To: Michael Hood, PE  
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: Lex/Rich/Newberry  
Rd./Route: I-26  
Const. Pin: P029208

From: MM 85  
To: MM 101

Length: 16.5 miles

MPO / COG: Central Midlands

Work Type: Interstate widening and interchange reconstruction

Functional Classification: Rural/Urban Freeways

Group Designation:  
(if applicable)

Type of Terrain: 
Level / Rolling / Mountainous

Design Speed: 70 mph

2015 ADT 71,700

2040 ADT 136,230

TRUCKS 23 %

CRASH ANALYSIS

(Attach additional sheets with accident history data)

TOTAL PROJECT ESTIMATE ($) 532,000,000

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 Clearance
- Stopping Sight Distance

DESCRIBE ELEMENT(S) FOR DESIGN Exception(S)

(Attach additional sheets as needed)

Two locations along the project contain vertical crest curves with SSD values of approximately 570'. These locations are 1) EB 7054+50 & WB 4054+50 (mainline station near 1054+75), and 2) EB 7431+80 & WB 4432+25 (mainline station 1432+00). The required SSD for a 70 MPH design speed is 730’. (see attached)
JUSTIFICATION FOR DESIGN EXCEPTION(S)

(Attach additional sheets as needed)

The existing SSD (570') for these vertical curves meets a minimum design speed less than or equal to 60 mph. The I-26 Traffic Safety Analysis Report shows a total of only three crashes within the limits of the substandard SSD; none appear related to SSD. In order to meet SSD of 730', significant amount of fills or cuts will be required. (attached)

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

(Attach additional sheets as needed)

Each location was evaluated to meet 70 mph stopping sight crest vertical curve criteria. The additional depth of cut or fill were developed. Cost to remove, lower and reconstruct the crest vertical curves for both locations is estimated to be $5,000,000. (see attached)

HOW WILL FUTURE CONSTRUCTION IMPACT DESIGN EXCEPTION(S)?

(Attach additional sheets as needed)

(See Attached)

RECORD OF DECISION

☐ For
☐ Against

☐ For
☐ Against

☐ Approved
☐ Denied

J.B. W. 7/24/18
(Regional Design Manager/ Program Manager / DEA) Date

☐ Approved

7/25/18
(Regional Production Engineer) Date

☐ Denied

I. D. Bright 7/25/18
(Director of Preconstruction) Date

☒ Concur

6/20/18

FHWA (NHS > $50 million & All Interstate)

cc:
Director of Preconstruction
FHWA
Preconstruction Support Engineer
Regional Production Group Engineer
District Engineering Administrator
Director of Traffic Engineering
Describe Elements for Design Exception

Stopping sight distance (SSD) is defined as the distance for drivers to see an obstacle in the roadway and safely bring their vehicle to stop. This distance is the sum of the distance traveled during a driver’s perception/reaction or brake reaction time and the distance traveled while braking to a stop. These distances will vary dependent on travel speed and grade. The criterion for SSD is applied to both horizontal and vertical alignments. For vertical alignments, a minimum length of crest curve is required to provide SSD for any given design speed.

Two locations along the project contain vertical crest curves with SSD values of approximately 570’. The first location is near mainline station 1054+75 (Location 1) and the second is near mainline station 1432+00 (Location 2). Both vertical curve locations are in the eastbound and westbound direction of travel. According to the 2011 AASHTO Policy on Geometric Design of Highways and Streets and the South Carolina Roadway Design Manual, a SSD of 730’ is required for a 70 mph design speed. The existing, substandard vertical curves have a SSD which meets a design speed of 60 mph. The proposed crest curves would have a SSD of 645’ and meet a design speed of 65 mph. These values were developed based on past practices on interstate projects where significant cuts and fills were required to meet design criteria, but where there was no significant crash history related to SSD. In this instance, cuts and fills were restricted to a maximum of 3’.

Justification for Design Exception(s)

The elimination of the SSD design exceptions would require extensive reconstruction of I-26, would present major traffic control issues, and would add significantly to the cost of the project. Significant excavation also introduces risks to the project associated with unknown subsurface conditions that have not been captured in preliminary cost estimates. Rock was encountered in preliminary borings within 4.5 feet of the surface 100 feet from the Location 1 curve, and within 4 feet of the surface in the Location 2 curve.

At Location 2, the vertical curve is between the exit ramp and entrance ramp in both directions of travel. The additional length of curve required to provide additional stopping sight distance will create longer temporary ramps for longer periods of time in order to complete the additional excavation. The longer vertical curve will require the proposed westbound exit ramp (loop) to be much lower than the existing ramp grade thereby creating potential construction issues while maintaining the existing ramp.

As described below, the crash history at these two locations does not indicate any issues attributable to the available stopping sight distance, and both curves are proposed to be improved from the existing condition.
In the Interstate 26 Traffic Safety Analysis Report prepared by STV, Inc., historical crash data is included for years 2013 thru 2015 (3 years) for the project area from mile marker 81.8 to 102.5. There were 1,037 crashes on the interstate mainline or ramps during this period and 130 crashes on interchange arterials and adjacent roadways. The majority of these accidents (82%) were classified as property damage only. There were seven fatal crashes during this period. These fatal crashes included four hitting a fixed object, sideswipe/head-on, and pedestrian illegally in roadway (one in each direction). The majority of the crashes along I-26 were rear end crashes (441) and no collision with motor vehicle (433) or 84% of the total crashes. Sideswipes same direction crashes accounted for 11% of the crashes. The widening of this section of I-26 is anticipated to reduce congestion and reduce rear-end crashes that could result from slowed or stopped traffic due to traffic queues. The substandard crest vertical curves occur in areas where the horizontal curvature does not cause issues with stopping sight distance.

The attached figures (A-5, A-6, A-13, A-14, B-15, B-16, B-23, B-24) show the location of all crashes in areas where the proposed design exception is located as well as the approximate location of the vertical curves. Location 1 had 4 crashes in the westbound lanes (improper lane usage/change, aggressive operation of vehicle, and two crashes of driving too fast for conditions) and 3 crashes (two were driving too fast for conditions and improper lane change) in the eastbound lanes. Location 2 had crashes (all driving too fast for conditions) in the westbound lanes and 4 crashes (all driving too fast for conditions) in the eastbound lanes. As shown on these figures, these locations are not in “hot spot” areas of this project.

The proposed SSD for the curves at these locations is 645’ which meets a design speed of 65 mph, greater than the current design speed but below the 70 mph design speed for the remainder of the project. Since the current length of crest curve does not appear to contribute to the crashes, the proposed length of curve should not contribute to future crashes and would be an improvement.

In addition to increasing the existing available SSD, other safety measures such as cross slope correction, additional clear zone, interchange improvements, and an additional travel lane in each direction, as proposed, will significantly improve the safety of I-26 through the project limits.

Based on the proposed improvements which mitigate crash history, construction cost to correct the vertical curve to meet 70 mph SSD, and minimal crash history related to the geometry, it is recommended to provide the 65 mph SSD.
Describe steps to eliminate Design exception(s)

In order to eliminate the design exceptions, longer crest curves are required to provide the 730’ SSD. This will require additional construction cost due to added depth of cut and length of reconstruction. During construction, the additional depth of cut will require temporary shoring in order to maintain the existing elevations of travel lanes in one direction while excavation and construction of the concrete median to the proposed elevations of the other direction can be accomplished. The additional length and depth of reconstruction along with temporary shoring will add approximately 3 weeks per side of each location or 3 months to the contract time.

At location 1, the 65 mph design eastbound requires 1.3’ cut versus 5.2’ for 70 mph. In the westbound direction the 65 mph design requires 2.2’ cut versus 6.1’ for 70 mph. At location 2, the 65 mph design eastbound requires 2.7’ cut versus 5.7’ cut for 70 mph. In the westbound direction the 65 mph design requires 2.5’ cut versus 5.9’ cut for 70 mph. The additional construction cost for both locations is approximately $5,000,000 which does not include engineering cost.

How will future construction impact Design Exception(s)

Future construction is not anticipated to be impacted by the design exception. Due to issues with constructability and maintenance of traffic to correct the grades and the fact that the crash analysis does not indicate adverse effects on safety, it is not anticipated these grades will be modified in the future provided an acceptable level of safety remains in the future.
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RECOMMENDATION
- DESIGN EXCEPTION 65 MPH (1.3' CUTF)

CRASH HISTORY
- Figures A-13, A-14

TRAFFIC REPORT FIGURES
- Figures A-5, A-6
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**Recommendation:**
- DESIGN EXCEPTION 65 MPH (1.5 YD) (Figures B-15, B-16)
- DESIGN EXCEPTION 65 MPH (2.5 YD) (Figures B-21, B-24)
Figure A-14
I-26 Eastbound
Exit 91 - Mt Vernon Church Road
03/2017
Location 2
MM 85.1
(1432+00)

Manner of Collision
- Backed Into EB
- Sideswipe Collision EB
- Head On EB
- No Collision With Motor Vehicle EB
- Angle Collision EB
- Rear End EB

Figure A-5
I-26 Eastbound Exit 85

03/2017
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