CHAPTER 9 - BASIC DESIGN CONTROLS

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9.2.5 **Procedures**

A design exception may be identified at any time during the development of the project. The project development process specifies opportunities when design exceptions should be identified. Identification of design exceptions is, also, included in the quality control review of the project plans.

When a design exception is identified by the Engineer of Record or any Project Development Team member, the Engineer of Record will first seek to eliminate the exception to design. If the design exception cannot be removed, then the Engineer of Record will initiate the formal design exception approval process. The request for approval of the design exception will be submitted to the Program Manager for routing to the appropriate personnel for the record of decision. The Design Exception Request will include the request form (see Figure 9.2A) and any support data needed to justify the reason why the exception cannot be eliminated through the design process including design alternatives. The request for approval will be prepared for a design exception to AASHTO guidelines and/or for a design exception from standard SCDOT procedures.

Request for Approval of Design Exceptions can be approved only by the Director of Preconstruction. On projects requiring oversight approval by the Federal Highway Administration, the Director of Preconstruction submits the approved Design Exception Request to FHWA for their concurrence.

Submitted By: _______________ Date: __/__/__ Recommended: _________________ Date: __/__/__
Engineer of Record

To: ________________________
Program / Project Manager

BASIS OF DESIGN EXCEPTION

- ☐ Request for Approval of Design Exceptions to AASHTO Guidelines
- ☐ Request for Approval of Design Exceptions from Standard SCDOT Procedures

PROJECT CHARACTERISTICS

County: ______________________ Rd./Route: _______________ Const. Pin: _________________________
From: ________________________ To: ______________________
Length: _________ (miles) MPO/COG ________________
Work Type: ____
Functional Classification: ____

Group Designation: (1 / 2 / 3 / 4) (if applicable)

Type of Terrain: (Level / Rolling / Mountainous)

Design Speed: _________(mph)

_______ ADT ________
_______ ADT ________
Trucks ______________%

CRASH ANALYSIS

(Attach additional sheets with accident history data)

TOTAL PROJECT ESTIMATE **($)__________________**

CHECK APPROPRIATE BOX(ES) FOR DESIGN EXCEPTION(S)

- ☐ Design Speed
- ☐ Horizontal Alignment
  - ❑ Minimum Radii
- ☐ Vertical Alignment
  - ❑ Level SSD K-Values
- ☐ Maximum Grade
- ☐ Vertical Clearance
- ☐ Bridge Width
- ☐ Structural Capacity
- ☐ Superelevation Rate
- ☐ Cross Slope
  - ❑ Travel Lanes
  - ❑ Shoulders
- ☐ Travel Lane Width
- ☐ Shoulder Width
- ☐ Horizontal Clearances
- ☐ Stopping Sight Distance

DESCRIBE ELEMENT(S) FOR DESIGN EXCEPTION(S)
(Attach additional Sheets as needed)____
____
____

DESIGN EXCEPTION FORM

Figure 9.2A

JUSTIFICATION FOR DESIGN EXCEPTION(S)

(Attach additional Sheets as needed) ____

____

____

____

DESCRIBE STEPS TO ELIMINATE DESIGN EXCEPTION(S), INCLUDE COST

(Attach additional Sheets as needed)____

____

____

HOW WILL FUTURE CONSTRUCTION IMPACT DESIGN EXCEPTION(S)?

(Attach additional sheets as needed) ____

____

____

____

____

RECORD OF DECISION

☐ For ☐ Against	☐ For ☐ Against	☐ Approved ☐ Denied
____________________ __/__/__ Regional Design Manager/ Program Manager / DEA)	__________________________ __/__/__ Regional Production Engineer	____________________ __/__/__ (Director of Preconstruction)

☐ Concur

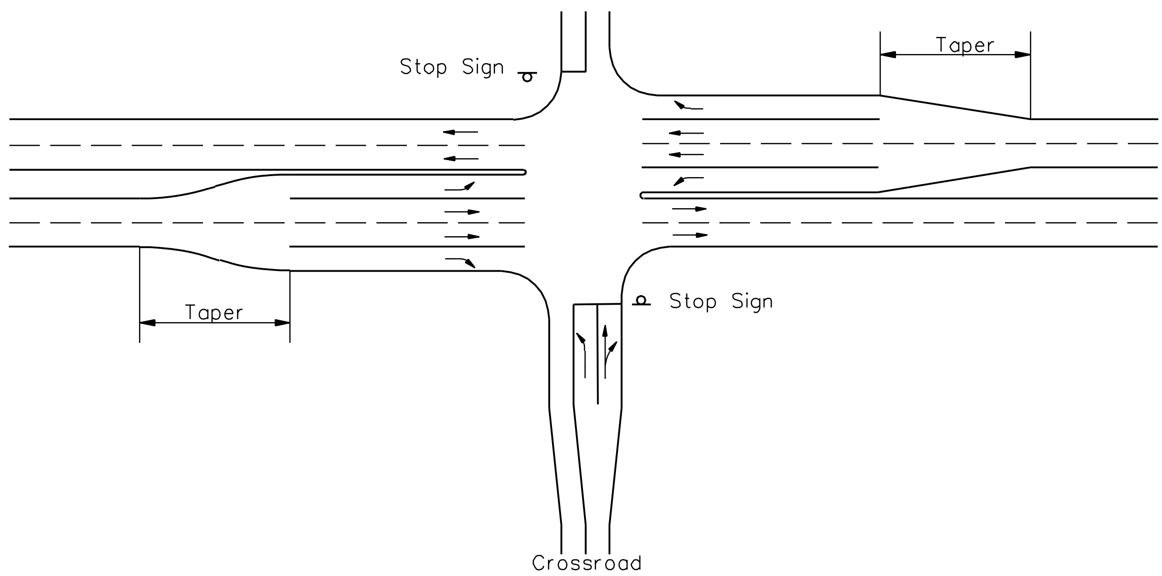
____ __/__/__
FHWA (NHS Routes > $50 million & All Interstate)

cc:
Director of Preconstruction
FHWA
Preconstruction Support Engineer
Regional Production Group Engineer
District Engineering Administrator
Director of Traffic Engineering

Revised record of decision– Revised: 11-2007

DESIGN EXCEPTION FORM
(Continued)

Figure 9.2A



Reverse Curve Taper					Straight Taper			
Design Speed (mph)	Radius (ft)	Auxiliary Lane Widths (ft)			Design Speed (mph)	Auxiliary Lane Widths (ft)		
		W=10 ft	W=11 ft	W=12 ft		W=10 ft	W=11 ft	W=12 ft
V ≤ 30	300	109	115	120	V ≤ 30	110	115	120
31 - 40	480	138	145	152	31 - 40	140	145	150
41 - 50	670	163	171	179	41 - 50	160	170	180
V ≥ 51	840	183	192	201	V ≥ 51	200	200	200

Notes:

1. *Create taper equivalent reverse curves.*
2. *Taper distance is approximately based on tangent alignment.*
3. *Based on the following formula:*

$$L=\sqrt{W(4R-W)}$$

Where:

L = Length of reverse curve taper, feet
W = Width of auxiliary lane, feet
R = Radius, feet

Notes:

1. *W = width of turning lane.*
2. *Where through road is on a curve, develop a uniform offset taper from the curved mainline.*

TYPICAL AUXILIARY LANES TAPER LENGTHS

Figure 15.5H

Revised chart and note no.3 – Revised 11-2007

Turning Volume (vph)	**Percent of Trucks in Turning Volume**				
	0 to 10%	**20%**	**40%**	**60%**	**100%**
50	Use Minimum Length of 100 ft				
100					125 ft
150		125 ft	175 ft	175 ft	175 ft
200	150 ft	175 ft	225 ft	225 ft	250 ft
250	200 ft	225 ft	275 ft	275 ft	325 ft
300	250 ft	275 ft	325 ft	350 ft	400 ft
350	300 ft	325 ft	375 ft	425 ft	475 ft
400	350 ft	375 ft	425 ft	500 ft	550 ft

Note: The Traffic Engineering Division should review the design to determine if longer turn lane lengths are required.

GUIDELINES FOR RIGHT-TURN LANE LENGTHS

Figure 15.5I

Turning Volume (vph)	**Percent of Trucks in Turning Volume**				
	0 to 10%	**20%**	**40%**	**60%**	**100%**
50	In Urban Areas, Use Minimum Length of 150 ft In Rural Areas, Use Minimum Length of 200 ft				
100					
150			175 ft	175 ft	175 ft
200		175 ft	225 ft	225 ft	250 ft
250	200 ft	225 ft	275 ft	275 ft	325 ft
300	250 ft	275 ft	325 ft	350 ft	400 ft
350	300 ft	325 ft	375 ft	425 ft	475 ft
400	350 ft	375 ft	425 ft	500 ft	550 ft

Notes:

1. *Consider providing dual-turn lanes if the turning volumes are greater than 300 vehicles per hour.*
2. *The Traffic Engineering Division should review the design to determine if longer turn lane lengths are required.*

GUIDELINES FOR LEFT-TURN LANE LENGTHS

Figure 15.5J

3. Widening Approaching Through Lanes. If a 30- to 36-foot throat width is provided to receive dual-turn lanes, the designer should also consider how this would affect the traffic approaching from the other side. The designer should also insure that the through lanes line up relatively well to insure a smooth flow of traffic through the intersection.

4. Median Widths. It is desirable to have a median width of at least 28 feet for dual left-turn lanes.

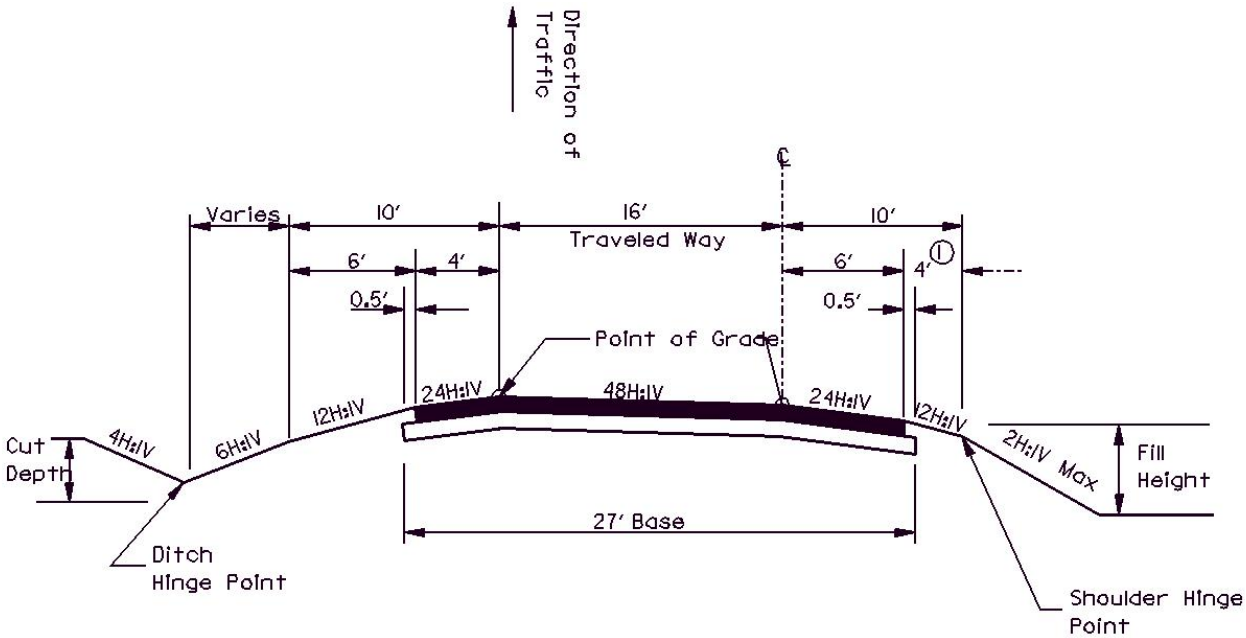
5. Pavement Markings. Pavement markings can effectively guide two lanes of vehicles turning abreast. See the *MUTCD* for applicable guidelines on the selection and placement of any special pavement markings.

6. Opposing Left-Turn Traffic. It is desirable that opposing left turns occur simultaneously; therefore, the designer should insure that there is sufficient space for all turning movements. The separation between turn lanes should be 10 feet; see Figure 15.5N. If space is unavailable, it will be necessary to alter the signal phasing to allow the two directions of turning traffic to move through the intersection on separate phases.

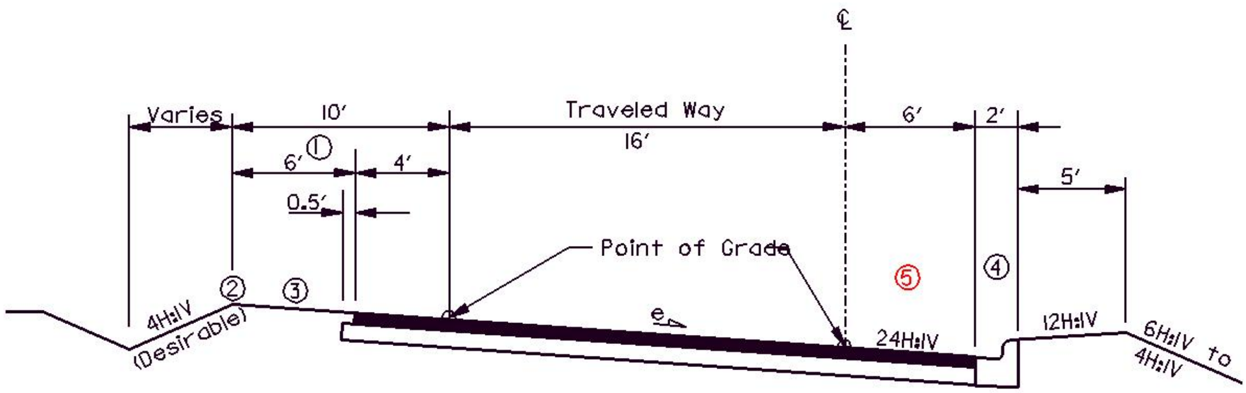
7. Length of Receiving Lanes. Dual left turn lanes require two receiving lanes. The minimum length of dual receiving lanes should be 1000 feet, excluding the lane drop taper.

15.5.5 Acceleration Lanes

On multilane facilities, acceleration lanes may be considered near industrial parks or other major traffic generators. The acceleration design lengths can be determined by reviewing the acceleration distances in Chapter 16 for ramps and the AASHTO *A Policy on the Geometric Design of Highways and Streets*.



One-Way Freeway Ramp



Loop Ramp

Notes:

① *Add 3.5 feet where guardrail is used.*

② *See Section 11.3 for maximum shoulder break.*

③ *Same slope as traveled way.*

④ *Curb and gutter is only used where necessary and will be determined on a case-by-case basis.*

⑤ *Shoulder to rotate with roadway when roadway meets 24:1*

TYPICAL RAMP CROSS SECTIONS

Figure 16.5D

Added bullet number 5 – Revised November 2007

16.5.5 Horizontal Alignment

The following will apply to the horizontal alignment of ramps:

1. Minimum Curve Radii. Figure 16.5C provides the minimum curve radii based on ramp design speed and e_{max}.

2. Superelevation Rates. The maximum superelevation rate on the ramp is e_{max} = 8 percent. See Figure 16.5E and Section 11.3 for superelevation rates based on design speed and curve radius. For ramp design speeds greater than 50 miles per hour, see Figure 11.3B.

   Because of the restrictive nature of ramps, the designer should insure that the design superelevation rates are not in place for only a short distance. This superelevation rate should be maintained for at least one to two seconds of travel time based on the design speed of the ramp.

3. Curve Type. On all except loop ramps, simple curves should be used unless field constraints (e.g., to avoid an obstruction) dictate the use of compound curvature. On loop ramps, compound curves are typically used, with the interior curve(s) of sharper radii than the exterior curves. For exits with loops, the radii of the flatter arc compared to the radii of the sharper arc should not exceed a ratio of 2:1 to prevent abruptness in operation and appearance. Where compound arcs of decreasing radii are used, the arcs should have sufficient length to enable motorists to decelerate at a reasonable rate over the range of design speeds. See Figure 16.5F.

   Comparable radii and length controls may be used on entrance loop ramps with compound arcs of increasing radii. However, for entrance ramps, the 2:1 ratio of compound curves and the lengths in Figure 16.5F are not as critical because the vehicle is accelerating into a curve with a larger radius or into a tangent section.

4. Trucks. Where there are a significant number of trucks on loop ramps, the designer should consider how the design may impact the rollover potential for large trucks. To reduce this potential, consider using flatter curve radii and/or a higher ramp design speed than the allowable minimums. Other critical factors include insuring that ample deceleration lengths are available and, if judged necessary by the Traffic Engineering Division, special “rollover” warning signs for trucks.