December 22, 2014

TO: Members of the MAG Standard Specifications and Details Committee

FROM: Tom Wilhite, City of Tempe, Chair

SUBJECT: MEETING NOTIFICATION AND TRANSMITTAL OF TENTATIVE AGENDA

Wednesday, January 7, 2015 at 1:30 p.m.
MAG Office, Suite 200 (Second Floor), Ironwood Room
302 North 1st Avenue, Phoenix

A meeting of the MAG Specifications and Details Committee has been scheduled for the time and place noted above. Members of the MAG Specifications and Details Committee may attend the meeting either in person, by videoconference or by telephone conference call. If you have any questions regarding the meeting, please contact Committee Chair Tom Wilhite at 480-350-2921 or Gordon Tyus, MAG staff at 602-254-6300.

In 1996, the Regional Council approved a simple majority quorum for all MAG advisory committees. If the MAG Specifications and Details Committee does not meet the quorum requirement, no action can be taken. Attendance at the meeting is strongly encouraged.

Pursuant to Title II of the Americans with Disabilities Act (ADA), MAG does not discriminate on the basis of disability in admissions to or participation in its public meetings. Persons with a disability may request a reasonable accommodation, such as a sign language interpreter, by contacting Gordon Tyus at the MAG office. Requests should be made as early as possible to allow time to arrange the accommodation.

It is requested (not required) that written comments on active cases be prepared in advance for distribution at the meeting.

MAG Standard Specifications and Details Committee
TENTATIVE AGENDA
January 7, 2015

	COMMITTEE ACTION REQUESTED
1. Call to Order and Introductions	
2. Call to the Audience An opportunity is provided to the public to address the MAG Specifications and Details Committee on items that are not on the agenda that are within the jurisdiction of MAG, or non-action agenda items that are on the agenda for discussion or information only. Citizens will be requested not to exceed a three minute time period for their comments. A total of 15 minutes will be provided for the Call to the Audience agenda item, unless the committee requests an exception to this limit. Please note that those wishing to comment on agenda items posted for action will be provided the opportunity at the time the item is heard.	2. Information.
3. Approval of October 1, 2014, Meeting Minutes	3. **Review and approve minutes of the October 1, 2014 meeting.**
Carry Forward Cases from 2015	
4. Case 14-03: Updates to Guardrail Details Revisions to Section 415 and/or inclusion of MCDOT guardrail details.	4. Information and discussion. Sponsor: Bob Herz, MCDOT
5. Case 14-06: Revisions to Section 718 Preservation Seal for Asphalt Concrete Update specifications for current preservative seal products.	5. Information and discussion. Sponsor: Jeff Benedict, Asphalt Working Group
6 Case 14-12: Proposed Revisions to Sections 336.3 and 336.4. Add pavement removal criteria to prevent full depth pavement cuts from being located within a lane wheel path.	6. Information and discussion. Sponsor: Bob Herz, MCDOT *Updated*
7. Case 14-17: Create New Section 322 Provide specifications for Asphalt Stamping - materials and methods.	7. Information and discussion. Sponsor: Brian Gallimore, Materials WG

New Cases for 2015

8.	Case 15-01: Misc. Corrections A. To Be Determined	8. Information and discussion.
9.	Case 15-02: Adjust Fence Requirements to Reference ASTM F1043 Revise Section 772, Table 771-1 and Detail 145.	9. Information and discussion. Sponsor: Bob Herz, MCDOT

General Discussion

10.	Working Group Reports	10. Information and discussion. Water/Sewer Chair: Jim Badowich Asphalt Chair: Jeff Benedict Materials Chair: Brian Gallimore Concrete Chair: Jeff Hearne Outside ROW: Peter Kandaris
11.	General Discussion Laser Profiling Presentation 2015 Edition of the MAG Specs Book Update ASTM Portal Update Update on Meeting Calendar Potential Technical Presentations for February	11. Information and discussion. Ed Driggs, Cues Staff report: Gordon Tyus Chair Tom Wilhite
12.	Request for Future Agenda Items Adjournment	12. Information and discussion.

2015 MAG Specifications and Details Committee
Ironwood, 2nd Floor

January 7, 2015	1:30 pm	
February 4, 2015	1:30 pm	
March 4, 2015	1:30 pm	
April 1, 2015	1:30 pm	
May 6, 2015	1:30 pm	
June 3, 2015	1:30 pm	
July 1, 2015	1:30 pm	
August 5, 2015	1:30 pm	
September 2, 2015	1:30 pm	
October 7, 2015	1:30 pm	(if necessary)

MEETING MINUTES FROM THE MARICOPA ASSOCIATION OF GOVERNMENTS STANDARD SPECIFICATIONS AND DETAILS COMMITTEE

October 1, 2014

Maricopa Association of Governments Office, Ironwood Room
302 North First Avenue
Phoenix, Arizona

AGENCY MEMBERS

Jim Badowich, Avondale, Vice Chair
Craig Sharp, Buckeye
Warren White, Chandler
Antonio Hernandez, El Mirage
* Wayne Costa, Florence
* Tom Condit, Gilbert
* Mark Ivanich, Glendale
Tom Vassallo, Goodyear
Bob Herz, MCDOT
* Julie Christoph, Mesa
Dan Nissen, Peoria
* Syd Anderson, Phoenix (St. Trans.)
Jami Erickson, Phoenix (Water)
Rod Ramos, Scottsdale
Kristin Tytler, Surprise
Tom Wilhite, Tempe, Chair
Harvey Estrada, Valley Metro
Gregory Arrington, Youngtown

ADVISORY MEMBERS

Jeff Benedict, ARPA
Arvid Veidmark, AZUCA
* Mike Sanders, AZUCA
Amanda McGennis, AGC (proxy)
Doug Laquey, AGC (proxy)
Jeff Hearne, ARPA
* Peter Kandaris, Independent
Paul R. Nebeker, Independent
* Jacob Rodriguez, SRP

MAG ADMINISTRATIVE STAFF

Gordon Tyus

* Members not attending or represented by proxy.

GUESTS/VISITORS

Jim Anderson, Olson
Martin Ramirez, FNF Construction
Stew Waller, Rinker

1. Call to Order

   Chair Tom Wilhite called the meeting to order at 1:30 p.m.

2. Call to the Audience

   Dan Shafer introduced Kristin Tytler from the City of Surprise. She will be their new representative on the committee. Mr. Wilhite then opened the call to the audience. No members of the audience requested to speak.

3. Approval of Minutes

   The members reviewed the September 3, 2014 meeting minutes. Bob Herz moved to accept the minutes as written. Harvey Estrada seconded the motion. A voice vote of all ayes and no nays was recorded.

Carry Forward 2013 Cases

4. Case 13-15: Revisions to MAG Sections 101, 601, 603, 615 and 618 for Rigid and Flexible Pipe. Updates to Details 200-1, 200-2 and 212. Update Sections 206, 355, 735, 739, 740.

   Update pipe installation requirements. Warren White asked members to review the introductory memo for the case, which summarized the changes made since the last committee meeting. The bulleted items were those revised based on feedback during the last water/sewer working group meeting. He said much of the time was spent wordsmithing the sections for the default fill materials in Section 601. A clean version of 601 was provided as a handout at the meeting.

   Bob Herz said he also provided a handout of Section 601 that had a few minor corrections and clarifications. He proceeded to highlight the changes which were shown in red on the handout. These included adding “barrel” after pipe in several places to clarify where measurements were made, and using the term “sheathing” instead of “sheeting” and the term “alternative” rather than “alternate”. He also spelled out “controlled low strength material” before the first use of the CLSM abbreviation. It was suggested to reference Sections 604 and 728 for CLSM and a consensus of members agreed. Other corrections were to reference “bedding” rather than “granular” material, add a reference to “Type I Backfill” for water consolidation, and refer to a specific Table 601-2 in Section 601.4.11.

   After discussing and agreeing with Mr. Herz’s changes, Warren White went back to discussing other changes to Section 601. He said that Section 603 was combined into Section 601, and so Section 603 would be deleted. The trench widths table (601-1) was updated and included the widths for both rigid and flexible pipe types.

Section 601.4 was changed to clarify the default fill material and options for the different areas. For the bedding, MAG ABC per Section 702 would be the default. For the haunching area ABC would also be the default, however, with agency approval other granular material or CLSM may be used. The initial backfill area would be the same as the haunching area with the additional option to use native material with concrete pipe. The final backfill area is basically the same as currently in MAG. It allows for "sound earthen material" and also references Detail 200-1 for the different options for trench repair.

Jeff Hearne asked if there was a conflict between the text not allowing broken concrete material in 601, but yet also referencing ABC in Section 702, which allows for the use of recycled material as long as it meets all specifications. Warren said that agencies can still allow recycled material in ABC, and that clarifying this issue could be addressed in a future case.

Next he described the final changes to other sections that were included in the packet. In Section 101, the definition for native material was removed because it is defined elsewhere. He noted the changes to Section 206 received from MCDOT were included, and other sections that referenced the deleted Section 603 were also updated. A list of these minor changes to Sections 355, 739 and 740 were included on the back of the summary memo.

Section 615 also deleted references to Section 603 and included updates made by previous cases. Section 618 didn't have any changes since the last meeting. Section 735 included changes Mr. Herz provided due to the RCP case. On Detail 200-2, the trench section detail was updated removing "max" from the trench width note. On Detail 200-1, references to subsections of 601 were changed to refer to Section 601 generally, and a few minor changes were made to the notes. No changes were made to Detail 212. Mr. White asked if there were any questions.

Paul Nebeker cautioned that changing the compaction requirements to 95% could cause problems in the future, especially in easement areas and utilities. Bob Herz said only areas subject to vehicle traffic had to meet Type I requirements, other areas would fall under Type II which was 85% compaction. Mr. Nebeker thanked Herz for the clarification and said he felt the consolidation of the spec made it much easier to use. Tom Wilhite and Jim Badowich also thanked Warren White, the working group, industry representatives, Bob Herz and everyone who helped with the case.

Craig Sharp moved to accept the case as presented, with Mr. Herz's corrections to Section 601 and adding references to the CLSM sections. Jim Badowich seconded the motion. Chair Wilhite restated the motion and listed that the Sections updated included 101, 206, 355, 601, 615, 618, 735, 739, and 740. Details 200-1, 200-2 and 212 would also be updated. Section 603 would be removed.

A roll call vote was taken and the case was approved: 13 yes, 0 no, 0 abstaining and 4 not present.

New Cases for 2014

5. Case 14-01: Miscellaneous Corrections.

   A. Change "transverse" to "longitudinal" in Section 321.8.2.
   B. In section 739.1, delete the extra occurrence of the word 'Pipe'.
   C. Delete "OR BRICK" from the title of Section 342.
   D. Change "forecast" to "for cast" in Section 750.3 JOINT REQUIREMENTS. Revise wording in Section 107.11 to match "careful and prudent manner" in Section 101.2.
   E. Change "off" to "of" in Section 211.3.
   F. Change "values" to "valves" in 336, 345, and 616.
   G. Remove steps from Details 429 and 522. Fix notes.

   Bob Herz discussed the new corrections items he provided including changing the word "off" to "of" in Section 211.3, and changing the word "values" to "valves in several places. Craig Sharp said Misc. Correction G included two details that needed to have the steps removed from the drawings since the step detail was deleted in a previous case. Mr. Herz said that in addition to deleting the step and related callout in Detail 429, he noticed that the units in Note 4 were incorrect. The inches " mark needed to be changed to feet ' after 4 and 6. For Detail 522, Mr. Herz said in addition to deleting the steps and related callouts, Note 5 should be deleted and Note 6 renumbered to 5.

   Jami Erickson moved to accept the miscellaneous corrections case A-G, including the modifications to the details as discussed. Bob Herz seconded the motion. A roll call vote was taken and the case was approved: 13 yes, 0 no, 0 abstaining and 4 not present.

6. Case 14-13: Revisions to Section 321. Incorporate MCDOT Supplements.

   Incorporate MCDOT enhancements to Section 321 PLACEMENT AND CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT into the MAG Specifications. Bob Herz said the included summary highlighted the changes. He said a redlined strikeout and final clean versions were provided in the packet. Mr. Herz explained that although there were questions about whether the thickness penalty table should apply to each layer, he decided to leave it as is. He gave an example of a contractor that was 3/16 short on one layer would not be penalized, and if he was 3/16 on the next layer, he wouldn't receive a penalty per layer, but based on the total thickness he would. Mr. Herz also felt that this also gave the contractor a chance to make up for thickness deficiency on the first layer by making the next layer thicker. He believed the final pavement would meet the strength requirements.

   Antonio Hernandez said if the pavement layers are off it could affect the pavement design. Jim Badowich asked about a scenario where the first layer was too thick leaving the top layer too thin. Mr. Herz said there was still a minimum lift thickness the pavement must meet.

   Mr. Hernandez commented that MAG needs a spec for how to repair cores. He said there were specs about how to take the cores, but nothing on the proper way to repair the holes, which

could lead to potholes. Rod Ramos thought it was a good comment, but maybe outside the scope of the current case. Jeff Benedict said they could address this problem at a future working group meeting and asked Mr. Hernandez to send the specs they use. Arvid Veidmark discussed how ADOT makes the repair using a type of grout. Mr. Hernandez said he would want matching asphalt. Tom Wihite said he also had concerns on the repair of pavement punctures. Mr. Veidmark noted that puncturing operations do go beyond the subgrade. For repairs, he said they typically were grouted and then repaved using a milling operation. Warren White said their discussions on pot-hole repair may relate to this issue.

With no further discussion, Mr. Herz moved to accept the case as presented. Rod Ramos seconded the motion. A roll call vote was taken and the case was approved: 12 yes, 1 no, 0 abstaining and 4 not present.

7. Case 14-19: Revisions to Section 325 and 717.

Add provisions for terminal-blended asphalt-rubber binder (ARB). Jeff Benedict introduced Doug Laquay who was filling in for Brian Gallimore of AGC, and who worked on the details of the case. He said the case primarily was to provide a method for acceptance testing using grade samples rather than only at the plant. The handout provided a list of all the revisions.

One of the revisions was removing “terminal” when referring to the plant so it was not confused with “terminal-blended” asphalt-rubber binder. There were a few other wording corrections. Mr. Laquay said they also updated Section 325.7.2 to make the default method for getting material into the paver hopper be to have the hauling vehicles dump directly into the paving machine. This was to avoid tracking of asphalt-rubber onto adjacent pavements. He also discussed how when samples are obtained at the plant, adjustments can be made on-the-spot to get the mix correct, but at grade the samples are tested later, and can’t be adjusted on site. This was the reason for adding a penalty table for samples that don’t meet the standards.

Jeff Benedict said that samples from the lay-down machine tend to have lower numbers because there is draw-down during the handling. The testing procedure uses language similar to that in Section 321. Another change was adding language to allow coring in Section 325.9.5. Mr. Laquay said that Section 717 added language about the binder, and also used the ARB abbreviation rather than spelling out Asphalt-Rubber Binder every time.

Antonio asked about the differences between blending rubber at the hot plant and onsite. Jeff Benedict discussed how the trucks have agitators that can deliver the asphalt-rubber to several different plants without difficulty. He also clarified that no TR is involved in this process.

With no further discussion, Mr. Ramos moved to accept the case as presented. Mr. Herz seconded the motion. A roll call vote was taken and the case was approved: 13 yes, 0 no, 0 abstaining and 4 not present.

8. Working Group Reports

Chair Wilhite asked for reports from the working group chairs.

a. **Water/Sewer Issues Working Group**
Jim Badowich said the last meeting was September 11, so the group could work on items discussed at the last committee meeting and so that Mr. Herz could attend. Mr. Badowich said the group spent most of the time finalizing Case 13-15. He said they also had an update to the proposed Horizontal Directional Drilling specifications, which will continue to be worked on next year.

b. **Asphalt/Materials Working Groups**
Jeff Benedict said the group would be on break until next year, but they will then continue to work on the Preservations Seal carry-over case. He said they can also look at the issue of repairing cores as discussed, and will likely have other updates to Section 321. One area they are looking at is in the area of permits for development work.

c. **Concrete Working Group**
Jeff Hearne said he would look at the sections that have not been touched yet, but doesn't have anything specific at this point. Warren White asked if addressing the ADA ramp issue would be appropriate for the group.

d. **Outside Right-of-Way Working Group**
Peter Kandaris was not present to provide an update.

9. General Discussion

Gordon Tyus again asked agency members to review the contact list of public works director and provide any updates to him. He provided an outline of the steps needed to complete the updates to the specs book including reviews by the public works directors, MAG Management Committee and Regional Council. He said he would post the update packet on the website, and said the updated cases were also provided on the "2014 Cases Under Consideration" page. He said the final updated books would be a complete new edition and were planned to be printed and available in January.

Tom Vasallo asked about the ASTM access. Mr. Tyus said the individual cities need to connect directly through the ASTM provider. He can provide the contact information for members.

10. Future Agenda Items:

Chair Wilhite asked members about future potential cases and items for discussion. He noted that January and February meetings were typically a good time for presentations if there were issues the committee to hear.

Some of the comments included:

- Reviewing ADA requirements and the need for dual ramps.
- Bob Herz mentioned he has some potential cases.
- Jeff Benedict said there were lots of possibilities including equipment with intelligent compaction systems, and other technologies.
- Jim Badowich asked about fiberglass reinforced asphalt.
- Amanda McGinnis reminded members about the upcoming ASU Materials Conference the 17th and 18th. She said she could provide the information to Gordon Tyus.
- Tom Wilhite mentioned the use of green technologies
- Gordon Tyus would like references to asbestos pipe removed from the specs.
- Tom Wilhite also asked members if they knew of any legislation that would affect the specifications.

11. Adjournment:

Seeing no further business, the chair thanked members for their service and the meeting was adjourned at 3:20 p.m.

2015 PROPOSED REVISIONS TO MAG SPECIFICATIONS AND DETAILS

(Updated information can be found on the website: http://www.azmag.gov/)

CASE	DESCRIPTION	PROPOSED BY	MEMBER	SUBMITTAL DATE Last Revision	VOTE DATE	VOTE	
	CARRY FORWARD CASES FROM 2014						
14-03	Case 14-03: Updates to Guardrail Details. Revisions to Section 415 and/or inclusion of MCDOT guardrail details.	MCDOT	Bob Herz	01/08/2014		0 0 0	Yes No Abstain
14-06	Case 14-06: Revisions to Section 718 Preservative Seal for Asphalt Concrete.	Asphalt WG	Jeff Benedict	02/05/2014		0 0 0	Yes No Abstain
14-12	Case 14-12: Proposed Revisions to Sections 336.3 and 336.4. Add pavement removal criteria to prevent full depth pavement cuts from being located within a lane wheel path and to prevent creation of narrow pavement edge strips.	MCDOT	Bob Herz	06/04/2014		0 0 0	Yes No Abstain
14-17	Case 14-17: Create New Section 322 Asphalt Stamping. Provide specifications for materials and methods.	Materials WG	Brian Gallimore	07/09/2014		0 0 0	Yes No Abstain
	NEW CASES FOR 2015						
15-01	**Case 14-01: Miscellaneous Corrections:** A. To Be Determined					0 0 0	Yes No Abstain
15-02	Case 15-02: Adjust Fence Requirements to Reference ASTM F1043. Revise Section 772, Table 771-1 and Detail 145.	MCDOT	Bob Herz	01/07/2015		0 0 0	Yes No Abstain
15-03						0 0 0	Yes No Abstain
15-04						0 0 0	Yes No Abstain

MARICOPA COUNTY
Department of Transportation

MEMORANDUM

Date: January 8, 2014

To: MAG Specifications and Details Committee

From: Robert Herz, MCDOT Representative

Subject: Guardrail Details and revisions to Section 415 FLEXIBLE METAL GUARDRAIL **Case 14-03**

PURPOSE: Notification of MCDOT's intention of revising its guardrail details.

REVISION: To be determined.

DISCUSSION: MCDOT will be revising the standard details for guardrail to have new guardrail installed with the top of rail height to be 31-inches, the current details have the top of rail height set at 28-inches. The revised details will be in the 2015 MCDOT Supplement to MAG Specifications and Details having a target publishing date of January 1, 2015. MAG Section 415 FLEXIBLE METAL GUARDRAIL references MCDOT guardrail details. If MAG agencies desire to keep the 28-inch guardrail height then MCDOT will provide its details to MAG for inclusion in the 2015 MAG Revisions.

2901 West Durango Street Phoenix, Arizona 85009 Phone: 602-506-4760 Fax: 602-506-5969

U.S. Department of Transportation
Federal Highway Administration

Memorandum

SENT VIA ELECTRONIC MAIL

Subject: ACTION: Roadside Design: Steel Strong Post W-beam Guardrail

Date: May 17, 2010

From: David A. Nicol, P.E.
Director, Office of Safety Design

In Reply Refer To: HSSD

To: Division Administrators

This memorandum provides guidance to all State DOTs and FHWA Division Offices on the height of guardrail for new installations on the National Highway System (NHS). It details the minimum mounting heights of systems successfully crash tested per the NCHRP Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features" and the AASHTO Manual for Assessing Safety Hardware (MASH).

NCHRP Report 350 Accepted Systems:
Recent research on standard 27-inch guardrail shows that it does not meet NCHRP Report 350 Test Level 3 (TL-3) criteria. This requires a revision of current policy with regard to new G4(1S) guardrail installation height.

Transportation agencies should ensure the minimum height of newly-installed G4(1S) W-beam guardrail is at least 27¾ inches (minimum) to the top of the rail, including construction tolerance. A nominal installation height of 29 inches, plus or minus one inch, may be specified and is acceptable for use on the NHS. For your reference, a sampling of States that currently specify G4(1S) W-beam guardrail at 27¾ inches or higher is included in Appendix A. A summary of standard height guardrail testing is included as Appendix B.

MASH Accepted Systems:
Recent research on metric height G4(1S) guardrail (27¾ inches to the top) to meet AASHTO MASH TL-3 criteria has revealed performance issues that require the following recommendation with regard to modified G4(1S) guardrail installation height. Transportation agencies should consider adopting generic or proprietary 31-inch high guardrail designs (instead of the G4(1S) system) as standard for all new installations. The

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installation height of 31 inches to the top of the rail is the nominal height and a construction tolerance of plus or minus one inch applies. These systems meet MASH test and evaluation criteria and have improved crash-test performance and increased capacity to safely contain and redirect higher center-of-gravity vehicles such as pickup trucks and SUVs. Existing crash testing of 27¾ inch high guardrail per MASH criteria can be found in Appendix B. Examples of 31-inch guardrail and end terminals are included in Appendix C. Experience in several States that have used the generic Midwest Guardrail System has shown that there is little or no increase in cost. Numerous guardrail terminals successfully tested under NCHRP Report 350 that are compatible with 31-inch high W-beam systems are also referenced in Appendix B.

Action Needed

Division Offices should work closely with their State transportation agencies to implement the revised minimum installation height for G4(1S) guardrail of 27¾ inches, and also request that States consider adopting the 31-inch high guardrail designs.

In my November 20, 2009, memorandum, "Manual for Assessing Safety Hardware," I noted the AASHTO/FHWA Implementation Plan provided that all highway safety hardware accepted prior to the adoption of MASH using criteria contained in NCHRP Report 350 may remain in place and continue to be manufactured and installed. The G4(1S) strong steel post W-beam guardrail system installed at a minimum of 27¾ inches is consistent with this statement and may, indeed, be used on the NHS for the foreseeable future. However, we believe that States should consider adopting 31-inch guardrail as their standard because these systems exhibit superior performance at little or no additional cost.

Attached to this memorandum as Appendix D is a series of Frequently Asked Questions (FAQs) regarding guardrail, guardrail terminals, transitions, and bridge rails. A future memorandum, which will be coordinated with the AASHTO Technical Committee on Roadside Safety, will provide guidance on addressing the height of existing guardrail. If you have any questions or comments on this guidance, please contact Mr. Nicholas Artimovich at nick.artimovich@dot.gov or Mr. William Longstreet at will.longstreet@dot.gov, Office of Safety Design.

5 Attachments

cc: Mr. John R. Baxter, Associate Administrator for Federal Lands Highway
Mr. King W. Gee, Associate Administrator for Infrastructure
Mr. Jeffrey A. Lindley, Associate Administrator for Operation
Directors of Field Services
Federal Land Highway Division Engineers
Safetyfield

Sampling of States that Specify G4(1S) W-beam guardrail at 27-3/4 inches (minimum) Height

The table below lists the Division Office contacts for State DOT's that specify 27-3/4 inch (minimum) guardrail height and their corresponding contact information.

Division	Contact	Post	Blockout
AZ	Jennifer Brown Karen King	Steel & Wood	Wood & Plastic
DE	Patrick Kennedy		
MA	Timothy White		
MI	David Morena		
MS	Teresa Bridges		
MT	Marcee Allen	Wood	Wood
NH	Martin Calawa		
ND	Steven Busek	Wood	Wood
OH	Joseph Glinski	Steel & Wood	Wood
OK	Huy Nguyen		
PA	Michael Castellano	Steel	Wood & Plastic
UT	Roland Stanger	Steel	Composite
VT	Roger Thompson		
VA	Ivan Rucker Josue Yambo	Steel	Wood Composite
WV	Hamilton Duncan		
WI	William Bremer		

Research on Standard Guardrail Height

The following full scale crash testing research provides the basis of new policy for minimum guardrail height:

NCHRP Report 350 (Report 350): Recommended Procedures for the Safety Performance Evaluation of Highway Features, 1993: Strong Post Steel Guardrail-G4(1S):

1. A full-scale physical crash test per Report 350 for TL-3 conducted at an accredited laboratory of the modified G4(1S) guardrail with timber blockouts with height of guardrail to the center of the W-beam rail element of 550 mm (21.65") or 27-3/4 inch nominal height [1]. The 2000P test vehicle was successfully contained and redirected, remaining upright and stable during and after the collision period. As a result, this test is a pass.

2. A full-scale physical crash test per Report 350 for TL-3 conducted at an accredited laboratory of the modified G4(1S) guardrail with recycled polyethylene blockouts with height of guardrail to the center of the W-beam rail element of 550 mm (21.65 inches) or 27-3/4 inch nominal height [2]. The 2000P test vehicle was successfully contained and redirected, remaining upright and stable during and after the collision period. As a result, this test is a pass.

3. A full-scale physical crash test per Report 350 Test No 3-11 conducted at an accredited laboratory using 27 inch G4(1S) guardrail (as measured to the top of the rail) [3]. This guardrail was slightly different than standard G4(1S) in that it utilized a tapered block which caused the posts to be embedded slightly less than the typical 27 inch guardrail system. The 2000P test vehicle was contained, but rolled over during redirection. When this test was repeated with the barrier mounted at 27-3/4 inches [4], the test vehicle climbed the barrier and came to rest upright on top of the guardrail. The laboratory concluded the results of both tests indicate the 27-3/4 inch height steel post guardrail is at the upper limit at which acceptable performance can be obtained and any modifications to the barrier could produce unacceptable results.

4. A full-scale physical crash test per NCHRP Report 350 for TL-3 conducted at an accredited laboratory of the modified G4(1S) guardrail with injection molded High Density Polyethylene (HDPE) blockouts with height of guardrail to the center of the W-beam rail element of 550 mm (21.65 inches) [5]. The 2000P test vehicle was successfully contained and redirected remaining upright and stable during and after the collision period. As a result, this test is a pass.

5. A full-scale physical crash test per NCHRP Report 350 for TL-3 conducted at an accredited laboratory of the modified G4(1S) guardrail with injection molded HDPE block outs with height of guardrail to the top of the W-beam rail element of 706 mm (27-3/4 inches) [6]. The 2000P test vehicle was successfully contained and redirected, remaining upright and stable during and after the collision period. As a result, this test is a pass.

6. Additional Computer Simulations:

   Two (2) crash test simulations[9] per NCHRP 350 Test No 3-11 conducted by a laboratory using a 2000P pickup truck (test vehicle) using Livermore Software or LS-DYNA finite element modeling conducted on 27-3/4 inch high metric version W-beam guardrail (metric barrier).

   i. Simulation crash test of a metric barrier lowered by approximately 2-1/2 inches (25-12/2 inches above the ground) resulted in the test vehicle vaulting the barrier. As a result, this test is a failure.
   ii. Continuation of additional Finite Element Modeling simulation of the same test vehicle with a barrier height lowered by 1 inch (26-3/4 inches above the ground), projected that the test vehicle would climb atop the rail. In the absence of physical testing, this indicates a likelihood of test failure due to barrier vaulting. As a result, this test is a failure.

AASHTO MASH, 2009:

1. Strong Post W-beam Steel Guardrail - G4(1S):

   Two (2) full-scale physical crash tests conducted at an accredited laboratory using metric height guardrail (27-3/4 inches) with a 5000 pound pickup truck.

   a. The first full-scale physical crash test[7] involved a three-quarter ton 2-door pickup impacting at 98.3 km/hr and 25.6 degrees. During this test the rail ruptured and the vehicle went through the barrier (the Impact Severity [IS] value was 158 kJ compared to a target of 156.4 kJ). As a result, this test is a failure.
   b. The second full-scale physical crash test[8] involved a one-half (1/2) ton, 4-door pickup truck. During this test the W-beam rail tore almost half way through, but the vehicle was contained and redirected. The impact conditions were 100.4 km/hr and 25.8 degrees (the IS value was 167 kJ or roughly 7 percent above the target value). The laboratory concluded that this partial tear of the W-beam was primarily due to pinch upon impact between offset block and the W-beam rail. As a result, this test is a pass.

2. Strong-Post W-beam Steel Guardrail - Midwest Guardrail System (MGS):

   A full-scale physical crash test per MASH for TL-3 conducted at an accredited laboratory of the non-proprietary strong-post W-beam guardrail, named the MGS longitudinal barrier. The guardrail increased mounting height of 31 inches, blockout depth of 12 inches and specifies mid-span splices[10]. The 2270P test vehicle was successfully contained and redirected, remaining upright and stable during and after the collision period. As a result, this test is a pass.

[1] TTI, Research Project 405421-1, dated January 1996
[2] TTI, Research Project 400001-MPT1, dated February 1997
[3] MwRSF Report No. TRP-03-90-99, dated November 10, 1999
[4] MwRSF, Report No. TRP-03-104-00, dated December 13, 2000

[5] TTI, Research Project 400001-TRB3, dated May 2001
[6] TTI, Research Project 400001-MON1, dated February 2002
[7] MwRSF, Report No. TRP-03-168-06, dated October 6, 2006 test no. 2214wb-1
[8] MwRSF, Report No. TRP-03-169-06, dated October 9, 2006 test no. 2214wb-2
[9] National Crash Test Analysis Center, Report No. NCAC2007-R-004, dated December 2007
[10] MwRSF Test Nos. MGS-1 and MGS-2, dated June 2009

Crashworthy 31-inch Guardrails and Terminals

The table below lists system availability as per the date of this correspondence. Corresponding Acceptance Letters in PDF format can be accessed from the electronic version of this Appendix through the links in the table.

All Longitudinal Barriers and Miscellaneous Items can be accessed through the following link: http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/listing.cfm?code=long.

All Barrier Terminals and Crash Cushions can be accessed through the following link: http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/barriers/term_cush.cfm.

Name	Status	FHWA #	Date	Comments
Midwest Guardrail System	Generic	B-133	March 1, 2005	Steel or wood posts
Midwest Guardrail System	Generic	B-175	June 25, 2008	MGS with various wood species
T-31 W-beam Guardrail	Proprietary (Trinity)	B-140	November 3, 2005	NCHRP Report 350 and MASH accepted
GMS Guardrail	Proprietary (Gregory)	B-150	October 27, 2006	Gregory Mini Spacer
GMS Guardrail	Proprietary (Gregory)	B-150B	July 16, 2008	GMS with 12'6" post spacing
Nu-Guard	Proprietary (Nucor)	B-162	September 11, 2007	U-channel post with slot. No block on 31" system
Nu-Guard	Proprietary (Nucor)	B-162B	June 27, 2008	TL-4 acceptance
Terminals for 31-inch high W-beam Guardrails				
Manufacturer	Status	FHWA #	Date	Terminal Type
Road Systems, Inc.	Proprietary	CC-88	March 8, 2005	FLEAT and SKT for MGS
Trinity Industries	Proprietary	CC-94 CC-94A	September 2, 2005 August 30, 2007	ET-Plus Terminal for MGS
Texas Transportation Institute	Proprietary	CC-100	August 30, 2007	Slotted Rail Terminal at 31 inches
GMS Guardrail	Proprietary	CC-96	December 27, 2007	FLEAT and SKT-MGS for GMS guardrail

FAQs:
Barriers, Terminals, Transitions, Attenuators, and Bridge Railings

The FHWA barrier guidance is contained in the AASHTO Roadside Design Guide. However, numerous issues are raised by the FHWA field offices that involve interpretations, extrapolations, device selection, hardware deployment, or simply trying to fit safety devices into real world conditions.

These questions and answers offer clarification on the use of roadside hardware for issues not covered by FHWA policy or topics that simply need additional explanation. They are the considered opinions of engineers in the FHWA Office of Safety Design and FHWA Resource Center with helpful input from members of AASHTO's Guardrail Committee.

In general the questions relate to rigid and semi-rigid barrier systems. Our July 20, 2007, memorandum on Cable Barrier Considerations dealt with numerous issues of cable barrier design, selection, and placement. Additional guidance on cable barrier selection and placement on sloping terrains and adjacent to median ditches will be provided in conjunction with NCHRP 22-25 scheduled for completion in 2010. A similar project (NCHRP 20-7(257)) synthesizing information on portable concrete barrier shapes, connections, anchorages, and other considerations has recently been completed and will also be available soon.

As noted at the end of the FAQ list, we expect to develop additional guidance in this format. Please contact Mr. Nicholas Artimovich at nick.artimovich@dot.gov if you have a special need for guidance in any of those areas, or to suggest others.

Barriers:

Q. Is it OK to use Weathering Steel (sometimes called Cor-Ten, A-588, or Rusting Steel) in longitudinal barriers?

A. No, the use of weathering steel guardrail should be limited. Where aesthetic concerns are primary, weathering steel guardrail may be used if the owner agency adopts a frequent periodic inspection and replacement schedule.

Roadside barriers and bridge rails are usually close enough to the travelled way that they can be sprayed with water from passing traffic. In most parts of the country this water contains deicing chemicals during winter months. In seaside locations in warmer climates the salt laden air deposits corrosive chemicals on barriers. In northern climates plows can throw snow onto the rail and the abrasive action of the snow can erode the protective layer. When exposed to these environments, weathering steel never develops the 'patina' that slows corrosion as in other less aggressive environments. Within a few years significant section loss may result. The interior of box beam barriers and the lap splice of W-beams can corrode rapidly to the point where the barrier may become more hazardous than the feature it was meant to shield.

Weathering steel may continue to be used on the backside of the Steel Backed Timber rail as the steel thickness is significantly greater than the typical 12 gage W-beam section.

One accommodation that has been tried is using zinc foil at the W-beam overlap where the zinc's galvanic action slows the corrosion. Use of thicker sections (exclusive of the terminal) may also prolong the life, but maintenance should still include inspection of the sections and joints. Powder coating of *galvanized* guardrail is an acceptable aesthetic option.

Barrier terminals are also subject to section loss at rail splices, but pendulum tests have been conducted on highly weathered barrier rails using galvanized extruder-type terminals and crash-test performance has been satisfactory. Questions on aesthetic treatments of barrier terminals should be addressed to the manufacturer.

Q. Can 6 x 8 inch timber, W6 x 9 steel, and W6 x 8.5 steel posts be used interchangeably in the length-of-need section of guardrail?

A. Yes. Crash testing under NCHRP Report 350 has shown that these posts may be substituted when not in a barrier terminal. For short stretches of damaged barrier it is probably better to use the same type posts as in the existing installation, but where longer sections must be repaired substituting posts is acceptable. Some States use 8 inch round posts for W-beam guardrail, but we do not have enough performance information to offer an opinion on whether they may be substituted for steel or rectangular wood posts. Some proprietary guardrail and cable barrier posts have also been shown to be interchangeable with the generic posts. Recent crash testing [see NCHRP Project 22-14(3)] under the AASHTO MASH has shown that there may be a difference in performance between steel post systems and wood post systems, especially when the top of the rail is less than 27-3/4 inches high.

Q. Can I use a water-filled barrier on my project instead of concrete barrier?

A. Only if it includes a steel framework that has been accepted as crashworthy. To explain why, we have to agree on some definitions first:

A "**barrier**" is a device that safely redirects, slows, or stops an errant vehicle preventing a more severe crash, or prevents vehicles from entering the work area. A "**barricade**" is a lightweight channelizing device that warns motorists of a hazardous situation and offers little or no resistance when hit. For example, a barrier offers "positive protection" to shield workers in a work zone from being hit by errant motorist while a barricade does not. A "**channelizer"** is a line of traffic control devices used to delineate the traveled way.

Barriers include W-beam guardrail, jersey barriers ("K-rail" in California), steel barriers, bridge railings, weak post cable barriers, certain water-ballasted plastic units, and crash cushions. They must be crash tested at 100 km/hr using a small car and a pickup truck to assess occupant risk and barrier integrity. The test vehicle may not penetrate or vault over a barrier. When put in place each unit must be physically connected to the next unit per the state standard or per the manufacturer's instructions. If the units are merely butted end to end, or if the connection hardware gets stolen, you are maintaining a hazard that is dangerous to both the traveling public and the workers.

Barricades must have orange and white reflectorized striping in accordance with Part 6 of the Manual Uniform Traffic Control Devices, and include Type I and II "sawhorse" barricades, Type III Road Closure barricades, and some large plastic units

that accept water ballast, among others. Barricades must be crash tested at 100 km/hr with a small car to ensure that they do not cause harm to occupants of the impacting vehicle when they are struck.

A hybrid device called a "**longitudinal channelizing device**" or **"longitudinal channelizer"** consists of the large plastic units linked together, end to end, forming a wall. They are useful for controlling pedestrian traffic, guiding vehicles through confusing work zones, discouraging the use of median crossovers, and in providing more delineation when only a line of cones or drums are called for. A longitudinal channelizer is not a barrier because, upon impact by a vehicle, the plastic units rupture and the vehicle penetrates the wall. Some longitudinal channelizers can be converted into crashworthy barriers with the addition of continuous steel rails or by virtue of an internal steel framework.

Now to answer the question - Concrete "New Jersey" Barrier or "K-rail" that is properly installed and connected will redirect most impacting vehicles. Certain "water filled barriers," namely those with internal or external steel rails or frames, can also contain and redirect vehicles. Without these external steel rails or the internal steel framework, water filled longitudinal channelizers do not have the capability to redirect vehicles and may not be substituted whenever a barrier is specified. Because of the confusion over water filled barriers and channelizers that look alike, the FHWA, the AASHTO/AGC/ARTBA Task Force 13, and the American Traffic Safety Services Association support the use of clear labels on each water-filled unit that explains its purpose as a channelizing device or as a barrier unit. A discussion and a sample label are to be posted on the Task Force 13 Web site (see www.aashtotf13.org).

Please note that barrier deflection should be considered. Precast concrete barriers have lower deflection and can also be pinned in place to severely limit deflection upon impact.

Q. Which concrete barrier shape should we use – Jersey Barrier, "F-Shape," Constant-slope, Single Slope, or vertical?

A. All these shapes are acceptable. Generally, the F-Shape or the 9.1 degree constant slope are preferred, since the "F" shape design was specifically engineered to limit the potential roll over and the 9.1 degree constant slope reasonably mimics that performance. Another consideration may be the nature of the traffic using the facility or future overlays.

An explanation of the differences in the shapes may be useful. The Jersey and F barriers are both "safety-shape" barriers that begin with a 3 inch vertical face at the pavement level. Then they break to a sloped face that goes up to 13 inches above the pavement on the Jersey barrier, but only up to a height of 10 inches in the case of the F-Shape. Both then transition to a nearly vertical face to the top of the barrier.

The Texas Constant-Slope Barrier is 1070 mm (42 in) high and has a constant-slope face that makes an angle of 10.8 degrees with respect to the vertical. California developed a Single Slope profile that makes an angle of 9.1 degrees with respect to the vertical. The crash tests indicate that the performance of the Texas Constant-Slope Barrier is comparable to that of

the NJ-shape and the performance of the California Single-Slope Barrier is comparable to that of the F-shape.

A vehicle impacting one of the safety shape designs will have a significant portion of its energy absorbed in the climbing or lifting action that occurs when the tires roll up the lower sloping face. In low speed impacts this may result in the vehicle's redirection with no sheet metal contact with the face of the concrete wall. In medium impacts there will be damage to the vehicle but the occupants will experience minimum forces. In high speed impacts to safety shaped walls there will be significant vehicle damage and minor to moderate injury potential to the occupants. For the Jersey barrier there is a much greater likelihood that a small car will be rolled by the "safety shape" profile. The "F" shape design was specifically engineered to limit the potential for small cars to roll over upon impact.

Vehicles impacting the single slope barrier or vertical wall will experience little potential for roll-over. However, the barrier will absorb none of the crash energy by lifting the vehicle – there is always sheet metal damage and the occupants get the full force of hitting a concrete wall. The vertical wall has similar impact parameters, with the added potential for an occupant's head to hit the wall if it is high enough.

A benefit of the constant slope, single slope, or vertical barriers is that you can apply multiple overlays without affecting the shape, and therefore the performance, as long as the total height remains adequate. Both "safety shapes" allow for no more than three inches of overlay.

In general, for high speed highways the single slope barrier is most appropriate to limit rollovers, since much of the fleet now has side airbags to absorb the impact to the occupants. The side impact airbags will improve the safety of the occupants. For lower speed roads, the F shape would be better for the majority of impacts it would be expected to handle.

Q. Do we need to tie down our portable concrete barrier?

A. It depends. If you are placing the barrier near the edge of a bridge deck a catastrophic failure could occur if a vehicle caused the barrier to deflect enough to push it over the edge. If the barrier were placed on pavement with a work area on the other side then you can tolerate more deflection and bolting it down usually isn't necessary. Barrier deflection in this case may, indeed, push the concrete into the work area, but there appears to be little if any data relating to workers injured when the barrier is deflected causing it to slide into the work area.

Q. Can I fix a channel shape or some other device to the pavement behind portable concrete barrier to keep the barrier from sliding?

A. No. If the barrier is struck by a vehicle tall enough to push it across the deck the barrier could 'trip' over the channel shape and tip over allowing the vehicle to intrude into the work area. The only acceptable location to secure a barrier is in front so that the anchors will resist the overturning moment.

Q. Do cable barriers pose an extraordinary safety risk for motorcyclists?

A. We understand that motorcyclists worldwide have raised this concern. First, the unprotected motorcyclist is at great risk anytime he or she goes off the roadway at speed and contacts a

barrier or any other object. Second, we have yet to see a crash report where the *cables* caused the severe injury. Our reviews show the barrier *posts* cause the greatest number of

injuries (other than the cyclist going completely over the barrier and impacting the ground or some other unforgiving hazard.) Since the post spacing on cable systems is typically two to three times greater than the post spacing on steel beam systems, cable systems allow a greater potential for the rider to avoid striking the posts.

We also note that some European installations (notably in Sweden and the United Kingdom) place cable systems in the paved roadway where there had been no median ("central reserve" as the Brits call it). The cable barrier separates traffic on "two plus one" roads that have three lanes, two lanes in one direction and one in the opposite direction. This puts traffic very close to the barrier and allows very little room for error for motorcyclists or auto drivers. The proximity of the barrier to traffic also results in an increase in the number of impacts, but the motorcyclists are much more vulnerable and have more reported crashes. We don't anticipate cable barrier installations of this sort in the United States.

The European community addressed this question in "Barriers to Change: Designing Safe Roads for Motorcyclists" where it states "The Panel concludes that, despite the amount of high profile coverage that wire rope barriers have attracted, limited research does not warrant the inference that they are more or less dangerous than other types of barrier on the market."

Q. What guidance is available on the timeliness of guardrail repair?

A. It is important that each agency develop their own guidance for when to make repairs. While severely damaged roadside barriers need to be repaired within a reasonable amount of time, FHWA cannot recommend a specific response time. Each agency must make a risk assessment about the timing of repair for each different category of damage and establish specific response times. The assessment would include, among other factors, agency resources (within its overall mission), hazard exposure (how likely is it the guardrail will be hit again), and hazard severity. Vagueness on the timeliness of repairs does not prevent liability. Timing of repairs should be dependent on providing a safe facility, not on recovering damages from insurance companies.

The performance of damaged guardrail was assessed in the NCHRP Project 22-23 "Criteria for Restoration of Longitudinal Barriers." Information on that study may be found here: http://144.171.11.40/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=696.

If repair work is done under contract the State should notify the contractor promptly when the damage is discovered. The time that the contractor is given to respond needs to consider utility coordination (i.e., "Miss Utility" or "One Call" to avoid damaging subsurface utilities) and the fact that additional terminal grading or lengths of barrier may be needed to bring the device up to current standards. Special events and weather factors should also be considered when establishing mandatory response times.

The FHWA has updated the publication "W-beam Guardrail Repair" (Publication

#FHWA-SA-08-002) and it is available on line at http://safety.fhwa.dot.gov/local_rural/training/fhwasa08002/fhwasa08002.pdf.

Information on the eligibility of Federal funding for replacement parts of safety features may be found at http://www.fhwa.dot.gov/federalaid/080610.cfm.

Q. What is "guardrail?" Our agency only uses "guiderail."

A. These terms are synonymous. A few States are required by judicial interpretation to refer to steel beam barriers as "guiderail" because the barriers are not seen as devices that can guard motorists from all injuries. Rather, the steel beam system can only "guide" the car and its occupants. (In Europe, "guard fence" and "road restraint systems" are the common names for roadside barriers.)

Barrier Terminals and Crash Cushions

Q. When repairing crash-damaged guardrail terminals or crash cushions, may we use "breakaway posts" or other components that fit if they are supplied by another manufacturer?

A. Barrier terminals and crash cushions are precisely engineered devices that are subjected to a range of crash tests (up to 8 different tests) meant to show proper performance when impacted by errant vehicles. If the substitute parts do not crush, break, bend, or slide the same way as the crash-tested parts, the device's performance will be affected, with the potential for negative performance. (Even if the device's performance in one test may improve with the substitute part in place, it may lead to failure under another test impact condition.) If the component in question is covered by patent and unique to the system then the overall effect can only be determined by the original manufacturer and/or a crash test laboratory.

Substitutions of components are allowable if any one of these conditions is met:

1) The substitute components are generic items (like guardrail line posts, W-beam rail elements, some fastener hardware, etc.) that meet the same specification as the crash tested parts, or
2) The manufacturer of a patented device has determined that the part will not adversely affect the device's performance and has agreed that the part may be substituted, or
3) The substitute component has been successfully crash tested as part of the same system, or
4) A critical or "smart" part that was formerly covered by a patent is manufactured to the same specification as the original part.

This guidance applies to the safety performance of barrier terminals, crash cushions, and the barriers themselves when considering the use of substitute components.

Most current guardrail terminals and impact attenuators are patented devices. Where the system, device, or components thereof are patented proprietary products, then the guidance in the January 11, 2006, FHWA memorandum, "Guidance on Patented and Proprietary

Product Approvals",
[http://www.fhwa.dot.gov/programadmin/contracts/011106.cfm] should be followed. This memorandum contains a link to additional FAQs on the use of proprietary products in Federal-aid contracts.

Q. Our highways are signed for 75 mph. Shouldn't we use crash cushions that have been crash tested at speeds higher than 100 km/hr (62.5 mph)?

A. No. The FHWA Office of Safety considers that a 100 km/hr test is representative of worst case run-off-road crashes.

Early on in the panel discussions related to the NCHRP project for the updating of the NCHRP Report 350, there was much discussion involving the need to increase test speeds over the 100 km/h (62.2 mph) maximum speed now used. Based on data available to the research team, it was concluded that regardless of posted speeds, most impacts with fixed objects occurred at somewhat reduced speeds, probably because most drivers are braking hard as they are about to run off the road or into some fixed object. Historically (from FARS data), crash cushions have been directly responsible for very few fatalities and even fewer of these can be attributed directly to inadequate cushion capacity. Granted, a longer cushion will perform better in some head-on full-speed crashes, but the cost-effectiveness of a 70 mph cushion over a 62 mph design is far from clear. FHWA's "official" position is that highway features tested to Report 350 TL-3 (i.e., 100 km/h) are sufficient, but if any DOT wishes to use longer designs, they are most certainly free to do so. The best question to ask is whether or not there has been a "capacity" problem with existing installations.

Q. What is the difference between energy absorbing terminals and those that allow the vehicle to break through?

A: All terminals dissipate energy during an impact, some more than others depending on impact conditions. It is agreed that in an end-on impact by a vehicle aligned with the terminal, "energy absorbing" terminals will dissipate more energy than "non-energy absorbing" terminals. However, there are also certain impact conditions in which both types of terminals dissipate essentially the same amount of energy. For these conditions the vehicle can be expected to travel a considerable distance after impact for both terminal types. Additionally, a vehicle that inadvertently leaves the road in advance of a terminal may be just as likely to miss the end as to impact it. Therefore, it seems prudent to require similar run out distances for both energy-absorbing and non-energy-absorbing terminals.

The FHWA memoranda entitled, "Guidelines for the Selection of W-beam Barrier Terminals," (October 26, 2004) and "Supplementary Guidance for the Selection of W-beam Barrier Terminals" (November 17, 2005) issued by the FHWA contain additional considerations beyond those in the Roadside Design Guide. As a point of clarification, guardrail run out distances and length of need requirements for terminals should follow recommendations in the RDG. They are dependent on traffic conditions, guardrail layout, and the characteristics of the hazard to be shielded. They are independent of the terminal type, assuming the point at which the length of need begins is the same for each terminal (normally 12.5 ft from the terminal's beginning).

Where narrow right-of-way restricts the width of the clear roadside an energy absorbing terminal may be preferred. Energy absorbing terminals can be installed parallel to the traveled way and can capture a vehicle that impacts it on the nose. However, with narrow rights-of-way come numerous unaddressed hazards including fixed objects and improper grading. It is not uncommon to see barriers used only to shield built hazards like the

approach end of a bridge railing or a culvert headwall, but terrain and other natural obstructions such as ditches and trees, are not addressed. When these hazards remain within the clear zone the guardrail designer should at least try to see that she/he has not made the situation worse when locating a guardrail terminal.

Transitions

Q. Are "lead anchors" acceptable when connecting the guardrail end shoe to the concrete parapet or end block?

A. No. Lead anchors can work loose over time due to vibration from traffic. The only sure method of attachment is to continue the bolt through the concrete and place the nut on the outside of the structure. A good quality epoxy anchor is acceptable if properly installed according to the manufacturer's instructions.

Bridge Railings

Q. Do bridge railings on reconstructed bridges off the NHS need to meet NCHRP Report 350 criteria?

A. In general, FHWA standards apply to projects on the NHS. State transportation agencies may establish different standards for non-NHS projects if desired and may elect to use roadside hardware that has not been successfully tested to NCHRP Report 350 guidelines. Nonetheless, the FHWA strongly recommends the use of crash-worthy devices on all public facilities where run-off-the-road crashes may occur.

Regarding the design of new railing standards for both "on and off" NHS routes, LRFD Section 13 should apply to all new bridges and rehabilitated bridge projects where railing replacement is required. However, repair or retrofit to the existing railing system that have been found acceptable under the previous crash testing and acceptance criteria (such as NCHRP Report 230, the 1989 AASHTO Guide Specifications for Bridge Railings or equivalent) do not require further testing to the NCHRP 350 requirements at the owner's discretion. Further support for this position can be referenced to the FHWA memorandum dated May 30, 1997. Please also be reminded that a new railing detail solely designed to the LRFD geometric and resistance requirements does not necessarily warrant "passing" of a full scale NCHRP 350 crash test at the specified performance level.

Information on crashworthy bridge railings may be found on the Task Force 13 Web site www.aashtotf13.org.

SECTION 718

PRESERVATIVE SEAL FOR ASPHALT CONCRETE

718.1 GENERAL

Asphalt Concrete preservative seal shall be one of the following types or equal, with typical application rates.

TYPE A - Asphalt rejuvenating agent shall be an emulsion composed of a petroleum resin oil base uniformly emulsified with water. Each supplier must submit a certified statement from the asphalt rejuvenator manufacturer showing that the asphalt rejuvenating emulsion conforms to the required physical and chemical requirements. They also must provide documentation of tests that determine the acceptable range of application of the product. Typical application rates are .07 to .18 gallons per square yard.

TYPE B - Petroleum Hydrocarbon emulsion. Applied at .05 to .20 gallons per square yard, diluted.

TYPE C - Tire modified surface sealer (TRMSS) or equal not diluted, and applied at a rate of .10 to .20 gallons per square yard.

TYPE D - Acrylic polymer, modified emulsion. Diluted to the manufacture's recommendation and applied at a rate of .08 to .20 gallons per square yard.

718.2 TEST METHODS AND REQUIREMENTS

Preservative seal for asphalt concrete material, shall meet type A, B, or C on Table 718-1 by certification from the manufacturer.

All tests shall be performed by AMRL accredited laboratory, accredited in the specified test being performed.

TABLE 718-1

PRESERVATIVE SEAL SPECIFICATIONS

Properties * (note 2)		Type-A	Type-B	Type -C	Type-D
Saybolt Viscosity @77°F (sfs)	ASTM D7496-09	45-55 (KU)* (note 1)	15-40	~~15-40~~45-85(KU)*note 1	15-40
Residue by evaporation 138°C	ASTM D6934-08	30-40	.10 Max	~~53~~30 min.	60-65
Sieve test %	ASTM D6933-08	N/A		~~.10 max.~~N/A	0.1
5 day settlement test	ASTM D6930-10		2.0% max	N/A	N/A
Test on residue from evaporation ASTM D6934-08					
Flash point °F(Min)	ASTM D92	450°F	450°F	450°F	385°F
Softening point	ASTM D36M-09	130°F min	N/A	~~130~~140°F min.	N/A
Accelerated weathering test	ASTM D4799-03	Report * (note 3)	N/A	Pass-Report (note 3)	Plant certification within 6 months
Ductility (@77°F) 100g 5 sec.	ASTM D113-07	N/A	N/A	~~20 min.~~N/A	N/A
Storage stability, test 1 day%	ASTM 6930-10	N/A	N/A	N/A	N/A
Viscosity @ 140°F, cSt	D-445	N/A	1,000-9,500	N/A	210-390

Asphaltenes, % w (max)	D-2006-70	N/A	10.0 Max.	N/A	1.00
Maltene Dist. Ratio	D-2006-70	N/A	0.2-1.4	N/A	0.3-0.6
PC/S Ratio[45] (Min) (Note 4)	D-2006-70	N/A	0.5 Min.	N/A	0.5
Saturated Hydrocarbons,S[5] (note 4)	D-2006-70	N/A	28 Max.	N/A	21-28

Notes:
1. Kreb units (ASTM D562)
2. A full set of tests shall be performed by as specified by the special provisions in the undiluted condition. These tests and any other specified will be performed at the contractor's expense.
3. ASTM G154, 1000 hours ~~The~~ Ultraviolet resistance testing results will be provided at no cost to the engineer.
4. Only residue by evaporation shall be run on diluted samples. Specification limits should be diluted rate times minimum residual value of concentrate.
5. PC/S ratio: $\frac{PC + A_1}{S + A_2}$[5]

- End of Section -

MARICOPA COUNTY
Department of Transportation

MEMORANDUM

Date: June 4, 2014 Revised 2014-09-29

To: MAG Specifications and Details Committee

From: Robert Herz, MCDOT Representative

Subject: Revisions to Sections 336, 321.10.3, 601.2.7 and Detail 200-1 **Case 14-12**

PURPOSE: Add pavement removal criteria to prevent full depth pavement cuts from being located within a lane wheel path and to prevent creation of narrow pavement edge strips.

REVISIONS:

1. Identified location restrictions for full depth longitudinal joints for asphalt pavement widening and for asphalt pavement trench repairs.

2. Defined vertically staggered joint as an alternative for full depth sawed joint.

3. Added pavement removal requirements when replacing existing curb or gutter.

4. Added requirement for asphalt pavement edge replacement to have a safety edge or thickened edge constructed per Detail 201 except when the asphalt edge abuts a concrete curb or gutter.

5. Trenching into portland cement concrete pavement, sidewalk, or other concrete flatwork shall require complete joint to joint replacement of damaged panels. Type C Trench Repair in Detail 200-1 is to be deleted.

6. Adjusted the default pay width for surface replacement to be the maximum trench width at top of pipe greater than O.D. of the pipe barrel as shown in Table 601-1.

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SECTION 336

PAVEMENT MATCHING AND SURFACING REPLACEMENT

336.1 DESCRIPTION:

This specification identifies requirements for removing and replacing or widening ~~Street and alley~~ pavement and other surfacing within ~~the Contracting Agency's~~ public rights-of-way~~, removed by construction activities or to be widened or matched in connection with the improvement of Public Works, shall be placed as shown on the plans and applicable standard details, in accordance with this specification and/or the special provisions.~~

Asphalt concrete roadway ~~pavement replacement~~ trench repairs shall be constructed in accordance with Type A, B, or T-Top Trench Repair of Standard Detail 200-1 and as indicated on the plans or in the special provisions.

Trench repairs for unpaved alleys, roadways, and designated future roadway prism shall be constructed in accordance with Type E Trench Repair of Standard Detail 200-1.

Trenching into ~~P~~portland cement concrete pavement, sidewalk, or other concrete flatwork shall require complete joint to joint replacement of damaged panels. ~~replacement~~ The joint system in PCCP shall be maintained. ~~in accordance with Type C of the Standard Detail 200-1 and as required by Section 324.~~

Comment [RTH1]: Delete Type C Trench Repair from Detail 200-1. The Joint system in PCCP should be maintained and not arbitrarily changed.

~~All other s~~Surface replacement in the right-of-way ~~but~~ not in paved roadways shall be constructed in accordance with Type D Trench Repair of Standard Detail 200-1 and as indicated on the plans or in the special provisions.

Temporary pavement replacement shall be constructed as required herein.

Pavements to be matched by construction of new pavements adjacent to or at the ends of a project shall be milled or saw cut in accordance with these specifications and where shown on the plans.

Pavement and surfacing replacement within ADOT rights-of-way shall be constructed in accordance with their permits and/or specification requirements.

336.2 MATERIALS AND CONSTRUCTION METHODS:

Materials and construction methods used in the replacement of pavement and surfacing shall conform to the requirements of all applicable standard details and specifications, latest revisions.

336.2.1 Pavement Widening or Extensions: Existing pavements which are to be matched by pavement widening or pavement extension shall be trimmed to a neat true line with straight vertical edges free from irregularities with a device specifically designed for this purpose. ~~The minimum depth of cut shall be 1 ½ inches or D/4, whichever is greater.~~

~~The e~~Existing asphalt pavement shall be cut and trimmed after placement of required ABC and just prior to placement of asphalt concrete for pavement widening or extension, and the trimmed edges shall be painted with a light coating of asphalt cement or emulsified asphalt immediately prior to constructing the new abutting asphalt concrete pavements. No extra payment shall be provided for these items and all costs incurred in performing this work shall be incidental to the pavement widening or ~~pavement~~ extension.

The location of longitudinal match points shall depend on the type of asphalt joint being constructed (full depth or staggered) and the location of the pavement lane striping to be in place at completion of construction. Full depth longitudinal joints shall be located within one foot of a post construction lane line stripe or within the center two feet of a post construction travel lane. The location restriction for full depth longitudinal joints does not apply to multi-layer pavements when a vertically staggered joint with the existing pavement is constructed. An acceptable vertically staggered joint must have a minimum six-inch horizontal offset with the nearest joint in the underlying asphalt layer. A vertically staggered joint may be obtained by edge milling to a depth that matches the adjacent asphalt surface course to be placed.

The exact point of matching, termination, and overlay may be adjusted in the field~~, if necessary,~~ by the Engineer or designated representative.

336.2.2 Pavement to be Removed: Existing asphalt pavement to be removed for trenches or for other underground construction or repairs shall be cut by a device capable of making a neat, straight and smooth cut without damaging adjacent pavement that is not to be removed. The Engineer's decision as to the acceptability of the cutting device and manner of operation shall be final.

In lieu of cutting trenches across driveways, curbs and gutters, sidewalks, alley entrances, and other types of pavements, the Contractor may, when approved by the Engineer, elect to tunnel or bore under such structures and pavements.

When installations are within the street pavement and essentially parallel to the center line of the street, the Contractor, with approval of the Engineer, may elect to bore or tunnel all or a portion of the installation. In such installations, the seal coat requirements, as discussed in Section 336.2.4, will be modified as follows:

(A) If the pavement cuts (bore pits, recovery pits, etc.) are 300 feet or more apart, the bore or tunneled distance will not be considered as part of the open trench and the seal coat may will not be required.

Comment [RTH2]: Does any agency require a longer distance prior to elimination of the seal coat requirement?

(B) If the pavement cuts (bore pits, recovery pits, etc.) are less than 300 feet apart, the distance between the cuts will be considered the same as a trench cut and the distance will be added to any trench cut distances.

Pavement removal limits when replacing existing curb or gutter shall be as follows. For curb or gutter replacement adjacent to a designated bike lane or paved shoulder area wider than three feet, the asphalt pavement removal and replacement shall extend to within 6 inches of the travel lane edge stripe. For curb or gutter replacement when no travel lane edge stripe exists, the asphalt pavement match point shall extend two feet or less from the pavement edge into the vehicle travel lane.

336.2.3 Temporary Pavement Replacement: Temporary pavement replacement, as required in Section 601, may be with cold-mix asphalt concrete, with a minimum thickness of 2 inches, using aggregate grading in accordance with Marshall mix design of Section 710. Permanent pavement replacement shall replace temporary repairs within 5 working days after completion of temporary work.

Temporary pavement replacement shall be used in lieu of immediate placement of single course permanent replacement or the first course of two course pavement replacement only on transverse lines such as spur connections to inlets, driveways, road crossings, etc., when required by the Engineer, by utilities or others who subcontract their permanent pavement replacement, under special prior arrangement; or for emergency conditions where it may be required by the Engineer. Temporary pavement replacement shall be placed during the same shift in which the backfill to be covered is completed.

Rolling of the temporary pavement replacement shall conform to the following:

(A) Initial or breakdown rolling shall be followed by rolling with a pneumatic-tired roller. Final compaction and finish rolling shall be done by means of a tandem power roller.

(B) On small areas or where equipment specified above is not available or is impractical, the Engineer will approve the use of small vibrating rollers or vibrating plate type compactors provided comparable compaction is obtained.

The surface of the temporary pavement shall be finished off flush with the adjacent pavement.

336.2.4 Permanent Pavement Replacement and Adjustments:

336.2.4.1 Permanent Pavement Replacement: All pavement replacement shall match gradation and thickness of the existing pavement. Immediately preceding the placement of permanent pavement the density of the base material shall comply with requirements of Table 601-2. Asphalt concrete pPavement replacement shall be compacted to the same density specified for asphalt concrete pavements in Section 321. The compacted thickness of all courses shall conform to the recommended thicknesses requirements of Table 710-1.

Unless otherwise noted, asphalt concrete pavement replacement shall comply with the following:

(A) Single course pavement replacement shall consist of a 1/2" or 3/4" mix in accordance with Section 710.

(B) The base course(s) of a multi-course pavement replacement shall consist of a 3/4" mix in accordance with Section 710.

(C) The surface course of a multi-course pavement replacement shall consist of a 3/8" or 1/2" mix in accordance with Section 710 to match the existing surface.

(D) Where the base course is to be placed with non-compactive equipment, it shall be immediately rolled with a pneumatic-tired roller.

(E) Pavement replacement over trenches wWhere the pavement replacement width trench is 6 feet or more in width, all courses shall be placed with self-propelled spreading and compacting equipment. When the pavement replacement width trench is from 6 to 8 feet in width, self-propelled spreading and compacting equipment shall not be wider than 8 feet.

Comment [RTH3]: Can this be accomplished for the first layer of a two course asphalt pavement?

(F) Placement of the surface course is to be by means which will result in a surface flush with the existing pavement. The pavement replacement surface shall not vary more than 1/4 inch from the lower edge of a straightedge placed across the replacement pavement surface between edges of the existing matched surfaces. When the pavement replacement includes replacement of the roadway crown, the surface smoothness shall comply with requirements of Section 321.

(G) Pavement replacement extending to the edge of asphalt pavement shall have a safety edge or thickened edge constructed per Detail 201 except when the asphalt edge abuts a concrete curb or gutter.

Laying a single course or the base course(s) of the asphalt concrete pavement replacement shall never be more than 600 feet behind the ABC placement for the pavement replacement.

The tTrench backfill must be compacted to its required density, and required ABC must shall be in place and compacted to the density required in Table 601-2 prior to the placement of the asphalt concrete structural section or other surfacing.

Laying a single course or the base course(s) of the asphalt concrete pavement replacement for trenches shall never be more than 600 feet behind the ABC placement for the pavement replacement.

For trench cuts, pavement widening, or other partial pavement installations greater than 300 feet in length the entire area shall then be slurry seal coated in accordance with Section 332 or as otherwise specified. Theis seal coat shall extend from the edge of pavement or lip of gutter to the street centerline except that on residential streets less than 36 feet face to face of curb or and where the pavement patch straddles the centerline, the entire width of street shall be seal coated.

In lieu of placing the seal coat as required previously, and with approval of the Contracting Agencylocal jurisdiction, the Contractor may deposit with the Street Maintenance Department Contracting Agency for credit to the Street Maintenance Department, a negotiated agreed upon amount. The Street Maintenance Department will incorporate this work into their street maintenance program.

336.2.4.2 Adjustments: When new or existing manholes, valuves, survey monuments, clean outs, etc. fall within the limits of the permanent pavement replacement as discussed in this Section, the Contractor shall be responsible for adjusting the various items to the new pavement surface or as directed by the Engineer. This will include but not be limited to slurry and chip seals.

The Contractor will coordinate with the Engineer and with representatives of the various utilities regarding the adjustment and inspection of the work. The Contractor shall be responsible for obtaining and complying with all specifications, special requirements, details, etc. of the Utility Company regarding the adjustments. When adjusting the Agency's utilities, survey monuments, etc., the adjustment will comply with these Specifications and Details.

The work will be done in compliance with OSHA standards and regulations regarding confined space entry. The Contractor shall remove all material attached to the lids and/or covers including that of prior work. The method of removal shall be approved by the Engineer and/or the Utility Representative.

336.3 TYPES AND LOCATIONS OF PAVEMENT ANDTRENCH SURFACEING REPLACEMENT:

Normally, the tType of pavement surface replacement and backfill required for trenches shall will be as noted on the plans or special provisions specified in other portions of the contract documents and construction will shall be in accordance with Detail

200-1 and 200-2. The surface replacement limits for asphalt concrete pavement may vary from Detail 200-1 for full depth longitudinal pavement cuts. If a trench repair type is not noted on the plans or specified in the special provisions, the following criteria will govern:

Type A trench repair will be used for ~~utilized on~~ all asphalt concrete paved streets where the excavation is essentially longitudinal or parallel to traffic. The pavement match point location shall depend on the type of asphalt joint being constructed. Full depth longitudinal joints shall not be located within forty-eight inches (48") of an asphalt pavement edge or within a lane wheel path. The lane wheel path is the entire lane width except the area within one foot of a lane line stripe and except the center two feet of the travel lane. When the required surface match point is located within 48" of an asphalt pavement edge, all asphalt surfacing shall be removed to the asphalt edge and the asphalt edge shall be the new asphalt surfacing match point location. When concrete curb and gutter exist adjacent to asphalt pavement, the lip of gutter shall be considered an edge of the asphalt pavement. The restrictions for full depth longitudinal joints will not apply for two course asphalt concrete pavement replacements when surface milling is used to create at least a six-inch horizontal offset between the matching joint of the surface course and the joint in the underlying asphalt layer. The depth of the asphalt surface course shall be equal to or greater than the minimum thickness recommended in Table 710-1. The milled offset distance shall be outside the match point shown in Detail 200-1.

Comment [RTH4]: The asphalt match point shown in Detail 200-1 needs to be revised to comply with removal requirements of Section 336.2.1 paragraph two.

T-Top trench repair will be utilized on all streets where the excavation is essentially transverse or not parallel to traffic, including trenches that go through an intersection.

Type B trench repair ~~may~~ shall only be used ~~to repair transverse trenches if~~ when specified by the local jurisdiction~~Agency~~.

~~Type C trench repair will be used to repair existing Portland cement concrete pavement.~~

Comment [RTH5]: Delete Type C Trench Repair from Detail 200-1. The Joint system in PCCP should be maintained and not arbitrarily changed as indicated in Sections 324.3.5 and 324.3.9.
Section 340.3.10 requires replacement from joint to joint.

Type D trench repair will be utilized to repair surfaces other than asphalt concrete or ~~P~~portland cement concrete pavement. ~~When a trench cut is in aggregate surfaced area, t~~The surface~~ing~~ replacement shall be of a like type and depth as the existing material, compacted to the densities required in Section 601. Type D trench repair~~It~~ may ~~also~~ be used when the condition of the existing pavement does not justify construction of Type A, Type B or T-Top trench repair~~.~~ with ~~P~~prior written approval of the Engineer ~~is required for this condition~~.

Where a longitudinal trench is partly in pavement, the pavement replacement shall ~~be replaced~~extend to the outside limits ~~edge~~ of the existing pavement.~~,~~ The replacement pavement ~~on a straight~~ edge shall be~~line~~ constructed in a straight line with an appropriate edge treatment~~, as indicated on the plans~~. ~~Measurements for payment shall be from the inner limit of pay width allowed below, to the outside edge of the existing pavement as defined herein.~~

Where no part of a trench is in pavement, surface~~ing~~ replacement will only be specified where existing surfacing materials have been removed.

~~When a trench cut is in aggregate surfaced area, the surfacing replacement shall be of a like type and depth as the existing material, compacted to the densities required in Section 601.~~

336.4 MEASUREMENT:

Measurement for payment and surface~~ing~~ replacement shall be by the square yard, based ~~up~~on actual field measurement of the area covered except as noted below.

(A) In computing pay quantities for surface replacement of Types B and E trench repair, the default pay widths will be based on the ~~actual field measured width; however the boundaries of the measurement will not extend further than ½ the distance, either side, from the centerline of the pipe as depicted on~~dimension calculated from Table 601-1~~,~~ for the "Maximum Width At Top Of Pipe Greater Than O.D. Of Barrel". The pay width for Type B longitudinal trench repair will be adjusted to the field width required when the default surface match point is relocated to the edge of the asphalt pavement or is adjusted to be outside of a wheel path.

(B) In computing pay quantities for a single lift asphalt replacement of a ~~Types~~ T-Top or~~,~~ Type A ~~, C and D~~ trench repair, ~~pay~~ the default width~~s~~ will be based on the dimension calculated from ~~actual field measured width, however the boundaries of the measurement will not extend further than ½ the distance plus 12 inches, either side, from the centerline of the pipe as depicted~~

~~on~~ Table 601-1~~,~~ for the "Maximum Width At Top Of Pipe Greater Than O.D. Of Barrel" plus 24 inches. The pay width for Type A trench repair will be adjusted to the field width required when the surface match point is relocated to the edge of the asphalt pavement or is adjusted to be outside of a wheel path. In all cases, the minimum pay width for a single lift ~~replacement Types~~ T-Top~~,~~ or Type A ~~and D~~ surface replacement shall be 48 inches.

In computing pay quantities for a multiple lift surface replacement for T-Top and Type A trench repair, the pay widths will be based on the dimension calculated from Table 601-1 for the "Maximum Width At Top Of Pipe Greater Than O.D. Of Barrel" plus an additional 30 inches. In all cases, the minimum pay width for a multiple lift T-Top or Type A surface replacement shall be 48 inches.

(C) In computing pay quantities of surface replacement for Type D trench repair, pay widths will be based on the dimension calculated from Table 601-1 for the "Maximum Width At Top Of Pipe Greater Than O.D. Of Barrel". In all cases, the minimum pay width for Type D surface replacement shall be 48 inches.

(~~C~~D) Where a longitudinal trench is partly in asphalt pavement, ~~computations of~~ pay quantities shall ~~be based on~~not exceed ~~the~~actual pavement replacement quantities. The measurement shall be the area as allowed for the respective Type A or Type B trench repair limited to that portion located within the existing pavement. ~~limitations specified above.~~The minimum 48 inch pay width for the Type A pavement replacement does not apply when the trench is partially in pavement.

(~~D~~E) The length of pavement and surfacing replacement shall be measured through any manhole, valve box, or other structure constructed in the pipe line, and any pavement or surface replacement and/or seal treatment in excess of the above pay widths shall be considered and included in the bid item for such structure.

(~~E~~F) Any pavement replacement in excess of the specified pay widths necessitated by the installation of valves, tapping sleeves and valves, valve by-passes, and concrete thrust blocks shall be included in the bid price for these items.

(~~F~~G) ~~When special provisions allow deviations from the trench widths specified in Section 601, the above allowed pay widths for pavement replacement may be altered where so specified.~~

~~(G)~~ Measurement of pavement and surfacing replacement shall be made along the finished surface of the ground to the nearest foot, and shall be computed to the nearest square yard.

Comment [RTH6]: This does not provide clarification but creates confusion, therefore suggest deletion.

Comment [RTH7]: This may be appropriate for trench length but not for trench width.

336.5 PAYMENT:

Direct payment for pavement or other surface~~ing~~ replacement will be made for replacement over all pipe trench cuts except as otherwise ~~allowed~~ noted in the special provisions. Payment for surface replacement~~s~~ over other work shall be included in the cost of constructing that work~~, in accordance with the applicable standard details and specifications~~.

Payment for temporary pavement replacement shall be included in the cost of the pipe.

Payment for pavement replacement shall include the replacement cost of any existing pavement markings that have been degraded, obscured, obliterated or removed ~~by underground trench construction or repairs~~.

When a Contractor has the option of jacking and/or boring or open cut construction, and elects to construct a pipeline by the jacking and/or boring method, ~~he~~ the Contractor will be paid for the replacement of such items of work as pavement, curb and gutter, sidewalk, driveway, and alley entrances, as allowed for open cut construction.

- End of Section -

321.10.3 Surface Testing: If directed by the Engineer surface drainage test shall be performed. The completed surfacing shall be thoroughly compacted, smooth and true to grade and cross-section and free from ruts, humps, depressions or irregularities. An acceptable surface shall not vary more than 1/4 inch from the lower edge of a 12-foot straightedge when the straightedge is placed parallel to the centerline of the roadway. The straightedge shall be furnished by the contractor and shall be acceptable to the Engineer.

All streets shall be water tested for drainage in the presence of the Engineer or designated representative before final acceptance. Any areas not draining properly shall be corrected to the Engineer's satisfaction at the Contractor's expense. Water for this testing shall be provided and paid for by the Contractor.

When deviations in excess of the above tolerance are found, humps or depressions shall be corrected to meet the specified tolerance, or shall be cut out along neat straight lines and replaced with fresh hot mixture and thoroughly compacted to conform with and bond to the surrounding area. Materials and work necessary to correct such deviations shall be at no additional cost to the Contracting Agency.

When pavement is cut out along neat straight lines, the restrictions for full depth longitudinal joints shall match the restrictions for longitudinal joints in Section 336.3 for Type A Trench Repairs. Full depth longitudinal joints shall not be located within a lane wheel path or within forty-eight inches (48") of an asphalt pavement edge.

601.2.7 Pavement and Concrete Cutting and Removal: Where trenchless methods are not used and trenches or other excavations lie within the portland cement concrete section of streets, alleys, driveways, or sidewalks, etc., such concrete shall be completely removed between the closest adjacent joints. ~~sawcut to~~ Removal methods shall produce neat, straight, vertical, ~~true~~ lines in such a manner that the remaining adjoining ~~surface~~ concrete will not be damaged. ~~The minimum depth of cut shall be 1 ½ inches or 1/4 of the thickness, whichever is greater.~~

Sidewalk, curb, gutter, and other concrete flatwork shall have complete joint to joint replacement of all damaged sections. The construction replacing damaged concrete sections and joints shall be compliant with Section 340.

The existing joint system in portland cement concrete pavement (PCCP) shall be maintained. Reconstruction of PCCP panels and joints shall be in accordance with Section 324.

Asphalt pavement shall be clean-cut, with approved equipment and by approved methods in accordance with the requirements of Section 336.

No ripping or rooting will be permitted outside limits of cuts. Surfacing materials removed shall be hauled from the job site immediately, and will not be permitted in the backfill.

SECTION 322
ASPHALT STAMPING

322.1 DESCRIPTION:

The work under this item will provide stamped asphalt which shall include surface patterning and/or asphalt surfacing (painting) as described herein in accordance with Owners Standard Details and/or as shown on the plans and called out in the special provisions.

322.2 GENERAL REQUIREMENTS:

A Contractor shall meet the following qualifications in order to perform asphalt stamping:

> The Contractor shall have completed a minimum of three (3) asphalt stamping projects in the past year (from the date of bid) in the State of Arizona and totaling at least 50,000 S.F. The Contractor shall furnish evidence of meeting these experience requirements to the Engineer.

The Contractor shall submit for review and approval all manufacturer product and technical data for materials proposed to be installed in the right-of-way. The Contractor shall also submit for review and approval a sample of the stamped asphalt material prior to installation. These submittals shall be submitted to the Engineer.

Prior to acceptance of the project, the Contractor shall repair all damaged or unsuitable areas, as determined by the Engineer, at no expense to the Owner.

322.3 MATERIALS:

322.3.1 Asphalt Concrete: All roadway construction materials and asphalt thicknesses shall conform to the applicable requirements of MAG Section 321 and the project plans and specifications. Aggregate base course (ABC) shall be clean, well-graded sand and gravel compacted and placed per MAG Section 321.5.1 and the project plans and specifications.

For raised medians and other areas not subject to vehicular traffic, the surface course shall be at least 2-1/2” of MAG 1/2” or MAG 3/8” asphalt concrete mix in accordance with MAG 710.

322.3.2 Surface Patterning: The patterning equipment shall be metal templates that shall correspond to the patterns shown in Owner’s standard details or as shown on the plans and called out in special provisions. Refer to the project plans and specifications for the pattern type to be used.

322.3.3 Surfacing System (Painted Asphalt): All products used in the surfacing system shall meet the minimum physical and performance properties in Tables 322-1 and 322-2. The Contractor shall submit a Certificate of Compliance to the Engineer indicating that the materials to be included in the work meet these specification requirements. The color used for painted asphalt shall be terracotta or as approved by the Engineer.

TABLE 322-1		
ASPHALT STAMPING SURFACING SYSTEM PHYSICAL PROPERTIES		
Characteristic	**Test Specification**	**Base**
Solids by Volume (%)	ASTM D2697	55%
Solids by Weight (%)	ASTM D2369	68%
Density	ASTM D1475	13.0 lbs/gal

TABLE 322-2		
ASPHALT STAMPING SURFACING SYSTEM PHYSICAL PROPERTIES		
Characteristic	**Test Specification**	**Test Result**
Dry-Time (To Recoat)	ASTM D5895	35 Min
Taber Wear Abrasion Dry H-10 Wheel	ASTM D4060 1 day cure	0.98 g/1000 cycles
Taber Wear Abrasion Wet H-10 Wheel	ASTM D4060 7 days cure	3.4 g/1000 cycles
QUV E Accel.	ASTM G154 Delta	0.53
HydrophobicityWater Absorption	ASTM D-570	8.3 %(9 Day Immersion)
Shore Hardness	ASTM D2240	63 Type D
Mandrel Blend	ASTM D522-93A	1/4" @ 21 Degree C Pass
Permeance	ASTM D1653	3.77 g/m2 /hr (52 mils)
VOC	Per MSDS	23 g/l
Adhesion to Asphalt	ASTM D4541	Substrate Failure
Friction Wet	ASTM E303 British Pendulum Tester	WP * Coated- 62 WP* Uncoated - 57 AC ** Coated - 70 AC ** Uncoated - 60

322.4 INSTALLATION:

322.4.1 Asphalt Concrete:
The hot-mix asphaltic concrete shall be placed per the project plans and specifications. The Contractor shall contact the Engineer for roadway compaction approval prior to beginning asphalt stamping. Asphalt shall be fully compacted prior to positioning the patterning template.

322.4.2 Surface Patterning: After application and compaction of the asphaltic concrete, while it is still hot, templates shall be positioned on the surface in the required orientation. Templates shall be set in

place using a plate compactor and fully embedded using the same compaction equipment used in placing the asphalt (minimum static weight shall be 700 lbs.

The template print depth shall be 3/8" over 99% of the patterned area. All hand tooling shall be complete, full depth, straight in manner, and to the edge of the asphalt pavement, common edge, concrete curb, gutter, or other border. There shall be no overprint of patterns and no remnants of excess print on surrounding unintended areas.

322.4.3 Surfacing System (Painted Asphalt): The air temperature shall be at least 50^{o} F and rising before the application of surface system products begins. There shall also be no precipitation expected within 24 hours of the anticipated surfacing completion in order for the application to be authorized by the Town.

The surfacing system products shall be spray-applied. Where required to cover small areas, the surfacing system may be painted on using brooms or brushes. When complete, the entire asphalt surface shall be covered with the surfacing product with no exposed asphalt present.

The Contractor shall use sufficient masking to ensure that the surface system products are applied only where specified. Masking shall be complete and no overspray onto surfaces not designated as coated surfaces shall be allowed.

The Contractor shall apply the surface system products with a minimum of four complete passes on a roadway surface. Three complete passes shall be allowed on medians, walkways, pathways, and bike paths where traffic is primarily pedestrian with minimal or no automobile traffic. Thickness of the surfacing product shall be 20 mils or greater.

After the surfacing system products have been applied, the treated asphalt shall not be exposed to vehicular traffic for eight (8) hours, overnight, or as approved by the Engineer.

322.5 MEASUREMENT:

Asphalt stamping shall be measured by the square foot, which shall include surface patterning and/or asphalt surfacing (painting).

322.6 PAYMENT:

Asphalt stamping shall be measured as provided above shall be paid for at the contract price per square foot which price shall be full compensation for the item complete as described and specified herein.

MARICOPA COUNTY
Department of Transportation

MEMORANDUM

Date: December 17, 2014

To: MAG Specifications and Details Committee

From: Robert Herz, MCDOT Representative

Subject: Proposed Revisions to Section 772, Table 771-1, and Detail 145 **Case 15-02**

PURPOSE: Adjust fence requirements to reference ASTM F1043 Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework.

REVISIONS:

1. Revise Note 1 on Detail 145 to read as follows:
   1. Posts and rails shall be 1.90 inch outside diameter high strength heavy industrial steel pipe conforming to ASTM F1043 Material Group IA-2 (2.72 lb/ft, minimum yield strength = 50 ksi) or Material Group IC galvanized after forming (2.28 lb/ft, minimum yield strength = 50 ksi).

2. Specification Section 771 GALVANIZING Modify Table 771-1 by adding ASTM F1043 groups IA and IC to the row for Steel Pipe – Rails and Post.

TABLE 771-1		
GALVANIZING SPECIFICATIONS		
Material	ASTM Spec.	Wt. of Coating Oz./Sq. Ft. (Min.)
Corrugated Metal Pipe	A929	1.80
Flat Steel or Iron Sheets	A653, A924	1.25
Iron or Steel Wire	A116	.80
Chain Link Fabric	A392	1.20
Barbed Wire	A121	.50
Steel Pipe - Rails and Posts	A53,	1.8
	F1043 IA	1.8
	F1043 IC Galvanized After Forming	0.9 oz w/chromate and organic clearcoat
Structural Shapes, Tie Rods, Ornamental Iron Railings, Handrails, Manhole and Catch Basin Steps, and Curb Armor	A123	2.00
Bolts, Nuts, Washers, Anchor Bolts, Packing Spools, Gray Iron and Malleable Iron Castings and Steel Castings	A153	1.25

3. Section 772 CHAIN LINK FENCE revise the material requirements identified in 772.2 POSTS, RAILS AND BRACES.

2901 West Durango Street Phoenix, Arizona 85009 Phone: 602-506-4760 Fax: 602-506-5969

CHAIN LINK FENCE

772.1 GENERAL:

All material shall be new and, upon request, the Contractor shall furnish to the Contracting Agency, a certification of inspection stating that the materials have been manufactured, sampled, tested and inspected so as to meet the requirements for its type as specified below.

772.2 POSTS, RAILS AND BRACES:

Posts, rails and braces shall be constructed of pipe in conformance with types A, B or C below. Unless specifically designated by type in the plans or specifications, the Contractor may utilize any of the three types. The posts and rails in this section will cover fencing up to 12 feet in height with post spacing not to exceed 10 feet. The nominal outside dimensions and minimum weights shall be in accordance with Table 772-1. The manufacturer or his representative shall legibly mark each length of pipe by rolling, stamping or stenciling to identify the product by product name, ASTM standard, etc. and the country of manufacture.

Type A: ~~Pipe s~~Shall be manufactured in conformance to ASTM F1043 IA-2 black steel pipe, welded or seamless, hot-dipped zinc coated, ~~manufactured in conformance to ASTM F1083,~~ plain end, standard weight (schedule 40). The hot-dipped zinc coating (galvanized) shall be applied both inside and outside with not less than 1.8 ozs. per square foot ± 0.1 ozs.

Type B: Shall be manufactured in conformance to ASTM F1043 IC Galvanized After Forming. Steel used in the manufacturing of the pipe shall be hot-rolled strip steel in compliance with ASTM A1011 having a minimum yield strength of 50,000 psi. The pipe will be manufactured by electric welded cold-formed process per ASTM A500. The exterior surface will be triple coated and the interior surface single coated ~~per ASTM F1043~~. The triple coated external surface shall be hot-dipped zinc coated (galvanized) having a weight of not less than 1.0 ozs. per square foot ±0.1 ozs., followed by a chromate conversion coating, having a weight not less than 1.05 micro ounces per square foot±0.353 micro ounces (30 micrograms per square inch ±15 micrograms) and an acrylic coating having a thickness of 0.0005 inches ± 0.0002 inches. The internal surface shall be coated with a zinc base paint having a 90% zinc powder loading and having a minimum thickness of 0.0005 inches.

Type C: Shall be manufactured in conformance to ASTM F1043 IC Galvanized Before Forming. Steel used in the manufacturing of the pipe shall be strip steel in compliance with ASTM A653 Grade D having a minimum yield strength of 50,000 psi. Both sides of the strip shall be hot-dipped zinc coated (galvanized) per ASTM A653 and A-924 having the weight of not less than 1.0 oz. per square inch ± 0.1 oz. The zinc coating will form the first coat of a triple coated external surface and the final coat of the interior surface. The pipe will be manufactured by electric welded cold formed process per ASTM A789. After manufacturing, the final two external coatings shall be a chromate conversion having a weight of not less than 1.05 micro ounces per square inch ± 0.353 micro ounces and an acrylic coating having a thickness of 0.0005 inches ± 0.0002 inches.

772.3 CHAIN LINK FABRIC:

Chain link fabric shall conform to the requirements of ASTM A392 (Zinc-Coated) or ASTM A491(Aluminum-Coated). The coating process must leave the fabric completely free of barbs, icicles, or other projections which might be hazardous. The wire used in the manufacture of the fabric shall be 11 gage for all fence 60 inches or less in height and shall be 9 gage for all fence over 60 inches in height unless otherwise specified.

All chain link fabric shall be woven into approximately 2 inch mesh. Fabric less than 60 inches wide shall have knuckled finish on the top edge, and twisted and barbed finish on the bottom edge. Fabric 60 inches or reater in width shall have twisted and barbed finish on both edges. Barbing shall be done by cutting the wire on the bias.

772.4 TENSION WIRES AND FABRIC TIES:

Tension wires shall be at least 7 gage galvanized coil spring steel wire per ASTM A824. Ties used to fasten the fabric to posts, rails, and gate frames shall be not smaller than 11 gage galvanized steel, 6 gage aluminum wire, or approved non-corrosive metal bands.

Tension bars used in fastening fabric to end and corner posts and gate frames shall be galvanized high carbon steel bars not smaller than 3/16 inch x 3/4 inch.

TABLE 772-1 FENCE MEMBER SIZES & WEIGHTS					
USE	FENCE HEIGHT (Feet)	NPS DESIGNATOR	OUTSIDE DIAMETER (Inches)	WEIGHT (Lb/Lf Minimum)	
				TYPE A Schedule 40	TYPE B and C
FENCE POSTS					
End, corner, slope, pull and strain posts	Less than 6	2	2.375	3.65	3.12
	6 and over but less than 9	2 1/2	2.875	5.79	4.64
	9 and over but not over 12	3 1/2	4.000	9.11	6.56
Line posts	less than 6	1 1/2	1.900	2.72	2.28
	6 and over but less than 9	2	2.375	3.65	3.12
	9 and over but not over 12	21/2	2.875	5.79	4.64
GATE POSTS					
Single swing gates 6 feet or less in width or double swing gates 12 feet or less	less than 6	2	2.375	3.65	3.12
	6 and over but not over 12	3 1/2	4.000	9.11	6.56
Single swing gates over 6 feet but not over 13 feet in width or double swing gates over 12 feet but not over 26 feet in width	—	3 1/2	4.000	9.11	6.56
Single swing gates over 13 feet but not over 18 feet in width of double swing gates over 26 feet but not over 36 feet in width	—	6	6.625	18.97	—
Single swing gates over 18 feet in width or double swing gates over 36 feet in width	—	8	8.625	28.55	—
OTHER MEMBERS					
Top rail and braces	—	1 1/4	1.666	2.27	1.84
Frame for gates	—	1 1/2	1.900	2.72	2.28
Stiffners for gates	—	1 1/4	1.666	2.27	1.84

Notes to Table 772-1:

- All unit weights shall be subject to the standard mill tolerance of ±5 percent.
- Posts shall be fitted with tops designed so as to fit securely over the posts and carry a top rail where specified. They shall have a total length of not less than the depth of the concrete footings, as specified, plus the length required above ground. Where no top rail is required, pipe posts shall be fitted with suitable caps.
- Top rail shall be furnished in random lengths of approximately 20 feet where required.

772.5 TRUSS OR TENSION RODS:

Truss or tension rods used in trussing gate frames and line posts adjacent to end, corner, slope or gate posts shall be adjustable 3/8 inch diameter galvanized steel rod. When used in trussing line posts, adjustment shall be provided by means of galvanized, turnbuckle or other suitable tightening devices.

772.6 FITTINGS:

Fittings shall conform to ASTM F626.

Fittings, hardware, nuts and bolts shall be galvanized.

Couplings to connect the individual lengths of top rail shall be of the outside sleeve type at least 7 inches long. The bore of the sleeves shall be sufficiently true to maintain adjacent lengths of rail in alignment.

Extension arms for barbed wire on pipe posts shall be of 13 gage steel or heavier, single piece construction and a type that can be attached to the tops of the posts. Extension arms shall carry 3 wires at approximately 5 1/2 inch centers in a plane approximately 45 degrees from the vertical, inclined as shown on the plans or as directed by the Engineer.

772.7 BARBED WIRE:

Barbed wire shall be 4 point pattern; composed of 2 strands of 12 1/2 gage galvanized steel wire with barbs spaced 5 inches apart and shall conform to ASTM A121.

- End of Section -

From: Gallagher, John
To: Gordon Tyus
Cc: Aubry, Shannon
Subject: AZ MAG - ASTM Standards
Date: Monday, December 01, 2014 1:24:24 PM

Gordon,

Thanks for your time today. I believe the best solution to get standards out globally to AZ MAG Members is to install a custom applet on your site to allow a seamless pass through for users once they are logged in to your secured area.

We had this in place some time ago with success. Unfortunately, ASTM has updated the applet that we offer which rendered the old applet that you were on inactive.

Shannon Aubry from the ASTM IT Department is copied on this email and can provide additional details on rolling this out.

We are confident that this is the best solution to get all AZ MAG Members access to ASTM Standards. If any members are looking to contact ASTM on their own, then can contact me directly.

Please let me know if you have any questions.

Thanks,
John

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