Meeting Minutes

AASHTO Technical Committee on Roadside Safety

Westin Crown Center KANSAS CITY, Missouri

SEPTEMBER 22, 2010

Steve Walker (AL) expressed his appreciation to Joe Jones (MO) and his team from MO Dot on the excellent facilities. Walker noted that Keith Cota (NH) is on the European Motorcycle Scan Tour this week.

Committee Business and Administration

All members except Cota, Teri Soos (MD), Damon Allen (ID), and Rick Wilder (NY) were present. Present were Walker, Steve Reeves (MS), Drew Boyce (DE), Kevin Herrit (CA), Dave Little (IO), Chuck Niessner (TRB), Jiten Sonji (DE), Paul Fossier (LA), Rod Lacy (KS), Mark Ayton (ON), Keith Platte (AASHTO), Nick Artimovich (FHWA HQ), Rory Meza (TX), Bernie Clocksin (SD), Dick Albin (FHWA), Frank Julian (FHWA RC), Ben Buchan (GA). Among the visitors were Keith Fulton (WY – nominated for TCRS membership), Mary McDonough (FHWA), Roger Bligh (TTI), Greg Schertz (FHWA), Malcolm Ray (WPI), J Marburger (KDOT), Ron Seitz (KDOT), Rod Salfrank (KDOT), Marc Thornsbury (FHWA), and Will Longstreet (FHWA HQ).

**Introductions**

Chapter Assignments. Keith Fulton will be added to the roster of Chapter 7 when he is approved as a member.

Walker briefed us on the agenda items for the week. Our major issue is to conduct final review of RDG chapters and approve final version. The Research Problem Statements need to be finalized by Thursday evening for Friday voting. We will see presentations on current research, discuss FHWA issues, and the pooled fund studies. We will also consider some of last year’s Research Proposals, and discuss MASH implementation plan for handling 350-tested hardware that failed MASH testing.

Walker noted that the Green Book has gone to SCOD for review. RDG and Green Book have been checked for consistency in “clear zone” terminology. Consistency needs to be verified prior to publication.

**Update on NCHRP Testing: Chuck Niessner of NCHRP**

Three new projects. Completed 4. 13 Underway. The active and recently completed projects below have a live link in the e-version of these minutes.

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| [NCHRP 16-05](http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2724) | Guidelines for Cost-Effective Safety Treatments of Roadside Ditches |

Survey being Distributed to state DOTs.

17-11(2) Currently resolving issues with database. Little asked if the study will look at recoverability? Bligh said that was not a goal, but it will be an outcome of the severity analysis of the study.

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| [NCHRP 17-43](http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=1637) | Long-Term Roadside Crash Data Collection Program |

The work plan has been submitted.

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| [NCHRP 17-44](http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2511) | Factors Contributing to Median Encroachments and Cross-Median Crashes |

Work underway

17-54 Roadside features in HSM –Develop more quantitative data and crash modification factors to use in the HSM. A new Project RFP is on the street. The Project Panel is set and Dick Albin is TCRS monitor.

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| [NCHRP 20-07/Task 257](http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2339) | Crash Tested Precast Concrete Barrier Designs and Anchoring Methods |

Completed by Dick McGinnis. Albin asked that an E copy of the report be sent to all TCRS members.

22-12 (03) TL2 thru TL-5 Bridge Rails Contract Signed July 2010 and Mac Ray is the contractor.

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| [NCHRP 22-14(03)](http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=686) | Evaluation of Existing Roadside Safety Hardware Using Updated Criteria |

Completed Published as RRD 349

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| [NCHRP 22-20](http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=693) | Design of Roadside Barrier Systems Placed on MSE Retaining Walls |

Project has been completed and will be published as NCHRP Report 663

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| [NCHRP 22-20(02)](http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2735) | Design Guidelines for TL-3 through TL-5 Roadside Barrier Systems Placed on Mechanically Stabilized Earth (MSE) Retaining Walls |

Follow on project. This project is for design forces, not warrants. Concrete barrier is placed directly on top of the wall and a moment slab is used to deal with forces. Conducting simulations on TL3 to TL5 on MSE walls

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| [NCHRP 22-21](http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=694) | Median Cross-Section Design for Rural Divided Highways |

Draft final report been submitted

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| [NCHRP 22-22](http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=695) | Placement of Traffic Barriers on Roadside and Median Slopes |

Interim report submitted.

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| [NCHRP 22-23](http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=696) | Criteria for Restoration of Longitudinal Barriers |

Completed as NCHRP Report 656

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| [NCHRP 22-24](http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=697) | Guidelines for Verification and Validation of Crash Simulations Used in Roadside Safety Applications |

Revising draft final report.

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| [NCHRP 22-25](http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=1640) | Development of Guidance for the Selection, Use, and Maintenance of Cable Barrier Systems |

Completing draft barrier placement guidelines. There will be a workshop to review the guidelines.

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| [NCHRP 22-26](http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2516) | Factors Related to Serious Injury and Fatal Motorcycle Crashes with Traffic Barriers |

Interim report approved by project panel. Getting details from trauma centers on extent of injuries.

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| [NCHRP 22-27](http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2517) | Roadside Safety Analysis Program (RSAP) Update |

Executing approved work plan. Beta testing workshop is planned for this fall.

22-28 Criteria for Restoration of Longitudinal Barriers, Phase 2. Request for proposals is out on the street.

[NCHRP 22-29](http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2984) Performance of Longitudinal Barriers on Curves and Super-Elevated Roadway Sections Initial panel meeting in October 2010 to draft RFP. Walker wanted good TCRS representation on this one. Niessner will get back to us with contact info and list of current panel members.

All recent NCHRP reports are on line. Niessner offered to send hard copies to members upon request.

Walker went over AASHTO TCRS NCHRP ACTIVITIES 2010-2011 Revisions will be noted on the master copy, but the following changes were recorded: Panel 17-11(2) add Frank Julian; 17-43 drop Opiela; 22-29 (C-17) add Boyce and Artimovich; 22-28 (C-18) add Clocksin as Chair, add Artimovich as FHWA Liaison.

Albin explained AFB-20 structure and noted they have two meetings per year, one in January at the TRB annual meeting, and one in conjunction with Task Force 13 in late spring. Albin is willing to add any and all TCRS members to his mailing list. Walker requested this. Albin offered to consider any TCRS members for AFB-20 membership.

**NEW NCHRP PROJECTS**

Project selection panel meeting will be in early November for 2012 projects. Walker served on the panel last year and commented on roadside safety proposals. Panel is well rounded with impressive credentials. Projects are ranked by high and low priority, then high priority projects are ranked. Need a volunteer for the current panel. Rod Lacy expressed interest in this assignment and will represent TCRS this year.

**22-29 Longitudinal Barriers on Curves**. Walker noted that it is surprising that there has been little research on barriers on curves. Superelevated bridge parapets being plumb or perpendicular to the deck are a legitimate question. Artimovich recalled testing under Barriers on Curves, Curbs, and Slopes using the 1989 “Guide Specifications for Bridge Railings” pickup that overrode the w-beam on a superlevated curve.

**17-54 Highway Safety Manual considerations for roadside safety**. $800K is in this project. It will develop crash modification factors for roadside concerns. HSM is to objectively quantify hazards in the design of highways. Texas has done some of this work and this project will expand that work nationwide. Meza described their process to develop AMFs, incorporate them into their design process, and train designers. Albin noted that the way that hazard ratings are assigned to various roadside features and hazards is not always appropriate. Combinations of factors also need to be looked at carefully, like rumble strips and steep slopes. The reliability of the process degrades when you have multiple factors. 30 month project duration is anticipated.

**22-28 Restoration of Longitudinal Barriers** Little described this project which will focus on strong steel post guardrail systems. The panel had good interaction with contractor on prior project that led to useful visual guidance. Manufacturers supplied guardrail, and FOIL provided free testing. Hope we can get the same for the follow up project. Follow on project hints as to where we think it could go but are leaving it open to researchers to cover other factors, including wood post systems.

PRESENTATION OF 2010 RESEARCH PROJECT PROPOSALS

**Develop plan and guidelines to improve roadways and roadsides for motorcycles**. Planned as a follow on to the Va Tech study on MC and GR and the MC Crash Causation Study. Peds and Bikes have separate consideration in AASHTO publications but MC are not covered in the Green Book RDG, nor a separate document. MC considerations should be incorporated into both the Green Book and RDG. Timing of this study could follow on the VA Tech study.

**Warrants for anchoring portable barriers in work zones**. Fossier noted Pooled Fund study has something underway on this. Lacy noted their pooled fund group also has looked at this. Use modeling to set how much deflection they can live with. Little noted that deflection is specific to the portable barrier you are using. Fossier noted steel barriers are easier to move and contractors prefer them, even though more expensive. Sicking noted they are expensive, but Ayton noted they can be cost competitive due to ease of moving them. Sicking noted that bolting on the backside of portable barrier encourages tipping of the barrier under impact. Much discussion ensued about designs that limit deflection without individual barrier anchorages, including anchoring the ends. NYS bolts a section of box beam to the back of the joint. Gist of the project proposal is to develop warrants for when the barrier is to be tied down, not to develop tie down methods. Bligh noted that the pooled fund studies and state specific data may be used to develop warrants on a nationwide basis. Currently many states are not providing the buffer zone to accommodate the deflection of the barriers. Walker noted that TL3 barriers are often installed on lower speed roadways. Lacy noted that barriers that constrain the work zone means the workers are getting run over by their equipment.

**Characteristics of Work Zone Barrier Crashes** Resulted from Positive Protection requirements coming out of Subpart K. TRB set up a Joint Subcommittee on Positive Protection with Jim Bryden as chair. Walker suggested that this might be combined with the Anchor Warrants proposal. Walker asked how the states have responded to Subpart K. Caltrans has developed guidance on positive protection. Bicyclists are expressing concerns about going over barriers. Alabama has developed guidance on concrete barrier especially in conjunction with edge drop-offs and worker protection. There is a need first to determine characteristics of WZ crashes, which would then lead to reconsideration of WZ crash testing in MASH, and then anchoring barriers to reduce deflection. Research into crashes may show that barrier deflection is not as much of an issue, or that low profile barriers are needed. Albin noted that this project was ranked first coming out of the Napa meeting of AFB20.

**Guidelines for Bridge Pier Protection** Lacy notes two parameters – roadside and pier. National experience of very few impacts into bridge piers that lead to bridge collapse or other significant damage does not appear to warrant LRFD barriers. Length of a barrier to redirect a semi will be extensive. The current recommendation of assuming a 15 degree angle of departure is unrealistic for trucks considering that the typical angle is closer to 5 degrees. Let’s give users some guidance on how to design barrier when it is needed. Walker asked if any states have implemented the LRFD requirements? Caltrans has implemented this on new construction. Mo Dot has implemented this as well, but called for LRFD barriers or barrier as appropriate for highway conditions. Julian asked where 54 inch height came from. Probably a risk analysis regarding the magnitude of damage to the crossing roadways overhead. ZOI concept may have led to 54 inch height, but the corner of a van will not take out a pier. SCOBS tech committee on security has looked into the issue of which high-risk bridges need to be shielded. Tim Keller of Ohio is Chair of T-7 SCOBS could be asked to sign off on this problem statement. Lacy asked if a synthesis might be done to address the question quickly. Fossier noted this could be brought up at his pooled fund group.

**Guidelines for Slope Traversability** SUVs and Trucks have a much greater propensity to roll over on a slope between 3:1 and 4:1 than automobiles do. Rollovers are a leading cause of ROR fatalities. Original slope testing did not consider trucks and SUVs as they did not exist in appreciable numbers in the 1970s. Sicking has Ohio DOT Lidar data and locations of run-off road – no object struck crashes. Much needed study but results will mean changes. Julian noted that cable barriers were not considered in the cost effectiveness analyses of the guardrail and slope warrants, nor were high CG vehicles.

**Injury and Fatality Causation during Rigid Barrier Impacts.** Sicking noted that high severity crashes are due to high speed high angle impacts, or rollovers, or occupant ejection or head slap. This study is needed to identify the magnitude and nature of the problem. Little asked after the safety shape vs constant slope. Safety shape has less impact pulse but greater propensity for rollover. Difference is not especially significant.

**Methods to protect motorists in side crashes with roadside safety features.** Side impacts into narrow objects, and non-tracking impacts into barriers or curbs are a problem. Side or non-tracking events are about 50% of ROR crashes. Electronic Stability Control has led to fewer ROR events. Sicking has a study on cable barrier fatalities and found at least half are non-tracking impacts. Ray notes the further away the barrier is the greater the angle of impact - shows up in cable studies. Bligh notes that the Project Statement focuses on revising test criteria, but that warrants for non tracking impacts are needed. Ray recalled the side impact study of the 1980s. Bad results almost always were crashes where the vehicle was not tracking upon impact. Really need to get a better understanding of roadside crashes.

**Comparison of Release Load Magnitude and Variability of 31-inch W-beam Guardrails.** Not answering any real question. Barrier designers already have the information needed .

**Perform In-service Performance Evaluation of Innovative GMS Guardrail at 12 ½ foot post spacing.** Simply self-promoting.

UPDATES OF CURRENT RESEARCH PROJECTS

**Mac Ray RSAP Update** NCHRP Project 22-27

Cota, Meza and Sicking are on that panel. The project will completely rewrite the software. Programming highlights: objectives were to pull all “data” outside of program so that it can be updated more easily without recoding the program itself. If new adjustment factors or severities change we will be able to just write a text file. Program itself will be the probabilistic calculations. User interface will be much more user friendly. Include connections to highway design suites.

Encroachment Adjustment Factor Look Up tables. Will add lane width, multi lanes, access density, rumble strip, shoulder, speed limit, terrain adjustment. Horizontal curve adjustment factors have two different variations, Wright and Robertson vs the factors in the HSM. Project will look at the HSM data and try to reconcile this discrepancy.

User interface – main project file is and Excel template. RSAP2010 has a file creation “wizard.” Can also import geometric data using Civil3D, InRoads, or IHSM. Output is provided in an Excel file. Can also generate PDF reports.

Data highlights: Reanalyzed Cooper data and looked at Washington State cable median barrier data for encroachment rates. No new data collection. Access density is an important factor.

Old RSAP looked at both directions at once. New RSAP looks at one direction of travel at a time. New RSAP also looks at cross median crashes. Old RSAP assumes all vehicles travel in a straight line. New RSAP includes an algorithm that accounts for curved path that may end up hitting a worse hazard or avoiding all hazards. Unfortunately that data isn’t available for that yet. Sicking suggested Ray look at 17-22 data for path information.

Probability of Injury: Old method used Severity Index. Now each hazard has a look up table by speed, vehicle orientation and goes directly to the KABCO injury severity distribution. Long term goal is to develop new models for POI for each type of hazard. This will allow us to have different injury distribution table for cable, w beam, etc. Old RSAP used Functional Classification. This is abandoned in favor of posted speed limit. Sicking noted 17-22 data can be used for this distribution.

The project is running a few months behind and this would put Alpha testing around the holidays. Members should let Ray know if they wish to participate in Alpha or Beta testing.

Delivery issues: RDG usually includes RSAP CD but program is also available on the web site. Should RDG refer to URL instead of including a CD? RSAP may also be incorporated into the IHSDM but would still be available as stand-alone program. Platte asked if we would have to go to NCHRP for updating the program. Platte also supported posting the program on a website rather than on a CDROM. Also discussed Appendices. Questioned how to include this info as it will not be finalized until RDG is ready to print. Could include reduced info in Chapter 2. Walker believes Appendix A should include a summary that has enough info that could influence the vote. The question was put to a vote and the continuation of an Abbreviated Appendix A with weblinks received 13 Votes and was adopted.

**Roger Bligh: Pooled Fund Study Program Update.** Participating states: AK, LA, PA, CA, MN, TN, WA. [www.roadsidepooledfund.org](http://www.roadsidepooledfund.org) Bligh described the following projects:

* Guardrail posts in mow strips. FHWA Acceptance Letter has been issued.
* Field applied fittings to cable barriers and conversion to high tension system. Also recommended height for the fourth wire rope. (Bottom height recommend 13.5”)
* Crash wall to put in front of MSE wall. Save cost of repair to wall. Came up with wall design based on simulation.
* Guardrail Deflection Synthesis. Provide site specific guardrail solutions based on crash test deflection characteristics.
* Guardrail at edge of 2:1 slope. Face of rail is at the slope break point. Tried 27 inch rail height at half post spacing but the pickup rolled on to its side. Will provide options for redesign to pool states and run crash test based on their preferences.
* Pinned down concrete barriers for placement on concrete. Uses a diagonal pin – no bolting . Want to extend research to soil and asphalt surfaces. Twelve and one half foot segments. Two pins per barrier. Need to determine number and depth of pins. Original study was Oregon pin and loop design. Transition from Pinned down to free standing concrete barrier.

TX DOT Roadside Safety Research Program

* MASH Median Barrier Gate. Steel section in line with concrete median barrier for emergency use under TL3 conditions. Showed crash tests of two small cars, first failed due to eleven inch occupant compartment deformation. They redesigned the rails and both the small car and pickup passed CIP and mid length tests.
* MASH Test Level Four Concrete Bridge Rail. Used Single Slope Barrier. Barrier height was simulated and determined that thirty six inches was optimum. I. S. was twelve percent low which violates MASH eight percent limit. Asked TCRS to discuss the need for the minimum I.S. threshold. Lacy asked if shape would have any effect? Roger said he saw no climb at all in that test. Sicking was concerned that the low I.S. on this test resulted in a redirection that just barely seemed to pass, and it is setting a minimum height for bridge railings – should aim for desirable I.S. rather than try to settle for the marginal results of this test. Dhafer asked what was the accuracy of the impact angle? Measuring the angle off the film is subject to imprecision. Fossier: What was the cantilever design? Designed for 80 kip yield line analysis.

**Jerry Graham: Midwest Research Institute** and PTI. NCHRP 22-21 Median Cross Section Design for Rural Divided Highways.

The goal of this project is to develop improvements to the guidelines for cross sections for new and existing divided highways, including barriers. Draft Final report is being turned in Sep 10,2010. Looked at rural freeway medians that were either traversable medians or medians with barriers. Did not differentiate between types of cable median barriers. CA, MO, NC, OH, PA, WA were the participating states. Most were HSIS states, and the database included 2000 miles. Used Pennstate terrain mapping system to get median information such as side slopes, offsets to hazards, etc. Crashes sought were total, cross median collision, cross median no vehicle crash, rollover hit fixed object, other. Database included 18,386 crashes, of which 4804 were median related. Of the median related crashes, 35 percent were rollover. 3.3 percent were cross median crashes. Fixed object crashes 33 percent. Looking at crash severity, 352 fatals on those same miles. 51 percent were median related. 58 percent of median related crashes were rollovers, cross median crashes were 17 percent, Hit fixed object were 12 percent of median related crashes. Cross median crashes (CMC) were always a small number of all crashes.

Cross median crashes decrease with wider medians but rollovers generally increase. Simulations showed there were diminishing returns to making medians wider. Flatter slopes lead to more CMC and fewer rollover and fixed object crashes. Once you get to 1:8 slopes CMC crashes do not increase. Adding barriers virtually eliminated cross median crashes, but hit-fixed-object crashes increase six to nine times.

Cable barriers are cost effective even at an ADT of 10,000 (evaluated 10 and 30,000 ADT.)

Guidelines: Recommend 1:8 slopes that were flatter at the bottom. Use cable barrier in medians up to 60 feet wide for flat slopes.

Factors contributing to Median Encroachments and cross median crashes.

MWRI and Human Factors North looking at the design of rural and urban freeway medians. They will supplement 22-21 data. Classify crashes related to driver workload levels – low driver workload will lead to sleepy drivers, and high workload areas will mean they are avoiding other crashes. Use the road safety audit reviews that were done in MA and WI of median encroachments. Most of the crashes started from one direction of the roadway. Many started from vehicle that was in the right lane.

Contributing factors leading to high driver workload include on ramps, off ramps, left exits, lane drops, standing queues, wet, snowy, icy pavement. Little noted that Iowa has hundreds of vehicles ending up in the median after snow events with no reports of crashes.

Listed contributing factors for low driver workload areas, too.

Countermeasures: redesign merger areas, additional signing, etc., etc….

**Dhafer Marzoughi: NCHRP 22-25** Development of Guidance for Selection, use and Maintenance of Cable Median Barriers. Now in task 6 generating final report. Workshop is planned to discuss guidelines. Final report expected by end of January.

Presentation focused on guideline development. Marzoughi covered Lateral Placement (used vehicle dynamics simulations), Median side slope, cable height (For V-ditches – low cable at 21” and high cable at 33”), Median profile (v-ditch, flat bottom, non-symmetric medians).

To avoid underride, no barrier should be located between 1 ft and 8 ft from either side of center of ditch. For medians sloped steeper than 6:1 you should also avoid the region at the center of the ditch.

When steeper than 6:1 do not place barrier more than 4 feet from edge of median.

For flat bottom ditches – low cable at 21” and high cable at 33” guidance is also provided.

When on non symmetrical medians, place barrier on flatter slope.

**Cable barrier deflection study** – most barriers tested at 100 feet but installed with greater distance between anchorages. This leads to greater deflection for field installations.

**Placement relative to horizontal curves.** Up to 70 percent increase in deflection when the convex side is struck.

Barrier deflection is an issue because the actual deflection between anchors may be much greater than was actually tested at 100 (350) or 200 (MASH) meters. TX now uses 12 foot offset from nearest travel lane. Accepting the risk of two or three foot deflection into opposing lane if use the old deflection of 8 feet.

**Construction and Maintenance Tolerance**: no notes.

Discussion ensued regarding soil condition for anchors as well as post sleeves. Sicking noted they have designed two anchors, one for strong soil, one for really poor soil and it is up to the contractor to analyze the soil and select the proper anchor.

MASH Crash Test Matrix for Testing Cable Barriers on Steeply Sloped Medians.

Dean Sicking: The goal is to establish a matrix of testing for Cable barrier placement on 1:4 medians so that it may be placed anywhere on that median. Arrived at a recommendation for 5 full scale tests.

Test to evaluate Pickup override. Place at 12 feet down the slope. (top cable about 42 to 45 inches high. There are two median widths, 46 feet wide or 30 feet wide. With wide ditch vehicle is nearly redirected by the time it hits the back slope. Narrow ditch causes contact right after barrier contact leading to rollover. Need to run these two tests on the same barriers. TTI said they could run the MWRSF barrier. UNL can get hardware to TTI by the end of the month and can determine which test is most critical.

Two tests to evaluate potential underride: 40 to 46 ft ditch, cable 3-4 feet up the side slope. Small car needs to be tested in soft and hard soil.

Two tests thru the median, up slope, engaging the backside of cable that is 4 feet from the hinge point, with the small car in both soft and hard soil.

To catch flying pickup top cable needs to be above the forward peak of the bumper.

TTI WILL RUN MWRSF SYSTEM ON THEIR 30 FOOT DITCH. MWRSF WILL SEND HARDWARE TO TTI. PAID BY $100K OF SCOR FUNDING.

[Aside – Artimovich noted an inquiry regarding performance of cable barriers when tying cables together vertically. Sicking replied that you want to keep cables engaged in the sheet metal – you do not want the vertical connection to be so strong as to pull a cable up and pull it over the vehicle. ]

Continuation of discussions with Sicking, Dean of Crash Testing:

MGS: even though some MGS tests have passed without blockouts, it is preferable to use the blockout where you have the room. Meza noted TX tested 31” MGS with 8 inch block and it worked OK.

Also discussed short radius Yuma county w-beam and UNL thrie beam. The original Yuma County system passed Report 230 testing. The UNL Thrie Beam is a far superior system that has performed much better, but it was unable to pass the full Report 350 Matrix.

TL- 4 Testing. Under 230 used a school bus. Under 1989 GSBR changed to box truck but overall severity was less energetic than TL3. MASH TL4 is back to level it was under 230. Should not reduce TL4 parameters because we would then be lower than TL3.

At height of 35 to 36 inches start getting into head slap issues on vertical concrete walls.

It was statistically significant that five years of Kansas crash data showed no fatalities due to bridge rail penetrations. Majority are 32 inch Corral or F shape barriers.

THURSDAY SEPTEMBER 23, 2010

FHWA OVERVIEW

Artimovich discussed the May 17, 2010 Memo that recommended minimum of 27 ¾ inches for strong post w-beam. A target value of 29 inches +/- one inch for construction tolerance. FHWA strongly recommends that states adopt the 31 inch guardrail systems.

Rod Lacy’s concern over raising to 30 inches. Concerned that transition does not pass. Haven’t seen a problem in the field with 27 inch height.

Julian: Unless you have done an in-service performance review you don’t know that you don’t have problems. Four states have tried 31 inch barriers ON, MO, KS, IO, couple more states are looking real hard at it. Plus WA and IL have adopted for new installations and can’t find a difference in costs. Iowa uses asymmetrical w-to- thrie-beam connections at same costs. TX did test MGS with 8 inch blockouts. Deeper blockout gives TXdot concern on narrow shoulders. They will adopt 31 MGS but blockout is a question.

Want FHWA guidance on raising w-beam rail after overlay but want some basis for it. We will send a draft to TCRS for their info but not necessarily allow wordsmithing.

Roundabouts. Yes, address the issue. Do need something visual in the middle, but do need to preserve sight lines around the circle. Big questions about maintaining the landscaping in the center. This question came up in subcommittee on design. Placing sculpture or other features in roundabout can be a net safety benefit if we need it to get a roundabout in place.

Mary McDonough discussed recent topics in FHWA Safety in addition to the above. Safety Edge is part of the FHWA Administrator’s *Every Day Counts* initiatives, with one of the goals being to make use of the Safety Edge standard practice in at least half the states in the next few years. The new technical advisory on Rumble Strips is forthcoming and it will update and clarify the current guidance. The comment period for the Retroreflective Pavement Marking Rulemaking ended a month ago. Review of comments is underway. An action memo on the appropriate applications of safety hardware will be issued soon. The memo will request FHWA Division Offices to be vigilant and work with the states to see that crash tested devices are being installed appropriately.

McDonough said the Office of Safety is being reorganized. David Nicol is taking a position in the Office of Infrastructure, and that the Office of Safety is being reorganized into two divisions and McDonough will no longer be the Roadway Departure Team Leader but will be leading a newly-created team dealing with Livability, Pedestrians, Bicyclists, Older and Novice Drivers, and Motorcyclists, so called “vulnerable road users.”

**RDG Chapter Reviews**

Platte asked how the rdg.transportation.org site was for using. Members found it useful but we did not use it optimally. Most were not proficient with the check in – check out procedure. Probably could use some training.

NOTE TO ALL CHAPTER AUTHORS: SEND NOTE TO KEITH PLATTE IF YOUR CHAPTER HAS TIME SENSITIVE DATA THAT NEEDS UPDATING JUST PRIOR TO PUBLICATION. AASHTO Publications will contact you prior to sending the document to the printer.

ALSO SEND PLATTE AN EMAIL INDICATING WHICH FILE IS THE LATEST VERSION. IF YOU HAVED SAVED YOUR CHAPTER WITH A NEW NAME EACH TIME, SAVE THE LAST ON WITH THE TITLE “BALLOT VERSION”. You may delete older versions in the database if you wish.

DO NOT EMBED PICS OR DRAWINGS IN THE WORD FILES.

LOOK FOR WORD ‘WARRANTED’ AND SUBSTITUTE ‘RECOMMENDED OR RECOMMENDATION’ WHERE APPROPRIATE. ALSO WEED OUT WORDS LIKE ENSURE, INSURE, ASSURE, AND REPLACE WITH LESS DEFINATIVE WORDS LIKE PROVIDE, ETC.

UPLOAD YOUR COMPLETED CHAPTERS TO THE RDG.TRANSPORTATION.ORG WEBSITE BY 15 OCTOBER.

AASHTO is exploring the option of making the RDG a web-based document, which means that the links will be live. It would be available on line on a subscription basis.

**Chapter 1. Introduction.** Mark Ayton. Updated crash statistics. Need to refer to 33K fatalities for 2009. May have to slip in 2010 numbers just prior to publication. Will include links to TF13 pages.

**Chapter 2. Economic Analysis.** Mark Ayton. No additional info will be added to chapter 2 but an abbreviated Appendix A will be included in the ballot document.

**Chapter 3. Topography and Drainage** Mark Ayton. Only minimal changes since we went thru line-by-line at Wood’s Hole. Definition of CZ revised to be consistent with Green Book. 3.3.6 New section on CZ for Auxiliary Lanes. Second asterisk under Table showing clear zone ranges should add min ten foot at the bottom of a 1:3 slope. Discussed why the \*\*\*\* has to permit greater CZ. Answer: because we design highways with speeds over 65 and need to specifically provide for wider CZ. Revised the discussion of curbs in conjunction with barrier – referred to Chapter 5 discussion. The examples include slope averaging - that is too fine a detail for the accuracy of clear zones. Look at most liberal CZ for the steeper slope in table 3.4. Just take out slope averaging concept.

Discussed guidance on arterials. TCRS recommends that Green Book not include any discreet recommended clear zones but should only refer to the RDG.

**Chapter 4 Breakaway Hardware.** Steve Reeves. All chapters will point to both TF13 and FHWA web sites. Includes wording that sets breakaway hardware as the default in urban areas. An engineering analysis should be done to justify using non-breakaway hardware if there are high concentrations of pedestrians during peak run-off-road hours.

**Chapter 5 Barriers.** Rod Lacy. Discussion over ensure, assure, insure and these are key words that can cause problems in the courtroom. Some of the example problems still need to be updated. Should discuss LRFD and Runout length. 5.2 Replace ‘warrants’ with ‘barrier recommendations.’ Added info on motorcyclists.

Per Chapter 8, end treatments are “anchorages”, “terminals”, or “crash cushions”. These are the approved words for a deadman, a crashworthy terminal, or an impact attenuator.

Seitz notes that 26 ½ inch criteria is good for state systems, but local roads may not need TL-3 performance. Julian concurs, but many resurfacing projects are 1 ¼ inch preventative maintenance and safety upgrades are not required there.

Made various comments on proprietary systems regarding deflection distance being a factor of post spacing, installation height for all systems. Should low-profile barriers belong in Ch 5 or Ch 9?

LRFD specs offer no guidance on the length of barrier needed to shield a bridge pier. There was much discussion over the need for such a barrier, the appropriate length of need, appropriate barrier over that LON. Very few bridges are brought down by truck impacts. Revise RDG to note what some states do (protect pier with 54 inches, then taper down on a 10-1, and note that LON is unknown and is needed research.) Sample design nomographs will be deleted.

Need to select a formatting procedure for the references. TCRS wants each chapter to have its own list of references. Let us include the published references.

**Chapter 6 Median Barriers.** Joe Jones handed out a summary of the changes he made. They generally focused on installation tolerances and use of cable barriers on 1:4 slopes.

**Chapter 7 Bridge Railings** Bernie Clocksin. Added ZOI, MASH matrices. Combined TL-1 thru 4 into one section and TL 5 and 6 rails in another. Removed short radius GR. Provided only one transition and the reference to the TF-13 site.

**Chapter 8 Terminals** Dave Little. This chapter has become a catalog of available devices. Removed old devices that are not being actively marketed. End treatment terms as discussed in Chapter 5 above should be used in all chapters. Drawings illustrate grading in conformance with FHWA memoranda on selection of w-beam guardrail terminals. Members discussed definitions of low-maintenance / self restoring.

Needs photos of: X-Tension, ET Plus, X-Tension Median, TAU-II, Quest, Compressor, EASI-CELL, HEART, SCI100GM, GRAB, Stop Gate.

Little also noted that he updated the list of RDG references that Kym Nystrom pulled together. Put it into an Excel database.

**Chapter 9 Work Zones** Rory Meza. Add Florida low profile barrier. Add reference to 20-7(257) on portable concrete barriers.

**Chapter 10 CZ for Urban and Restricted Areas** Ben Buchan. No substantial changes to the chapter since Rehoboth. King Mak made some editorial changes. Concept of Enhanced Lateral Offset is relatively new. Subcommittee on Design (Region 1) was bothered by the idea that 6 feet is a “mandatory” clear zone. This is meant to counter the 18 inch offset to fixed objects. Reference to breakaway supports in urban areas should use the wording in Chapter 4.

**Chapter 11 Mailboxes** Artimovich. Very few revisions since Rehoboth. Mak noted changes in recommended placement dimensions in the US Postal Service regulations and made these changes in Chapter 11. Also replaced the appendices related to this chapter with links to the USPS websites where the information is provided. Also deleted the appendix on Model Mailbox Ordinance in favor of including that text within Chapter 11 itself.

**Chapter 12 Low Volume Roads** Ron Seitz offers the following comments on Low volume roads:

Not sure CH 12 really addresses safety improvement on low volume roads. Ch 12 is good guidance for designing a project on a low volume road. However, you will never address the system wide problems if you wait for a project to do anything. Needs far outweigh the funds available. Need to address roadside safety on a system wide basis rather than through individual projects.

Looking at roads less than 400 ADT. Roadside environment should be made as safe as practical for vehicle leaving the roadway. Look at small improvements that can be made on a system wide basis, also look for hot spots.

Practical ideas, some can be done by counties with normal maintenance. Such as cross road drainage structures. May be better off with no bridge railing than with a hazardous railing. Replace with delineation. Driveway pipes can have sloped ends added.

Very low volume roads need to be addressed on a maintenance basis as they cannot be held to the same standard as state highways. It would be helpful to state something as simple as removing a culvert headwall would improve safety because the drainage channel may be less of a hazard than the concrete fixed object.

Need to define Low Volume. Where do you measure clear zone from on a gravel road? CZ should be measured from the right wheel path. Seitz and Meza will develop wording to address sub 400 ADT roads that avoids conflict with other language in RDG in general and Ch 12 in particular.

**FINAL VOTE ON 2011 ROADSIDE DESIGN GUIDE**

Steve Walker called for a vote. Unanimous approval to send to SCOD and SCOH with the understanding that the changes that were discussed will be implemented. Changes to be made by October 15, 2010 and posted to the rdg.transportation.org database.

**FRIDAY SEPTEMBER 24, 2010**

RDG Balloting Process. Final revisions uploaded to Library by 10/15/2010. DELETE OLDER VERSIONS THAT ARE NOT NEEDED OR WANTED. Chapter files will be put into a single PDF and sent to SCOD (for vote) and SCOBS (will not get a vote) perhaps to SCOH at the same time. Comments will be sent to chapter authors for answers but all members will see full spreadsheet. Could expect to receive comments late November.

King Mak is still on contract and there are a few $$$ left. He could be asked to do word searches for words that may cause problems for lawyers, but this would delay the process. Chapter Authors should do this ourselves. Dave Little noted we had a similar goal of finalizing our chapters in 2009 and we missed that one. Let’s do better this time. It doesn’t have to be perfect as we will probably get comments that will require revision.

Discussed the updating process with electronic versions. Could do it on a rotating basis looking at one third of the book each year. SCOBS issues Interims every year. Could consider annual updates to the RDG – will have to discuss this on the agenda. Do we continue with the 3 ring binder? It worked with Chapter 6 update, and often used by designers . AASHTO can sell hole punched pages but skip the binder. AASHTO would sell licenses for the number of users can be on line at any one time, for example.

**Vote on NCHRP Research Proposals**

Proposals have to come through AASHTO Subcommittees, therefore SCOD needs to rank these before being sent to SCOR. In order for this to work better next year we may have to review and vote on proposals in advance of our meeting next year. This needs to be done in August of 2011 via conference call or GoToMeeting. This could actually improve our annual meetings as we will not have to review research proposals. We do have a lot on our agenda.

INDICATE ON EACH PROPOSAL THE SUBMITTAL DATE AND THAT IT WAS SUBMITTED BY THE SUBCOMMITTE ON DESIGN.

**Develop Guidelines to Improve Roadways and Roadsides for Motorcycles** : Artimovich. Little and Jones believe this is premature as there is a lot going on in this area. Current project focuses on barriers and this project will address full roadside scenario. There is a lot of interest in this area from the MC community and a lot going on in Europe but we should look at what info we have before going forward. Albin believes this will follow on in a timely manner. There will be an AASHTO event following the MC scan to address these issues and see how the US is dealing with these issues.

**Warrants for anchoring portable barriers in work zones** : Meza. Pinning at the edge of the deck is common, but no guidance on when you need to reduce deflection when barrier is placed on pavement. Should this be added to the Characteristics project? Little noted that they tried to record info on barrier impacts in Iowa but got no hits because the barrier was so close. During a prior year the barrier was set back further and was struck. 10 votes in favor of combining this with the Characteristics of WZ Barrier Crashes. 2 votes against.

**Characteristics of Work Zone Barrier Crashes AND Warrants for Anchoring Portable Barriers:** Herrit, Developed by the Joint Subcommittee on Roadside Safety and Work Zones.

**Guidelines for Design and Shielding of Bridge Piers** Lacy and Fossier: This is important from a monetary issue that needs to be coordinated with SCOBS T-7, Tim Keller of Ohio. Add Length of Need to the problem statement. Need to redirect research away from head slap towards warrants and length of need. Head slap is covered in the other rigid barrier proposal.

**Guidelines for Slope Traversability:** Boyce. Big issue that we have not looked at since the 1960s. Little notes that Iowa and other states have Lidar data that can give us this slope information that we can use to analyze crashes. Should look at transverse slopes? This was addressed in the 1980;s\\’s and led to 1:10 on crossovers. Need to address cut slopes as well as fill slopes.

**Injury and Fatality Causation during Rigid Barrier Impacts**: Wilder, in absentia. Proposed projects for the collection of data do not sit well with SCOR. Getting this info out of crash reports could be difficult. However, we are getting this info from the MC crash study from trauma centers. This would require greater funding than proposed for this project.

**Methods to protect motorists in side crashes with roadside safety features** Reeves: Should add info on non-tracking impacts into barriers and re-focus the question? That would require significant revision. Proposal does note that vehicle side door strength has improved. Should we send this one back to look at non-tracking issues? Yes, but it is too late to re-write the proposal this year – return to submitters for consideration next year. Julian notes that Electronic Stability Control may affect performance as much as side door strength.

**Guidance for curbs used in conjunction with guardrail and crash cushions:** Little: This was a high ranking project from TCRS last year but SCOR isn’t hot on spending money on proprietary devices, and is this really a problem? Should a generic terminal be tested to assess the level of the issue, and challenge manufacturers to do their own testing? Little noted that the RDG state survey indicated that this was a great need of Chapter 8 users. If we want it to get funded we should indicate the info is to be incorporated into the Roadside Design Guide. Came up in MW pooled fund group and was not a high enough priority. Julian noted that he found manufacturers were interested in addressing this issue by pooling their funds. McDonough noted that challenge here is that study looks at urban freeways whereas FHWA focus is on rural two lane roads where the greatest number of fatalities is occurring.

**Comparison of Release Load Magnitude and Variability of 31-inch W-beam Guardrails.** Self serving and does not answer any important questions.

**Perform In-Service Performance Evaluation of Innovative GMS Guardrail at 12 ½ foot post spacing.** Self serving and does not answer any important questions.

Voted proposals:

**Guidelines for Designing and Shielding of Bridge Piers** Eight Priority One votes

**Guidelines for Slope Traversability and Vehicle Rollover** Eight priority two

**Characteristics of Work Zone Barrier Crashes** combined with **Warrants for anchoring portable barriers in work zones**  Seven priority 3

**Curbs with Terminals and Crash Cushions** Eight Priority 4

**Injury and Fatality Causation during Rigid Barrier Impacts**

These did not get enough votes to move forward:

**Develop Guidelines to Improve Roadways and Roadsides for Motorcycles**

**Methods to protect motorists in side crashes with roadside safety features**

**Comparison of Release Load Magnitude and Variability of 31-inch W-beam Guardrails.**

**Perform InService Performance Evaluation of Innovative GMS Guardrail at 12 ½ foot post spacing.**

**Process to address NCHRP Report 350-tested devices that have failed MASH testing.** Discussed concept and set up a task force. Potential strategies include:

* Review of failure mechanism – establish review committee?
* Barrier retrofits design – computer simulations by TFHRC
* Barrier testing through pooled fund studies or NCHRP
* In Service performance evaluation by pooled fund states or NCHRP
* Recommended continuance / discontinuance of hardware system use (notice process AASHTO balloting?)

Task Force. Solutions would be sent out via FHWA memo that references our agreement with AASHTO on a particular piece of hardware. 32” Jersey is OK at TL 3. Wood Post GR should be set higher than 27 inches. PSST signs should be more firmly affixed to post.

Members: Artimovich, Little, Lacy, Albin, Clocksin, Invite Roger Bligh, Ron Faller, John LaTurner as advisors. ) This group will flesh out the flow chart of the process and return to TCRS. DO THIS BY TRB IN JANUARY)

September 2012 on the Mississippi Gulf Coast

The Membership expressed their sincere appreciation to Joe Jones and Rod Lacy and their team members for organizing a flawless pair of meetings. Many thanks, guys.