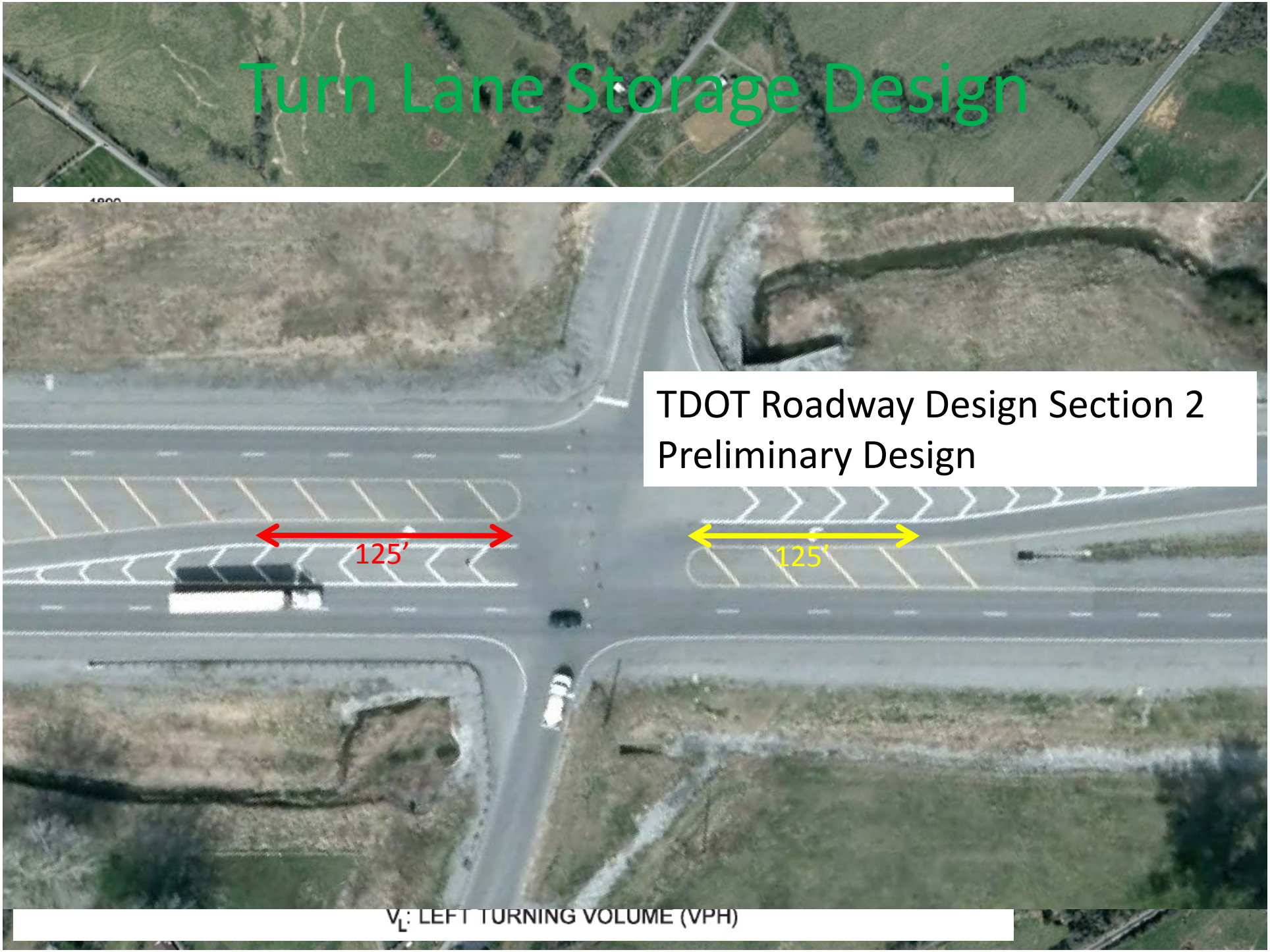
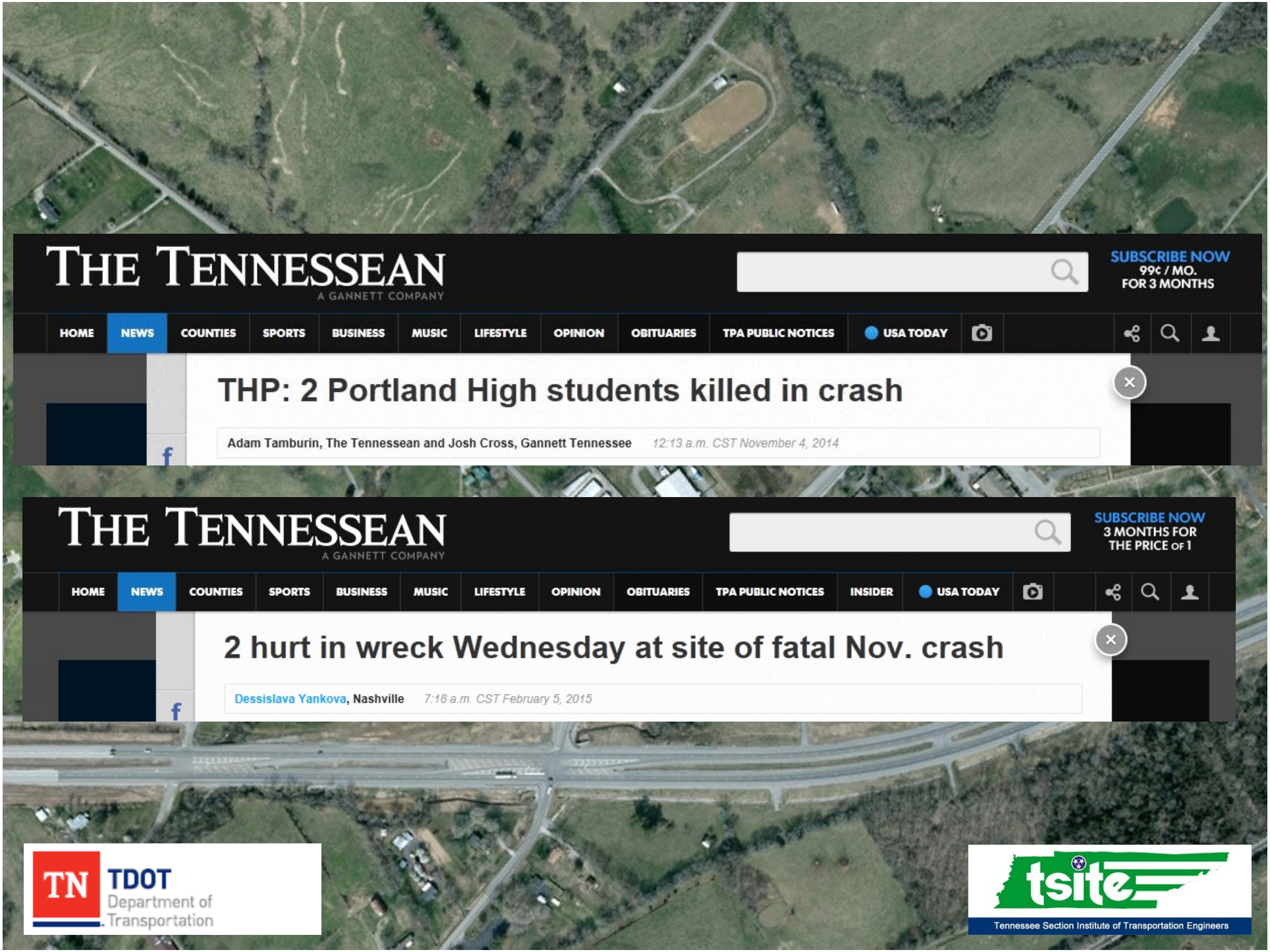
Turn Lane Storage Design



So, What's the Problem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COUNTIES
SPORTS
BUSINESS
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LIFESTYLE
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OBITUARIES
TPA PUBLIC NOTICES
USA TODAY
THP: 2 Portland High students killed in crash
Adam Tamburin, The Tennessean and Josh Cross, Gannett Tennessee
12:13 a.m. CST November 4, 2014
THE TENNESSEAN
A GANNETT COMPANY
SUBSCRIBE NOW
3 MONTHS FOR
THE PRICE OF 1
HOME
NEWS
COUNTIES
SPORTS
BUSINESS
MUSIC
LIFESTYLE
OPINION
OBITUARIES
TPA PUBLIC NOTICES
INSIDER
USA TODAY
2 hurt in wreck Wednesday at site of fatal Nov. crash
Dessislava Yankova, Nashville
7:18 a.m. CST February 5, 2015
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Department of
Transportation
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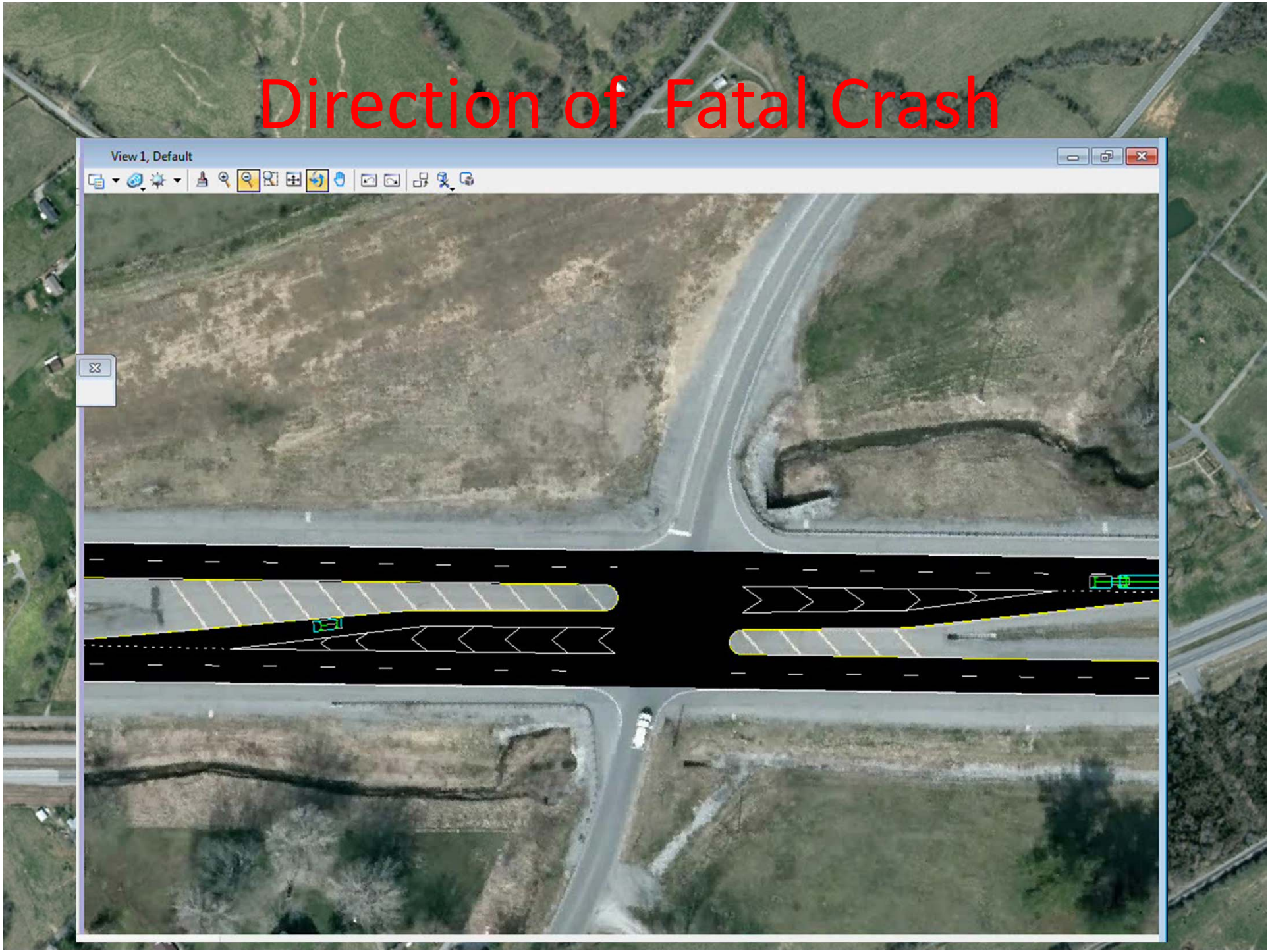
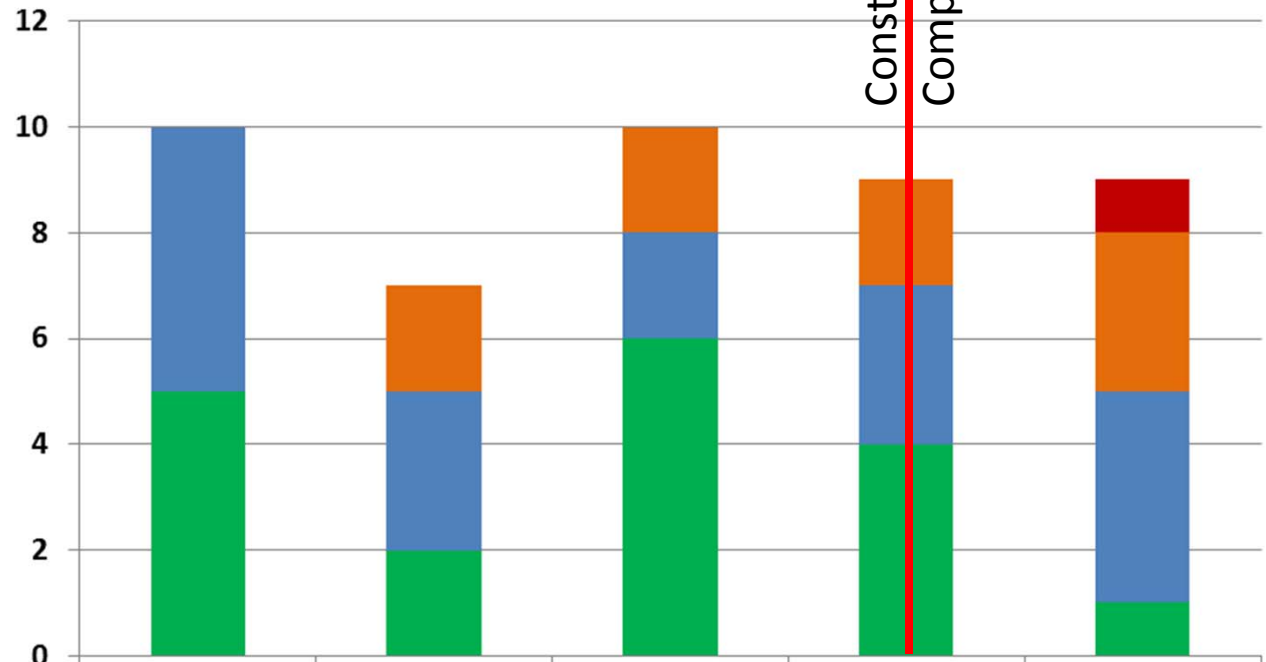
Direction of Fatal Crash

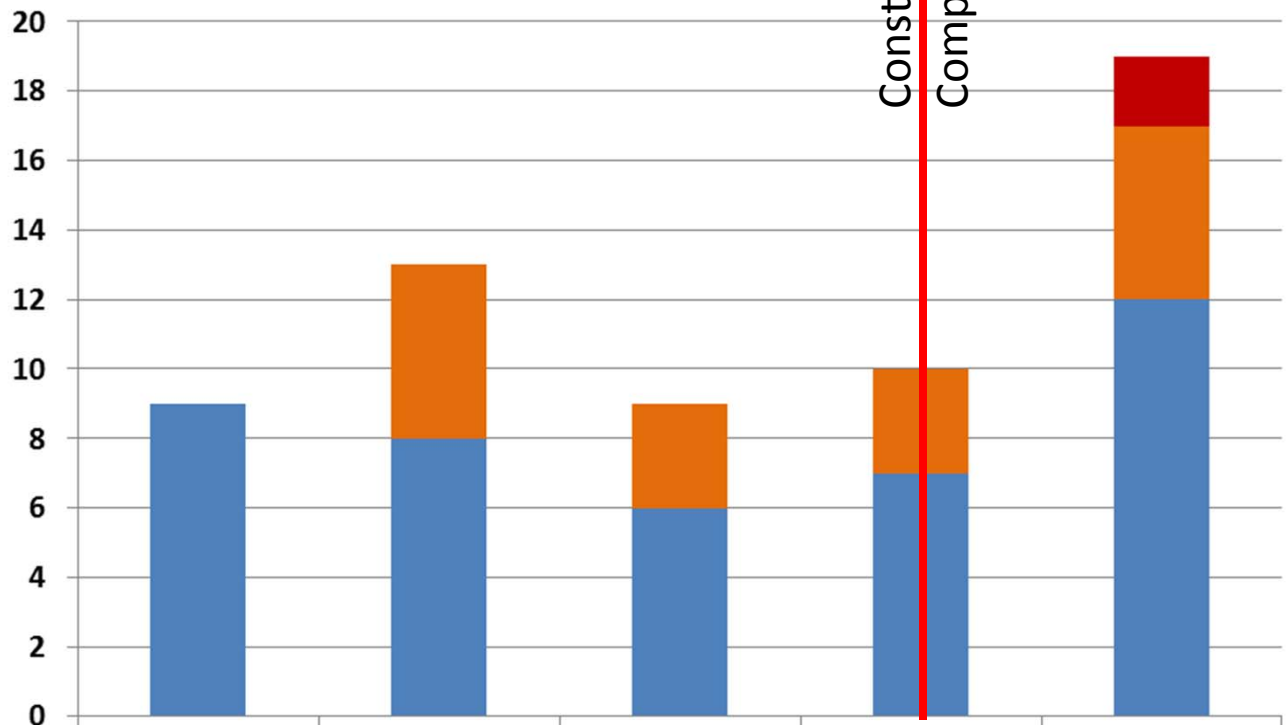


Total Crashes

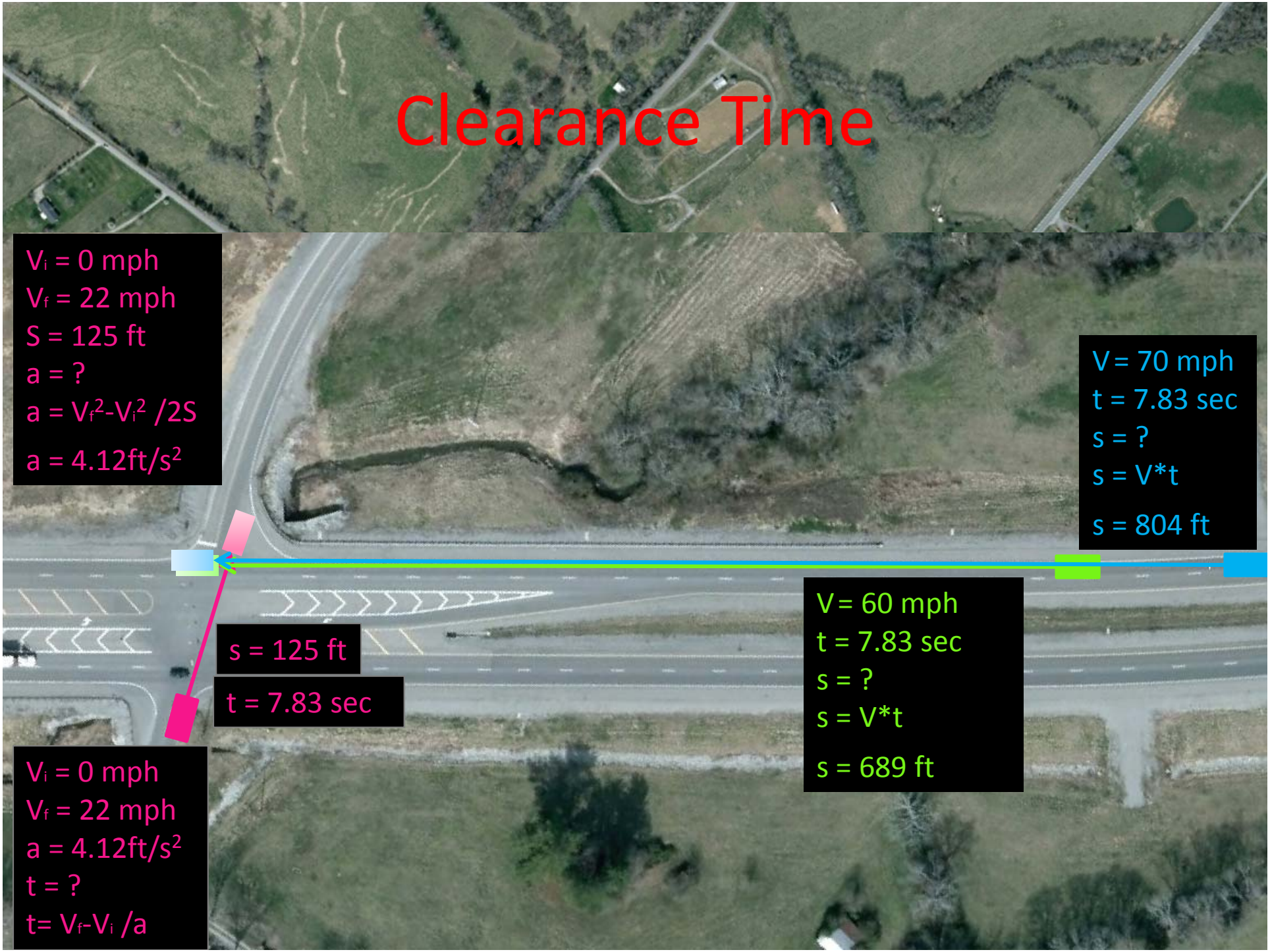


	2010	2011	2012	2013	2014
Fatal Crashes	0	0	0	0	1
Incapacitating Injury Crashes	0	2	2	2	3
Other Injury Crashes	5	3	2	3	4
Property Damage Crashes	5	2	6	4	1

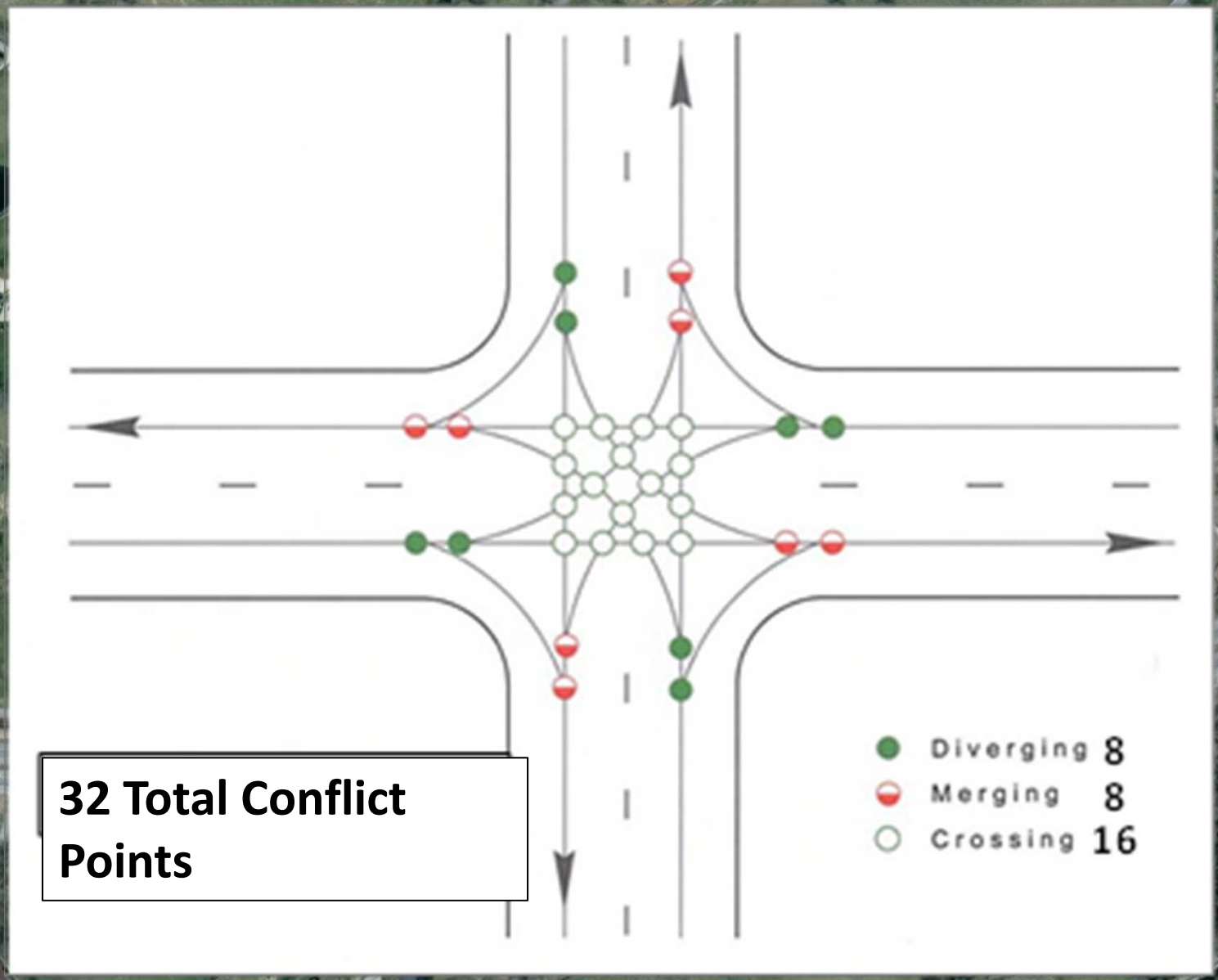
Injury Severity



	2012	2011	2012	2013	2014
Total Killed	0	0	0	0	2
Total Incapacitating Injuries	0	5	3	3	5
Total Other Injuries	9	8	6	7	12

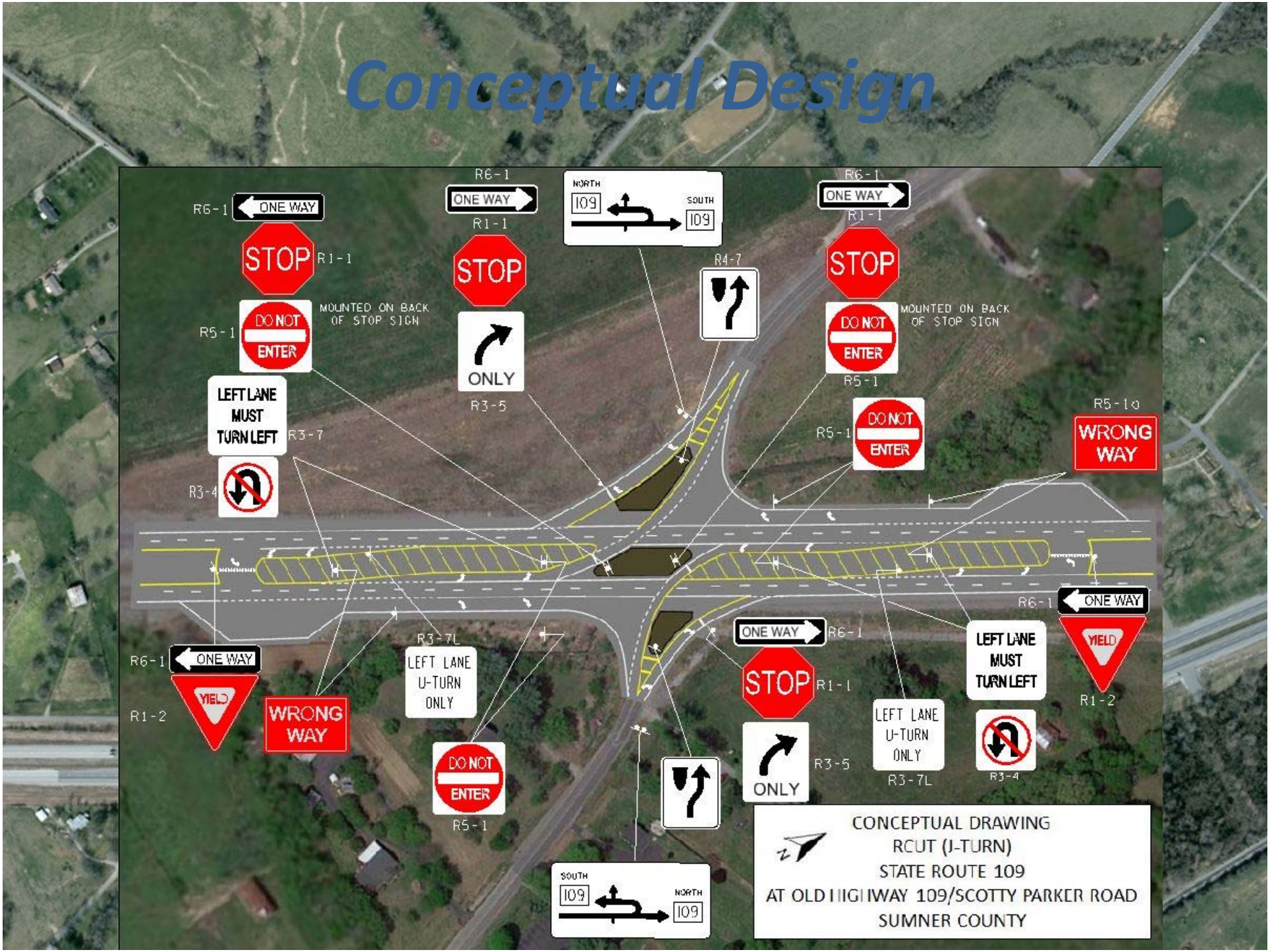

Clearance Time
V_i = 0 mph
V_f = 22 mph
S = 125 ft
a = ?
$a = V_f^2 - V_i^2 / 2S$
$a = 4.12 ft/s^2$
V = 70 mph
t = 7.83 sec
s = ?
s = V*t
s = 804 ft
s = 125 ft
t = 7.83 sec
V = 60 mph
t = 7.83 sec
s = ?
s = V*t
s = 689 ft
V_i = 0 mph
V_f = 22 mph
$a = 4.12 ft/s^2$
t = ?
$t = V_f - V_i / a$

Existing Conflicts

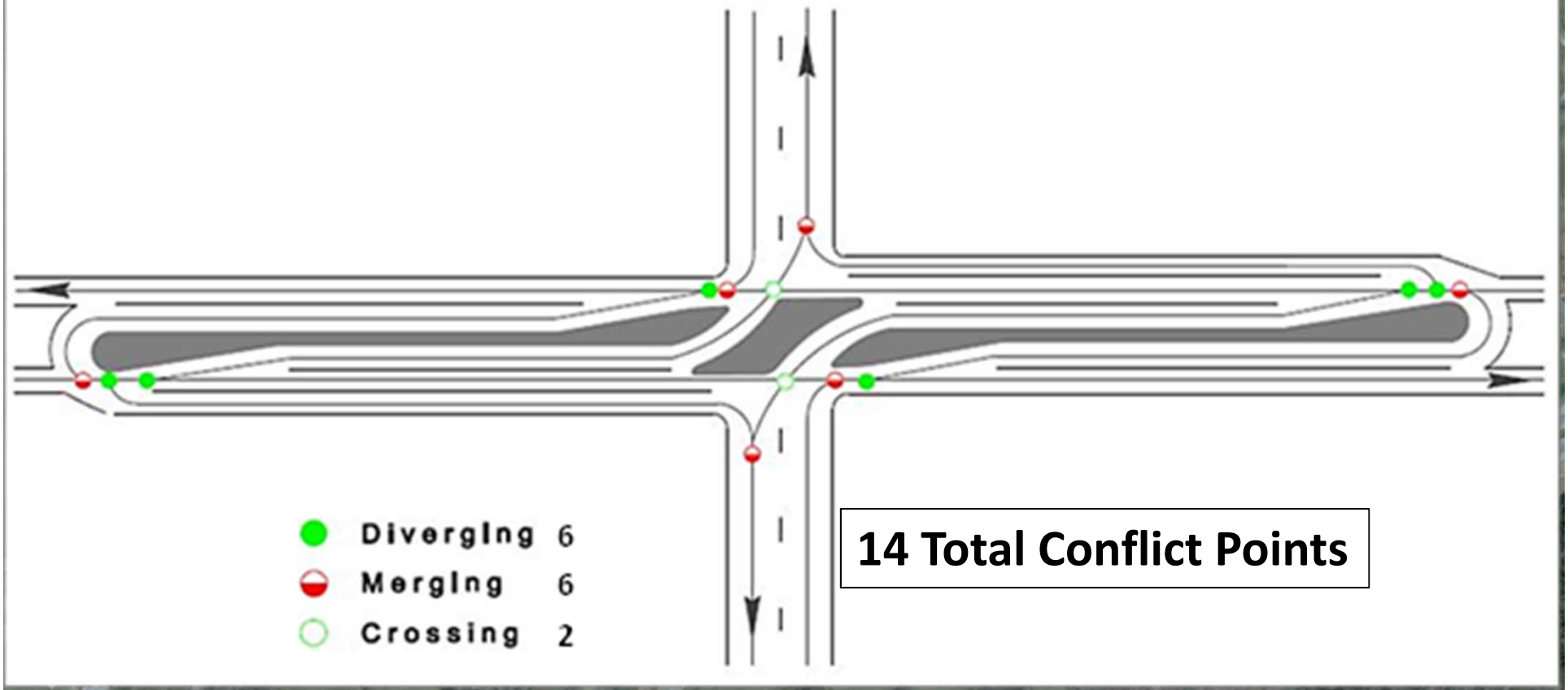


32 Total Conflict Points

Conceptual Design



Conceptual Conflicts



14 Total Conflict Points

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Lessons Learned

- Visualize design
- Safety considerations
- Future training
- Check all appropriate design vehicles

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THANK YOU
Quest?ons & Comments
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