



December 13<sup>th</sup> and 15<sup>th</sup>, 2016

*Design Exception Process*

Glenn W. Mumford, PE, CPM



# *What is the Design Exception Process?*

- It is the procedure followed to document the physical, social, environmental or economic constraints that prevent the application of a specific highway design criteria or standard.
- The process is intended to acknowledge and document concurrence that fulfillment of a particular design standard requires an unreasonable impact or expense.



# *Why is a Design Exception necessary?*

- NCDOT policy states all projects shall meet the minimum AASHTO or Sub-Regional Tier standards.
- Failure to meet the minimum standards requires a Design Exception.
- It formally documents the “why’s” of selecting design criteria that do not meet accepted standards.
- Note: An exception is not applicable when unmet criteria are only at locations where a project ties to existing conditions.



# *What do we check for in a Design Exception?*

## **13 Design Criteria**

- Design Speed
- Lane Width
- Shoulder Width
- Bridge Width
- Structural Capacity
- Maximum Grade
- Horizontal Alignment  
(Min. Radius)
- Vertical Alignment  
(Crest & Sag K Factors)
- Horizontal SSD
- Vertical SSD
- Cross Slope
- Superelevation
- Horizontal and Vertical Clearance



# *New FHWA guidance for NHS $\geq$ 50 mph*

## **10 Design Criteria**

- Design Speed
- Lane Width
- Shoulder Width
- Maximum Grade
- Minimum Horizontal Curve Radius
- Stopping Sight Distance (Horizontal and Crest Vertical)
- Cross Slope
- Superelevation
- Vertical Clearance
- Structural Capacity



*New FHWA guidance for NHS < 50 mph*

## **2 Design Criteria**

- Design Speed
- Structural Capacity



## *When is a Design Speed Exception needed?*

- If several of a project's design elements are in violation of standards.
- If a single design element is in violation of the standard for the majority of the length of a project.
- If the design speed of the element(s) in question are significantly below the standard.



# *Documentation of the Process*



Design Exception Checklist



Design Exception Letter





# Design Exception Checklist

Rev. 3/25/96

**DESIGN EXCEPTION PROCESS CHECKLIST**

Date: February 9, 2016 Project Engineer: Jason Moore, PE  
 TIP No: I-5000 Functional Classification: Principal Arterial / Interstate  
 Posted Speed: 60 mph (I-85) Terrain: Rolling

**Items requiring formal approval**

<b>Items requiring formal approval</b>	<b>Prop Design</b>	<b>AASHTO Std<sup>(1)</sup></b>	<b>Exception Req'd</b>
Design Speed <sup>(2)</sup>	<u>60mph</u>	<u>60mph</u>	<u>No</u>
Lane Width	<u>12'</u>	<u>12'</u>	<u>No</u>
Shoulder Width	<u>14'</u>	<u>12'</u>	<u>No</u>
Bridge Width	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>
Structural Capacity <sup>(3)</sup>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>
Maximum Grade	<u>2.30%</u>	<u>4%</u>	<u>No</u>
Min. Horizontal Curve Radius	<u>1910'</u>	<u>1330'</u>	<u>No</u>
Sag Vertical Curve K	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>
Crest Vertical Curve K	<u>216</u>	<u>151</u>	<u>No</u>
Horizontal SSD	<u>470<sup>(4)</sup></u>	<u>570'</u>	<u>No</u>
Vertical SSD	<u>683'</u>	<u>570'</u>	<u>No</u>
Pavement Cross Slope	<u>2%</u>	<u>2%</u>	<u>No</u>
Superelevation	<u>6%</u>	<u>6%</u>	<u>No</u>
Vertical Clearance	<u>15'-7"</u>	<u>16'-0"</u>	<u>Yes</u>
Horizontal Clearance	<u>10'-0"</u>	<u>6'-0"</u>	<u>No</u>

**Listed below are the known non-complying items not requiring an approved design exception**

(1) The AASHTO STD. as it relates to the design speed should be equal to the higher of either the posted speed or the minimum "Greenbook" value for design speeds.  
 (2) If design speed is less than the posted or statutory speed, a design exception is required.  
 (3) Structure Design's responsibility - be sure they have checked for need of design exception.  
 (4) 470' horizontal stopping sight distance measured from the center of the existing inside lane, closest to the existing raised median barrier. This is an existing condition and not a part of the proposed design.



# Sub Regional Tier Design Exception Checklist

**Bold items above are the known non-complying items not requiring an approved design exception.**

- (1) The AASHTO STD. as it relates to the design speed should be equal to the higher of either the posted speed or the minimum "Greenbook" value for design speeds.
- (2) If design speed is less than the posted or statutory speed, a design exception is required.
- (3) Structure Design's responsibility - be sure they have checked for need of design exception.
- (4) This element only meets 45 mph design speed.
- (5) This element only meets 25 mph design speed.
- (6) This element only meets 20 mph design speed.
- (7) This element only meets 30 mph design speed.

ck\_PE \_\_\_\_\_  
 Subregional \_\_\_\_\_  
 ception Req'd \_\_\_\_\_  
 NO/NO \_\_\_\_\_  
 YES/NO \_\_\_\_\_  
 NO/NO \_\_\_\_\_  
 NO/NO \_\_\_\_\_

Bridge Width	N/A	27'-10"	20'	20'	NO/NO
Structural Capacity <sup>(3)</sup>	N/A	HL-93	HL-93	HL-93	NO/NO
Maximum Grade	2.30%	<b>8.53%</b> <sup>(4)</sup>	6%	6%	YES/YES
Min. Horizontal Curve Radius	1910'	<b>200'</b> <sup>(5)</sup>	1500'	1500'	YES/YES
Sag Vertical Curve K	N/A	<b>17</b> <sup>(6)</sup>	136	136	YES/YES
Crest Vertical Curve K	216	NA	151	151	NO/NO
Horizontal SSD	470' <sup>(4)</sup>	<b>200'</b> <sup>(7)</sup>	570'	570'	YES/YES
Vertical SSD	683'	<b>116'</b> <sup>(6)</sup>	570'	570'	YES/YES
Pavement Cross Slope	2%	2%	2%	2%	NO/NO
Superelevation	6%	0.04	0.04	0.04	NO/NO
Vertical Clearance	15'-7"	NA	NA	NA	NA
Horizontal Clearance	10'-0"	NA	NA	NA	NA

**Listed below are the known non-complying items not requiring a**

- (1) The AASHTO STD. as it relates to the design speed should be equal to the higher of either the posted speed or the minimum "Greenbook" value for design speeds.
- (2) If design speed is less than the posted or statutory speed, a design exception is required.
- (3) Structure Design's responsibility - be sure they have checked for need of design exception.
- (4) 470' horizontal stopping sight distance measured from the center of the existing raised median barrier. This is an existing condition at design.

**Bold items above are the known non-complying items not requiring an approved design exception.**

- (1) The AASHTO STD. as it relates to the design speed should be equal to the higher of either the posted speed or the minimum "Greenbook" value for design speeds.
- (2) If design speed is less than the posted or statutory speed, a design exception is required.
- (3) Structure Design's responsibility - be sure they have checked for need of design exception.
- (4) This element only meets 45 mph design speed.
- (5) This element only meets 25 mph design speed.
- (6) This element only meets 20 mph design speed.
- (7) This element only meets 30 mph design speed.



# Design Speed Design Exception Checklist

<b>DESIGN EXCEPTION PROCESS</b>			<b>DESIGN EXCEPTION PROCESS CHECKLIST</b>					
Date: <u>February 9, 2016</u> Project E			Date: _____ Project Engineer: _____					
TIP No: <u>I-5000</u> Functional Class			TIP No: _____ Functional Classification: _____					
Posted Speed: <u>60 mph (I-85)</u>			Posted Speed _____ Terrain _____					
+	<b>Items requiring formal approval</b>	<b>Prop Design</b>	<b>AAS</b>	<b>Items requiring formal approval</b>	<b>Prop Design</b>	<b>AASHTO Std For Proposed Design Speed</b>	<b>AASHTO Std<sup>(1)</sup></b>	<b>Exception Req'd mph/ mph</b>
	Design Speed <sup>(2)</sup>	<u>60mph</u>	<u>60</u>		_____	_____	_____	<u>60</u>
	Lane Width	<u>12'</u>	<u>12</u>		_____	_____	_____	_____
	Shoulder Width	<u>14'</u>	<u>14</u>		_____	_____	_____	_____
	Bridge Width	<u>N/A</u>	<u>0</u>		_____	_____	_____	_____
	Structural Capacity <sup>(3)</sup>	<u>N/A</u>	<u>0</u>		_____	_____	_____	_____
	Maximum Grade	<u>2.30%</u>	<u>2.30</u>		_____	_____	_____	_____
	Min. Horizontal Curve Radius	<u>1910'</u>	<u>1910</u>		_____	_____	_____	_____
	Sag Vertical Curve K	<u>N/A</u>	<u>0</u>		_____	_____	_____	_____
	Crest Vertical Curve K	<u>216</u>	<u>216</u>		_____	_____	_____	_____
	Horizontal SSD	<u>470'<sup>(4)</sup></u>	<u>470</u>		_____	_____	_____	_____
	Vertical SSD	<u>683'</u>	<u>683</u>		_____	_____	_____	_____
	Pavement Cross Slope	<u>2%</u>	<u>2</u>		_____	_____	_____	_____
	Superelevation	<u>6%</u>	<u>6</u>		_____	_____	_____	_____
	Vertical Clearance	<u>15'-7"</u>	<u>157</u>		_____	_____	_____	_____
	Horizontal Clearance	<u>10'-0"</u>	<u>100</u>		_____	_____	_____	_____
<b>Listed below are the known non-complying items not requiring an approved design exception.</b>								
<p>(1) The AASHTO STD, as it relates to the design speed should be equal to the higher of either the posted speed or the minimum "Greenbook" value for design speeds.</p> <p>(2) If design speed is less than the posted or statutory speed, a design exception is required.</p> <p>(3) Structure Design's responsibility - be sure they have checked for need of design exception.</p>								



# Design Exception Letter



**MEMO TO:** Rodger D. Rochelle, PE  
Technical Services Division Administrator

**FROM:** Glenn W. Mumford, PE  
State Roadway Design Engineer

**DATE:** February 9, 2016

**SUBJECT:** Project: 41153.1.1 (I-5000) Gaston County  
F. A. Project: IMF-85-1(113)17  
I-85/US 321 Geometric Safety Improvement

**Request for Design Exception**

This is a request for a design exception for the vertical clearance (-Ramp D-) under the existing Marietta Street (-Y2-) bridge. See Attachment.

If you have any questions, please contact Jason Moore, PE, at 707-6286.

Roadway Project Design Engineer      Assist. State Roadway Design Engineer

Roadway Project Engineer              State Roadway Design Engineer

GWM/bck

Attachment

cc: Jason Moore, PE,

APPROVED: \_\_\_\_\_

DATE: \_\_\_\_\_

cc: Glenn Mumford, PE  
Jason Moore, PE  
Jimmy Hamrick, PE

Nothing Compares™

State of North Carolina | Department of Transportation  
1000 Birch Ridge Drive | 1582 Mail Service Center | Raleigh, NC 27617  
919 707 6200 T | 919 250 4036 F

**NCDOT DESIGN EXCEPTION**

F.A. Project No.: **IMF-85-1(113)17** State Project No.: **41153.1.1**

TIP No.: **I-5000** County: **Gaston**

Design Exception Requested for: **Minimum vertical clearance**

Location of Design Feature in Question: **-L- Sta. 55+27.9 auxiliary lane under existing Marietta Street (-Y2-) bridge**

**PROJECT DATA**

Current ADT (2017): **50,500** Design ADT: \_\_\_\_\_

% Trucks: **12%** Design Speed: **70 mph (I-85)**

Functional Classification: **Principal Arterial / Interstate**

Minimum AASHTO Dimensions: **16'-0"** Dime: \_\_\_\_\_

Total Estimated Cost of Project: **\$13,800,000**

Additional Cost to Meet Minimum AASHTO Requirement **Exception, Item 4)**

**BASIS FOR EXCEPTION**

1. Describe how the accident history relates to the proposed design, including year accident history, attached (number, type, rates, and statewide average, etc.).

This project adds new ramps and additional drainage at the interchange. There were a total of 36 accidents during the period from January 1 to December 2015. The majority of the accidents were minor property damage only. There were no fatalities and none of the accidents were related to the design of the interchange.

2. Describe any future plans for upgrading this roadway project.

I-85 through this area is scheduled to be widened under the current program in 2022 and Let in 2024. The widening of I-85 will include the widening of the Marietta Street (-Y2-) bridge therefore eliminating the

3. Describe the cross section, geometrics, access control, etc. of the existing roadway outside the project limits.

I-85 is an existing interstate with three 12-foot lanes in each direction divided by a double-faced median barrier. In the area of this project I-85 has full control of access and is currently posted at 60 mph.

Ramp D introduces a new traffic movement, replacing the existing Loop C movement, which takes US 321 traffic to northbound I-85. Ramp D consists of two 12-foot lanes and narrows to a single lane before it ties to the outside of a horizontal curve on I-85 with an approximate 1,910-foot radius measured from the centerline of the median. Traffic continues in a parallel auxiliary lane an additional 1000 feet before merging onto I-85. The existing vertical alignment on I-85 has a grade of a little over +1%, cresting approximately 850 feet beyond the Ramp D tie in point.

The existing horizontal clearance under the Marietta Street bridge is sufficient to allow the 12-foot auxiliary lane and a 10-foot paved shoulder with a single faced barrier protecting the Marietta Street bridge piers. The ramp travel speed will be approximately 40-50 mph as motorist pass under the existing bridge.

4. Explain why it is not reasonable or feasible to meet (engineering, environmental and/or ROW constraints) minimum AASHTO requirements.

The existing Marietta Street bridge is in very good condition with many years of service life remaining.

The upcoming I-85 widening project, I-5719, currently scheduled for Right of Way in 2022 and for Let in 2024, will require this bridge to be replaced to allow more width for additional travel lanes. The exact typical section under this bridge has not been determined for this future project. The existing Marietta Street bridge should remain in place until the exact requirements for the I-85 widening project have been determined and subsequently replaced as a part of the future project.

5. Describe any measures proposed to mitigate the design element that is below standards.

The existing I-85 bridge over US 321 has a minimum of 15'-7" vertical clearance. Currently the existing southbound US 321 traffic must go under the existing I-85 bridge to access Loop C. Since the proposed Ramp D replaces the existing Loop C traffic movement, the Ramp D clearance under the Marietta Street bridge is equivalent to the clearance of the current traffic pattern.

With the substandard vertical clearance matching the existing conditions, and with the bridge's imminent replacement with the upcoming I-85 widening project, no mitigation measures are proposed at this time.



# Basis of Exception

1. Describe how the accident history relates to the proposed design exception. See current 3-year accident history, attached (number, type, rates, severity, cause, comparison to statewide average, etc.).

F.A. Project No.: **IMF-85-1(113)17** State Project No.: **41153.1.1**

TIP No.: **I-5000** County: **Gaston**

currently posted at 60 mph.

Ramp D introduces a new traffic movement, replacing the existing Loop C movement, which takes US 321 traffic to northbound I-85. Ramp D consists of two 12-foot lanes and narrows to a single lane before it ties to the outside of a horizontal curve on I-85 with an approximate

2. Describe any future plans for upgrading this roadway either at or in the vicinity of this project.

Current ADT (2017): **50,500** Design ADT (2037): **60,100**

% Trucks: **12%** Design Speed: **70 mph (I-85)** Posted Speed: **60 mph (I-85)**

Functional Classification: **Principal Arterial / Interstate**

4. Explain why it is not reasonable or feasible to meet (engineering, environmental and/or ROW constraints) minimum AASHTO requirements.

The existing Marietta Street bridge is in very good condition with many years of service life

3. Describe the cross section, geometrics, access control, etc. of the existing roadway outside the project limits.

## BASIS FOR EXCEPTION

1. Describe how the accident history relates to the proposed design exception. See current 3-year accident history, attached (number, type, rates, severity, cause, comparison to statewide average, etc.).

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The existing I-85 bridge over US 321 has a minimum of 15'-7" vertical clearance. Currently the existing southbound US 321 traffic must go under the existing I-85 bridge to access

4. Explain why it is not reasonable or feasible to meet (engineering, environmental and/or ROW constraints) minimum AASHTO requirements.

project.

I-85 through this area is scheduled to be widened under STIP I-5719, scheduled for Right of Way in 2022 and Let in 2024. The widening of I-85 will require the replacement of the Marietta Street (-Y2-) bridge therefore eliminating the basis of this design exception.

5. Describe any measures proposed to mitigate the design element that is below standards.



## *Important Points To Remember*

- A Design Exception Checklist should be completed for every project.
- Not every situation requires a formal Design Exception letter.
- Discuss the need for an exception early in project development.
- The basis for the exception must clearly show why the design standards cannot be met.





# *Questions?*

