HEADING: **AASHTO**

SUBJECT: EXAMPLE DESIGN EXCEPTION REQUEST MEMORANDUM RELATED TO HORIZONTAL CURVE SUPERELEVATION

The attached is an example of a Design Exception Request Memorandum where there are requested design exceptions for horizontal curve superelevation. Also attached is the EXISTING HORIZONTAL CURVE SUPERELEVATION NOT MEETING AASHTO METHOD 5 DESIGN EXCEPTION SCREENING PROCESS flow chart.

A design exception for superelevation is requested when the exiting superelevation (or improved superelevation after construction) of a horizontal curve does not meet AASHTO recommended minimum requirements based upon AASHTO Method 5 for distributing e and f. If a design exception for superelevation is required, then the superelevation of the existing horizontal curve is compared to the AASHTO recommended minimum based upon AASHTO Method 2 for distributing e and f.

If there appears to be 1) no correlation between the superelevation of the existing curve and the Crash History and 2) the Method 2 speed is greater than or equal to the posted speed, then a Design Exception based upon AASHTO Method 5 is requested. Mitigation strategies are not required. This is noted by curves 1, 2, 4 and 7 in the attached example.

If the superelevation of the existing horizontal curve does not meet AASHTO recommended minimum requirements based upon AASHTO Method 5 and Method 2 for distributing e and f, then a mitigation strategy needs to be evaluated. This is noted by curves 3, 5 and 6 in the attached example. Please refer to the U S Department of Transportation Federal Highway Administration publication “Mitigation Strategies for Design Exceptions - July 2007”. http://safety.fhwa.dot.gov/geometric/pubs/mitigationstrategies/ Mitigation measures could include such items as rumble strips, wide pavement markings, shoulder widening or special pavement treatments. Differential milling and overlay will need to be evaluated in coordination with the Design Project Manager to determine what is practical and the availability of additional funding sources. The Predesign Project Manager and Supervisor should discuss engineering aspects of the curves and other data provided by Traffic to determine recommendations of mitigation measures to be included in the project scope of work and the Design Exception Request Memorandum.

The Design Exception Request Memorandum is typically attached to the Design Exception Request Letter which is signed by the Assistant State Engineer with Roadway Engineering Group. The following cc list should be added to the bottom of the Design Exception Request Letter only:

cc:	Design Project Manager	MD XXXX	(w attachments)
	Barry Crockett, Contracts and Specifications	MD 121F	(w/o attachments)
	Paul O’ Brien, Predesign Section Manager	MD 605E	(w attachments)
	Marta Raiford, Predesign Records Retention	MD 605E	(w attachments)

EXISTING HORIZONTAL CURVE SUPERELEVATION NOT MEETING AASHTO METHOD 5
DESIGN EXCEPTION SCREENING PROCESS

Field Review Is Scheduled. Traffic Engineering HES Section Reviews The Crash History To Determine If There Are Specific Locations Within The Project Limits That May Warrant Any Horizontal Curve Improvements / Mitigation Measures	Prepare AASHTO Report For The Project Based Upon The Posted Speed As The Design Speed And AASHTO Method 5. Determine Any Horizontal Curves Which Require A Design Exception
	The AASHTO Report Is Sent To Traffic Design For The Crash Analysis

Review Information Provided By Traffic Engineering HES Section And List Horizontal Curves Which May Require A Design Exception For Horizontal Curve Superelevation Not Meeting AASHTO Method 5

For Each Horizontal Curve Calculate The Curve Speed and e Minimum Based Upon AASHTO Method 2

If The Method 2 Speed ≥ Posted Speed And The Horizontal Curve Does Not Have Any Issues Related To Crash History, Then A Design Exception Based Upon AASHTO Method 5 Is Requested. Mitigation Strategies Are Not Required	If The Existing e < Method 2 e Minimum And / Or The Horizontal Curve May Have An Issue Related To Crash History, Then A Design Exception Is Requested And Mitigation Strategies Need To Be Evaluated

Project Manager and Supervisor should discuss engineering aspects of the curves and other data provided by Traffic to determine recommendations of mitigation measures to be included in project scope of work and the Design Exception Request.

Superelevation Mitigation Measure		
Low Cost	Medium Cost	High Cost
Proposed e < Method 2 e	Proposed e = Method 2 e	Method 2 e < Proposed e ≤ Method 5 e
Incremental Superelevation Improvement Which Can Be Constructed Under Traffic	Improvement To Method 2 e Should Not Trigger "Reconstruction Of The Roadway"	If The Horizontal Curve Needs To Be Reconstructed, It Should Be Improved To The Method 5 e

Other Mitigation Measures Which Can Be Implemented To Reduce The Potential Impact Of The Existing Feature To Remain These measures could include: additional signing, rumble strips, chevrons, shoulder widening, pavement treatment to increase the friction and using wide pavement markings. See USDOT FHHA Mitigation Strategies for Design Exceptions - July 2007.
http://safety.fhwa.dot.gov/geometric/pubs/mitigationstrategies/

Arizona Department of Transportation

ROADWAY ENGINEERING GROUP

MEMORANDUM

To: Mary Viparina, 611E Assistant State Engineer Roadway Engineering Group	**Date:** July 07, 2009
From: Paul O'Brien, 605E Manager Roadway Predesign Section	**Subject:** Design Exception Request Project 017 YV 285 H XXXX XXC XX XX TI – XX XX TI (SB) Phoenix – Flagstaff Highway I-17

This project is not programmed nor listed in the 2010 ADOT Five-Year Transportation Facilities Construction Program. It is anticipated that the pavement rehabilitation part of the project will use federal (IM) funds. The intent of this project is to extend the usable life of the roadway pavement and to address safety issues, which can be accomplished within the scope of a Pavement Preservation Project.

Design Exceptions are hereby requested for maximum allowable grade exceeded at one location and for minimum superelevation rate not met at seven locations as per the attached AASHTO Controlling Design Criteria Report. An Accident Analysis Report has been prepared for this project and is also attached.

The reasons for requesting the Design Exceptions are as follows:

Maximum Allowable Grade

1. I-17 within the project limits is classified as a rural interstate with rolling terrain. The natural terrain dictates the profile of the Interstate. Traveling in the southbound direction the profile grade between the McGuireville TI and the Verde River Bridge is almost continuous downhill. The Verde River Bridge (MP 287.93, Elev. 3,108') is the low point from where the profile grade changes to one long ascending grade that continually increases before reaching the top of Copper Canyon (MP 281.0±, Elev. 4,700'). The terrain classification for I-17 through Copper Canyon would be considered mountainous. This section of I-17 between MP 286.00 and MP 286.65 (3,432') for which the design exception is being requested is in the transitional area between rolling to mountainous terrain. The posted speed limit in this section changes to 65 mph, which is indicative of a mountainous terrain classification. The natural ascending terrain as well as the General Crook Trail TI OP (located 2,600± south of the begin project limit) dictates the profile grade of the Interstate.

2. To achieve the 4.0% grade would require lowering of the existing roadway profile grade. This would require reconstruction of the southbound roadway (and most likely the northbound roadway), which would have to continue through the Copper Canyon Section, which is outside of project limits. In all probability the entire Copper Canyon Section of I-17 would either have to be reconstructed or relocated to new alignment. Also the General Crook Trail TI OP would have to be reconstructed / relocated.

3. Reconstructing/relocating 5.65± miles of interstate highway as well as reconstructing the General Crook Trail TI OP would be classified as major reconstruction, require a Design Concept Report with an extensive evaluation of alternate routes, public involvement and would be far beyond the scope, intent and funding limits of a Pavement Preservation Project.

Minimum Horizontal Curve Superelevation Rate

Seven horizontal curves within the project limits require a design exception for superelevation since they do not meet the recommended AASHTO minimum (based upon Method 5 for distributing superelevation and side friction factor). Utilizing the

ADOT methodology for reviewing superelevation, based upon Method 2, three of these seven horizontal curves (those curves beginning at MP 289.31, MP 292.26 and MP 292.71) were further analyzed to determine if mitigation strategies would be appropriate.

Curves 1 through 7

1. MP 286.78 to MP287.33 – the existing superelevation is 0.015ft/ft (0.039ft/ft greater than the Method 2 minimum & 0.027ft/ft less than the Method 5 minimum). The Method 2 speed (85 mph) is greater than the posted speed (75 mph).

2. MP 289.02 to MP 289.20 – the existing superelevation is 0.015ft/ft (0.072ft/ft greater than the Method 2 minimum & 0.006 ft/ft less than the Method 5 minimum). The Method 2 speed (99 mph) is greater than the posted speed (75 mph).

3. MP 289.31 to MP 289.92 – the existing superelevation is 0.016 ft/ft (0.009ft/ft less than the Method 2 minimum & 0.054 ft/ft less than the Method 5 minimum). The Method 2 speed (73 mph) is less than the posted speed (75 mph). This curve was analyzed for a spot safety improvement. The 5-Year Crash Analysis stated that eight of the nine crashes on this curve occurred during wet conditions and recommended the superelevation be increased. A superelevation of 0.025 ft/ft was calculated as the improvement needed to bring the speed of the curve up to the posted speed. This level of superelevation will also facilitate roadway drainage. This work has been included in the scope of work of this project.

4. MP 290.48 to MP 290.98 – the existing superelevation is 0.016 ft/ft (0.008ft/ft greater than the Method 2 minimum & 0.045 ft/ft less than the Method 5 minimum). The Method 2 speed (77mph) is greater than the posted speed (75 mph).

5. MP 292.26 to MP 292.70 – the existing superelevation is 0.029ft/ft (0.045ft/ft less than the Method 2 minimum & 0.066ft/ft less than the Method 5 minimum). The Method 2 speed (68 mph) is less than the posted speed (75 mph). This curve was evaluated for a mitigation strategy. The 5-Year Crash Analysis stated that four of the six crashes on this curve included 2 over-turn and 2 sideswipe same direction. The project team concurred that a mitigation strategy should be implemented and recommended improving the existing horizontal curve superelevation by adding an additional 0.01ft/ft to provide an improved superelevation rate of 0.039 ft/ft. This work has been included in the scope of work of this project.

6. MP 292.71 to Mp 292.97 – the existing superelevation is 0.015 ft/ft (0.026ft/ft less than the Method 2 minimum & 0.046ft/ft less than the Method 5 minimum). The Method 2 speed (70 mph) is less than the posted speed (75 mph). This curve was evaluated for a mitigation strategy. Since there was no discernable accident pattern, the 5-Year Crash Analysis recommended post mount delineators should be placed on this curve as a minor mitigation measure. This work has been included in the scope of work of this project.

7. MP 293.01 to MP 293.28 – the existing superelevation is 0.015 ft/ft (0.007ft/ft greater than the Method 2 minimum & 0.064ft/ft less than the Method 5 minimum). The Method 2 speed (77 mph) is greater than the posted speed (75 mph).

Recommended Remedial Action:

Mitigation measures for horizontal curves where the existing superelevation is less than the AASHTO Method 5 and AASHTO Method 2 for recommended minimum superelevation:

The existing superelevation of curve 3 beginning at MP 289.31 and curve 5 beginning at MP 292.26 do not meet the AASHTO Method 5 recommended minimum superelevation. Superelevation improvements have been included for these curves in the scope of work for this project.

The placement of post mount delineators along horizontal curve 6 beginning at MP 292.71 have been included in the scope of work for this project.

No mitigation measures are recommended for horizontal curves where the existing superelevation is less than the AASHTO Method 5 but greater than the AASHTO Method 2 for recommended minimum superelevation:

The Method 2 speed for curves 1, 2, 4 and 7 is greater than the posted speed.

Design Exceptions are required for all seven curves since the curves will not meet AASHTO Method 5 for recommended minimum superelevation after construction of this project is complete.

Concur: _____ _____
Mary Viparina Date