TRAFFIC AND SAFETY NOTE 1004A

SUBJECT: Design Exception Request Crash Analysis

PURPOSE: To Promote Uniform Application of the Required Elements of a Comprehensive Design Exception Analysis

COORDINATING UNIT: Geometrics and Operations Unit

INFORMATION: In order to promote uniform application of the required elements of a comprehensive design exception analysis the following information is attached:

1) List of the Required Elements

2) Table A for Crash Types associated with various geometric features to which a design exception applies.

3) Two sample crash analysis memorandums identifying and illustrating the 10 elements.

4) Two sample TSC memos for when the analysis is done by a third party. The memos give concurrence with the third party write-up.
REQUIRED ELEMENTS OF A COMPREHENSIVE DESIGN EXCEPTION REQUEST CRASH ANALYSIS

1) Subject heading which includes a description of the project (route number, control section, P.R. number, control section and P.R. beginning and ending mile points, and job number).

2) A statement that the crash analysis is in relation to a specific design exception request (as opposed to a project wide analysis).

3) A statement indicating which geometric feature the design exception has been requested for, and the location to which it applies (Control Section or P.R. number and mile points).

4) A description of the existing condition or value of the geometric feature in question.

5) A description of the proposed condition or value of the geometric feature in question.

6) A statement detailing what the standard value is for the geometric feature in question, and a reference to the appropriate governing Standard or Guide.

7) A description of the crash data used in the analysis (time span and mile point limits of the data query). This should be the most recent four years for which crash data is available, using the Safety Management System in TMS.

8) A summary of the total numbers and types of crashes found in the analysis.

9) A statement that the crash types associated with the geometric feature in question were specifically investigated in detail. Refer to Table A to determine which crash types are associated with which geometric features. This detailed investigation shall include a review of all crash reports (UD-10’s) for these crash types. If there are a large number of crashes of the associated types, a representative sample of UD-10’s may be selected for review (as opposed to all of them).

10) A statement that the analysis did not (or conversely, did) find a pattern or concentration of crashes associated with the geometric feature for which the design exception has been requested.
## TABLE A

<table>
<thead>
<tr>
<th>GEOMETRIC FEATURE TO WHICH DESIGN EXCEPTION APPLIES</th>
<th>ASSOCIATED CRASH TYPES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Speed</td>
<td>All Crash Types</td>
</tr>
<tr>
<td>Lane Width</td>
<td>Sideswipe, Fixed-Object, Run-Off, Overturn</td>
</tr>
<tr>
<td>Shoulder Width</td>
<td>Sideswipe, Fixed-Object, Run-Off, Overturn</td>
</tr>
<tr>
<td>Bridge Width</td>
<td>Sideswipe, Fixed-Object</td>
</tr>
<tr>
<td>Structural Capacity</td>
<td>N/A</td>
</tr>
<tr>
<td>Horizontal Alignment</td>
<td>Fixed-Object, Run-Off, Overturn, Sideswipe, Head-On</td>
</tr>
<tr>
<td>Vertical Alignment</td>
<td>Rear-End, Sideswipe, Head-On, Fixed-Object, Run-Off, Overturn, Angle</td>
</tr>
<tr>
<td>Longitudinal Grade</td>
<td>Rear-End, Sideswipe, Head-On</td>
</tr>
<tr>
<td>Stopping Sight Distance *</td>
<td>Rear-End, Sideswipe, Head-On, Fixed-Object, Run-Off, Overturn, Angle</td>
</tr>
<tr>
<td>Cross-Slope/Roll-Over</td>
<td>Too Little: Rear-End, Percent Wet, Percent Icy</td>
</tr>
<tr>
<td></td>
<td>Too Great: Fixed-Object, Run-Off, Overturn</td>
</tr>
<tr>
<td>Superelevation</td>
<td>Fixed-Object, Run-Off, Overturn, Sideswipe, Head-On</td>
</tr>
<tr>
<td>Vertical Clearance</td>
<td>High-Load Hits</td>
</tr>
<tr>
<td>Horizontal Clearance (Excluding Clear Zone)</td>
<td>Sideswipe, Rear-End, Head-On, Fixed-Object</td>
</tr>
<tr>
<td>Ramp Acceleration or Deceleration Length</td>
<td>Sideswipe, Rear-End, Fixed-Object, Run-Off, Overturn</td>
</tr>
</tbody>
</table>

* At night, the available sight distance through sag vertical curves is largely determined by headlight illumination distance. Therefore, when reviewing crashes in relation to sag vertical curves, particular attention should be paid to night-time crashes, including animal collisions. A high percentage of night-time crashes could indicate a crash pattern related to insufficient stopping sight distance. While animal collisions are not generally included in crash analyses due to the large uncertainty as to their causes and/or exact locations, they should not be summarily dismissed, either. Animal crashes can be taken with together with the crash data set as a whole, and can sometimes help identify crash patterns specifically related to restricted sight distance.

When performing a crash analysis as part of a design exception request, focus the review on the crash types which are associated with the geometric feature in question. Use the table above to determine which crash types are associated with each geometric feature. Also, consider only the crashes which have occurred in the vicinity of the subject geometric feature (not necessarily project wide). It is usually sufficient to set the mile point limits of the crash data query to a few hundred feet on either side of the geometric feature in question.

Crash analysis is, by its nature, an inexact and subjective exercise. There will often times be uncertainty as to whether or not a particular geometric feature contributed towards a given crash. The information provided in the UD-10’s, along with engineering judgement, can usually resolve any questions adequately.
A crash analysis has been completed for a spot location within the subject roadway segment. This analysis focuses on the crash history at this location as it relates to a design exception request. A more general safety analysis spanning the entire project limits should have been completed as part of this project’s 3R/4R Safety Review.

A design exception has been requested to retain an existing normal crown cross-slope through a horizontal curve from mile point 2.58 to mile point 2.74. Current standards call for minimum (Straight-Line) superelevation rate of 3.5% for this curve. Crashes which occurred between these mile points, and within 500 feet on either side, were considered in this review.

Four years of crash data (January 1, 2002 through December 31, 2005) was used in the analysis of this location. During the four-year study period, there were 92 total crashes within the limits described above. These consisted of 41 rear-end, 15 angle, 15 sideswipe, 7 head-on left-turn, 4 fixed-object/overturn, 2 pedestrian, and 8 miscellaneous type crashes. Crash types which are typically allocated with the lack of superelevation, or with inadequate superelevation rate, were specifically investigated in detail. Such crash types include sideswipe, fixed-object, overturn, and other crashes which indicate loss-of-control or inability to maintain the desired path of travel.

A detailed review of the crash reports for these crash types revealed that the vast majority of these collisions were not caused by a loss of control or failure to maintain vehicular path. Of the 15 sideswipe crashes, 7 were caused by improper lane changes or by vehicles attempting to turn from the wrong lane 4 were the result of parallel parking maneuvers, 1 was alcohol related, and 1 was actually a miscoded angle-turn crash. Only two of the sideswipe crashes were unexplained, or the possible result of a loss-of-control. Of the four fixed-object crashes, one was due to icy conditions, and one was caused by excessive speed. Two of the fixed-object crashes were unexplained, or the possible result of a loss-of-control. In summary, there is no crash pattern, or any other evidence, indicating that the absence of superelevation (normal crown cross-slope) is either causing, or significantly contributing to, crashes at this location.
A crash analysis has been completed for the subject roadway segment. This analysis focuses on the crash history at this location as it relates to a design exception request. A more general safety analysis spanning the entire project limits should have been completed as part of this project’s 3R/4R Safety Review.

A design exception has been requested to retain the existing non-standard shoulder slope on the outside (southbound side) of a horizontal curve located within the subject roadway segment. Currently, this shoulder slopes at 1.0%, away from the traveled way. This results in a 6.2% grade-break (roll-over) with the mainline pavement, which is superelevated at 5.2% in the opposite direction. Standard Plan R-107-E specifies that the shoulder slope should match the cross-slope of the mainline pavement (5.2% in the same plane). Standard Plan R-107-E further stipulates that the roll-over between the shoulder and the traveled way should not exceed 6.0%.

Four years of crash data (January 1, 2002 through December 31, 2005) were analyzed for the one-mile section of roadway which includes the subject horizontal curve. The crash history was reviewed to ensure that there are no patterns or concentrations of crashes attributable to, or compounded by, the non-standard shoulder slope and/or roll-over value. During the four-year study period, there were 12 total crashes within the subject roadway segment. These consisted of one sideswipe-opposite, three fixed-objective run-off road, and eight animal crashes. Crash types which could be indicative of excessive roll-over or cross-slope differential were specifically investigated in detail. Such crash types typically consist of fixed-objective/run-off road, overturn, and any other crashes which indicate a loss-of-control or departure from the roadway.

A detailed review of the crash reports for these crash types revealed that the collisions were not related to the design feature in question. All three fixed-object/run-off road crashes involved northbound vehicles. Therefore, these crashes are not attributable to the southbound shoulder slope or roll-over. The sideswipe crash was also reviewed, to ensure it was not caused by a southbound vehicle which was drawn onto the shoulder and which then over corrected back across the centerline and into the northbound lane of travel. In fact, this crash occurred on the bridge over the Hopeful River, and involved contact between the side-view mirrors of two trucks; it was in no way related to the design feature in question. In summary, there is no indication that the non-standard cross-slope and/or roll-over rate of the southbound shoulder has either caused, or contributed to, crashes at this location.
DATE:        April 20, 2004

TO:          Adam Peters
             Project Manager

FROM:        Michael Brown
             Traffic & Safety Engineer
             Local TSC

SUBJECT:     Design Exception Analysis Review
             JN XXXXXA, CS 94072
             US-XX, Glenbrook to Third

This office has reviewed the Crash Analysis and Safety Review as submitted by the design consultant PQRS Engineers dated March 02, 2004 for the above referenced project.

The exceptions reviewed include two for Cross Slope, six for Super Elevation, and one for stopping sight distance.

This office has no objection to the recommendations of the Crash Analysis as presented.

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Michael Brown
Traffic & Safety Engineer
Local TSC
DATE: January 03, 2006

TO: Gina King
Project Manager

FROM: Michael Brown
Traffic & Safety Engineer
Local TSC

SUBJECT: Design Exception Analysis Review
JN XXXXXA - CS 95292

This office has reviewed the Crash Analysis as submitted by the design consultant PQRS Engineers dated November 31, 2005 for the above referenced project.

The design exception reviewed was for Acceleration/Deceleration Length Design.

The Crash analysis indicated that it did not review the UD-10’s and therefore was unable to determine if a definitive crash pattern related to the design exception requested exists.

Therefore, in review of this analysis, this office did conduct a through review of all of the UD-10’s for the listed PR numbers and mile points of the Crash Analysis. Of all of the UD-10’s reviewed, there were five crashes that occurred at or near the merge point of Ramp E and NB I-87. Four of the crashes were related to inclement weather/roadway conditions (three icy/snow and one rain). The other crash appears to be a driver medical condition resulting in the crash.

Of all the UD-10’s reviewed, there is no correctable crash pattern associated with the requested Design Exception for Acceleration/Deceleration Length Design.

As the design is to significantly improve the existing acceleration taper from 725 feet to 1209 feet (50 feet shy of required), this office has no objection to the conclusion and recommendations of the Crash Analysis as presented.

Michael Brown
Traffic & Safety Engineer
Local TSC