**Meeting Minutes**

**Pooled Fund Roadside Safety**

**November 17 & 18, 2009**

**College Station, Texas**

Attendance: Roger Bligh, Lance Bullard, Dean Alberson, Nauman Sheikh, Akram Abu-Odeh, William Williams, Dusty Arrington, Dave Olson, Rhonda Brooks, Jeff Jeffers, Mike Elle, Paul Fossier, Kurt Brauner, Will Longstreet, Dick Albin,

 Ali Hangul, (teleconference), Mark Burkhead (teleconference).

The business meeting began at 8:00 A.M. with two members participating via teleconference (see attendance list). The meeting began with introductions, followed by a meeting overview and agenda review. Agenda modifications were made to accommodate the schedule of a planned crash test, discussion of the MASH implementation plan, and distribution of completed research.

The first order of business was to discuss the status and progress of active projects.

**Status of Projects**

Project – Concrete Barrier on Slopes – Nauman Sheikh – Task AM

The objective of this project is to develop a design where concrete barrier can be placed in front of slopes as steep as 1.5H:1V or on top of MSE walls that do not require a moment slab. The design evaluated through full scale crash testing placed 20 feet long segments of single slope barrier with a grouted rebar grid connections in compacted soil 10 inch deep by 2 feet wide behind the barrier. Simulation indicated that this design would result in deflections of 10 inches. Full scale crash testing successfully contained and redirected the vehicle, with a barrier deflection of 5.5 inches under MASH testing conditions. This project was completed and a report published in August 2009. The Roadside Pooled Fund state members requested that this work culminate with a request for FHWA acceptance of the design.

Project – Short Radius T-Intersection – Akram Abu-Odeh – Task AJ

Over the past year, this project has focused on an objective of obtaining an acceptance for a design for short radius guardrail that is compliant at NCHRP TL-2. This application is targeting guardrail installations at T Intersections and driveways where one end of the guardrail in anchored along the minor roadway or driveway, and the other end is anchored along the major roadway. Midwest Roadside Safety Facility has done some work in this area, treating the application similar to a crash cushion. A design developed for Yuma County, Arizona in the late 1980’s shows some promise as a design for TL-2 use. That design was developed with the AASHTO Guide Specification for Bridge Rails and included testing with a pickup truck rather than the sedan used for NCHRP 230 tests. Deflection for this design is approx. 12’. The report for this project is in internal review at TTI. In conjunction with the project monitor, TTI will prepare a package for FHWA acceptance on this design. If further testing is not necessary, this project may not expend the full allocation, freeing up funds that could be used on other projects.

Project – Cable Barrier Retrofit – Dusty Arrington - Task AK

The objective of this project is to identify and test alternative methods of terminating cables with field applied fittings while developing a procedure to convert low tension systems into high tension systems. Four fittings were identified for testing (1 swaged, 2 mechanical and 1 epoxy). Static and dynamic load testing was conducted. Full scale crash testing was conducted with a ¾ ton pickup, using the epoxy fittings. Swaged fittings are the preferred method of connection, but since there were several tests previous evaluated with swaged fittings, the epoxy fitting was chosen to determine if it was a viable option. The pickup was successfully contained and redirected in the test however the wide end of the epoxy socket did snag on the sheet metal and tore a gouge down the side of the pickup. If this fitting is likely to be used, TTI recommends that it be tested with the small car. TTI reviewed NCAC studies of bumper traces on median departures to evaluate placement of a forth (bottom) cable to reduce under-ride potential. The recommendation from MwRSF is 13.5” above ground line. The evaluation of the fourth cable is on-going and is the last piece of this project. In conjunction with the project monitor, TTI will prepare a package for submission to FHWA for an acceptance letter.

Project – Posts in Mow Strips – Dusty Arrington – Task AL

The objective of this project is to develop alternatives for fill material around the posts in leave-out sections of mow strips. Designs had specified low-strength grout that is hard to inspect and is inconsistent in strength. A wide variety of products were reviewed, and ultimately 5 were chosen for bogey impact testing to ensure that post performance was not compromised. Those solutions tested were: two sack grout, urethane foam, concrete pop-out, top hat (rubber mat), and another rubber mat product. The final report summarizing this work is complete and the report and test data have been submitted to FHWA for acceptance.

Project – Lake Pontchartrain William Williams – Task AN

The objective of this project is to develop a replacement bridge railing to retrofit a design implemented in the 1930s. The existing rail was damaged by Hurricane Katrina. Two designs using tubular rails were considered. Ultimately, the Illinois rail design was selected, which is a TL4 design with 2 steel tubes. The posts are on 6’-3” centers anchored with Hilte epoxy anchors on top of a 9” concrete curb. This project is complete.

Project – F-Shape Barrier with Drain Holes – William Williams – Task AR

This project evaluated an F-shape bridge railing will 6” high drainage slots. The barrier is comparable to a TxDOT design used to accommodate wildlife crossings. The evaluation is complete and the final report is being drafted.

Project – WSDOT sponsored Single Slope Barrier with Pin & Loop Connections – William Williams – Task AS

This project is evaluating two issues. A single slope barrier utilizing a pin & loop connection, similar to what Oregon has used in their F-shape barrier. It is also evaluating a drainage scupper in the bottom of the barrier. The design has been analyzed and crash simulations have been done. The next step is full scale crash testing. 8 of the 16 barrier segments have been fabricated and the remaining sections are being fabricated. Full scale crash testing is expected in February 2010 using MASH criteria. If the full scale crash testing is successful, an FHWA acceptance letter will be requested.

Project – Guardrail on Slopes – Akram Abu-Odeh - Task AT

The objective of this project is to evaluate beam guardrail designs suitable for placement in front of or on slopes 2H:1V or flatter. In particular, this design would be useful in mountainous areas where shoulder width is very limited. After evaluation of several design alternatives, a design using 8’ long steel posts utilizing a 3’ 1 ½” post spacing was selected for full scale crash testing. The ¾ ton pickup was restrained and redirected, but did not remain upright. The crash test was not successful. The test results are being used to calibrate the model and work continues to develop this system. A 31” high rail with an 8” blockout is being considered for future testing. Further testing will continue using MASH criteria.

Project – Crash Wall for MSE –Akram Abu-Odeh – Task AP

The objective of this project is to develop a crash wall for placement in front of MSE wall to protect the MSE wall from vehicular impact forces. A TL4 design has been analyzed using a single unit truck evaluated using MASH criteria. This project has developed a design using an 8’ high wall 8” thick, constructed from reinforced concrete. A model was developed and evaluated using simulation. This design appears to accomplish the goals of the project. The final report is expected in June 2010.

Project – Long Span Guardrail – Eugene Buth – Tasks AA & AH

The objective of this project is to develop long-span guardrail designs that allow multiple missing posts, while minimizing the length of a custom designed segment. The system design is for an NCHRP 350 TL-3 system on a 27” high guardrail. This project has reviewed previous work in developing designs for omitted guardrail posts. After gathering that information, simulation of crash testing has been initiated to model performance. Phase 1 and 2 of this work are complete. The team elected to discontinue this project over concerns about the value of pursuing further research in this system given the predictions demonstrated by the model, and the knowledge that there are systems available that have passed testing.

In addition to the projects previously mentioned the question of FHWA acceptance letters was discussed. An FHWA acceptance letter for the following completed projects will be pursued.

Project – Guardrail over Box Culverts – William Williams - Task AE

The objective of this project is to develop a means to attach guardrail posts to box culverts or similar subsurface structures, when the depth of fill over the structure prevents full embedment of a standard post. Preferred characteristics of an alternate design include attachment using adhesive anchors. Four 7/8” diameter anchor bolts were used to anchor a steel plate to the top of the box culvert. A steel guardrail post was welded to the steel plate with 9” of fill. Standard 6’ 3” post spacing was tested. In the full scale crash test, a ¾ ton pickup traveling at 100 KPH impacting at 25 degrees was restrained and redirected, however the guardrail element ruptured. The final report on this testing has been published. Although the vehicle was restrained and redirected, there is concern over whether a test resulting in a ruptured rail element would be viewed as successful. The team ultimately decided to request an FHWA acceptance letter focusing on use of the epoxy anchors for attaching the post to the culvert. A proposal was offered to continue this project with an approach that moves the rail splices to mid-span, in the hope that it will resolve the rail rupture experienced in the previous design.

Project – Steel Posts Underground – William Williams - Task AO

The objective of this project is to develop a shallow spread footing design for attaching guardrail posts when full embedment cannot be achieved. Footing is designed to resist overturning on impact. The design was developed for 6 inches or more of cover over the footing. Two designs were evaluated with pendulum testing. One design used a 5 feet square by 8 inch thick concrete slab and the other used a 4 feet square by 8 inch thick slab. Other elements of the design were identical. The pendulum testing showed that the smaller footing demonstrated more rotation than the larger footing. TTI recommended a crash test be conducted if it is desired to use this design on multiple consecutive posts. TTI will prepare a package for submission to FHWA for an acceptance letter for use of the spread footing at a single post location in a run of guardrail.

**Crash test**

TTI ran a crash test of a proprietary cable barrier design under consideration by European client. The client had expressed some concerns about how the system might perform when impact speeds exceeded the standard (100 kpm) tests. This crash test impacted the barrier system at a 10 degree angle with a Chevy Lumina traveling at 80 mph. The vehicle was contained and redirected by the barrier system, and remained upright.

**Presentation of New Research Proposals**

TTI/21 - Anchoring Temporary Concrete Barrier on Asphalt or Soil – TTI (Nauman Sheikh) - This proposal would build upon work completed in a previous task, anchoring F-shape concrete barrier to concrete pavement with drop in anchor pins. This proposal would evaluate similar anchorage methods that would be appropriate for use in asphalt pavement or on soil. Estimated cost is $70,000. (Upon review TTI estimated $75,000 for this work)

LA/11 - Development of a Generic Multi-Directional Breakaway Multi-post System – Paul Fossier – This research project would develop a cost-effective generic system for a breakaway sign post appropriate for multiple impact directions. A successful project would develop an economic alternative to proprietary designs.

Estimated cost is $50,000. (Upon review, TTI estimates $90,000 for this work)

LA/13 - Transition for Anchored Temporary Barrier System – Paul Fossier – This proposal would build upon work completed in a previous task, anchoring F-shape concrete barrier to concrete pavement with drop in anchor pins. The purpose is to develop a transition for the approach to the anchored section of the barrier to reduce snagging potential. Estimated cost is $30,000. (TTI estimated $90,000 for the full range of tests for this work)

LA/20 - Development of a Generic Omni-Directional Breakaway Single-Post Sign System for round posts up to 5” diameter. – Paul Fossier – This proposal would develop a single post sign support utilizing a 5” diameter steel support. This would reduce the need to rely on proprietary designs for this purpose. Vermont has a similar design, but it’s not clear whether this was ever crash tested. Estimated cost is $30,000. (TTI estimates $90,000 for this work)

LA/22 - Anchoring Temporary Concrete Barrier to Rigid Bridge Rail – Paul Fossier - This proposal would build upon work completed in a previous task, anchoring F-shape concrete barrier to concrete pavement with drop in anchor pins. The purpose is to develop a transition for the approach to permanent concrete barrier or bridge rail to reduce snagging potential. Estimated cost is $30,000. (TTI estimates $90,000 for this work)

WA/15 - Phase 2 Guardrail on Slopes – Dave Olson – This proposal would continue the previous efforts to develop a beam guardrail system suitable for placement at the slope break on 2H:1V or slopes. A taller rail height and larger blockout may be considered in this next phase. This proposal was approved as part of the 2009 program. TTI recommended that we initiate this project through simulation of a small car impact. TTI estimated $15,000 for this work.

WA/18 - Synthesis of Beam Guardrail Deflection Characteristics - Dave Olson – This proposal build upon work done for the AASHTO Roadside Design Guide to evaluate different beam guardrail system designs and present deflection characteristics determined from previous crash testing. It would include different post spacing, nested rail, single ply rail, 10 gauge rail, 12 gauge rail, and different mounting heights. Estimated cost is $7,500 (TTI estimated $15,000 for this work)

WA/13 - Sign & Light Standard Foundation when Installed on Slopes – Dave Olson – This proposal would develop a subsurface concrete foundation with a steel stub post extending to ground line, as a foundation for steel signs and light standards mounted on slopes. The steel stub post would terminate with a slip base. This design would reduce the potential for vehicle snagging on a larger diameter concrete foundation that extend to or about ground line. Estimated cost is $60,000. (Upon review, TTI estimated $20,000 for an Engineering analysis of impact and wind loads – recommended this as the starting point)

WA/19 - Wood Guardrail Post Life Expectancy – Dave Olson – This proposal would evaluate options for a field inspection procedure for determination of wooden guardrail post integrity. It would investigate non-destructive methods for testing guardrail posts in place to determine if the posts were rotted or suffered from insect damage. Phase 1 would focus on inspection methods. A phase 2 project would develop measures to predict post life expectancy with installation variables. Estimated cost of Phase 1 is $20,000. (TTI estimates $75,000 for this work)

PA/8 - Earth Mounds at Dual Bridge Openings on High Speed, High Volume Expressway – Mark Burkhead – This research project would develop and test a countermeasure to reduce the potential for vehicles to traverse the median and drop into the opening between parallel bridges. PennDOT has been using a combination of strong post guardrail and earth mounds as a countermeasure. There have been instances where vehicles have gone through these configurations. Constructing the mounds in narrow median is problematic. After discussions, it was suggested that other solutions in use by other states may be a better approach to resolving this concern. Other state members were asked to share their design approaches with Mark. This project was removed from consideration.

PA/ 10 - Strong Post Guardrail Post Radius at Driveways – Mark Burkhead – This research project would develop a guardrail application utilizing standard components to terminate the approach ends at driveways and road approaches. A successful project would result in a TL-3 design that is more cost-effective than an attenuator. Based on discussions associated with Task AJ, this proposal was withdrawn, over concerns that chasing a TL-3 solution may be very costly and seems to have a low probability of success.

Guardrail over Box Culvert – Phase 3 – Midspan splices – Mike Elle – This proposal would continue the development of previous work on this project. The next iteration of this project would look at moving the rail splices to mid-span to see if this resolves the issue with rail rupture. TTI estimates $65,000 for this work.

Cable Barrier Transition to Non-Flared Terminal – Direct Connection – This proposal would look at transitioning high tension cable barrier systems to non-flared beam guardrail terminals. No formal proposal or cost was developed for this.

Curbing used in Conjunction with Crash Cushions and Terminals – This proposal would evaluate the performance of crash cushions and guardrail terminals when placed behind curbing. Because the majority of this hardware is proprietary, product manufacturers are not inclined to want to test a crash worthy device in a different placement configuration. It was suggested that this evaluation could start with a non-proprietary terminal such as the MELT to determine if there is reason to be concerned. No formal proposal or cost estimate was developed for this.

**Selection of Research Projects for Next Year**

After the presentation of the proposals for the next round of projects, each member state was asked to rank their top five projects. Each contributing state representative was asked to assign 5 points to their highest priority project, 4 points for their second priority, etc. with declining point values down to 1 point for their 5th ranked priority. Once each member had offered their scores, they were added together to determine the total points for each research proposal and the highest point score reflected the group’s top priority. Following in priority order, the projects were ranked and selected for the next research cycle until the available funds were exhausted. Projects selected for the next round of research are:

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| --- | --- | --- | --- |
| **Rank** | **Project** | **Funding Amount** | **Project Monitor** |
| 1 | Anchoring Temporary Concrete Barrier on Asphalt or soil | $75,000 | Paul Fossier |
| 2 | Small Car simulation for Phase 2 Guardrail on Slopes | $15,000 | Dave Olson |
| 3 | Transitions for Anchored Temporary Barrier Systems | $90,000 | Paul Fossier |
| 4 | Synthesis of Beam Guardrail Deflection Characteristics (TCRS) | $15,000 | Dave Olson |
| 5 | Guardrail over Box Culvert –Phase 3 – Mid-span Splices | $65,000 | Mike Elle |
| 6 | Sign & Light Standard Foundation when Installed on Slopes | $20,000 | Dave Olson |

The funds available to invest in research over the coming year are estimated to be $280,000 to $290,000.

Sample technical summary notes and an informational brochure on the Roadside Safety Pooled Fund program were provided to the team members for review and comments. Team members were asked to review this material and provide comments back to Lance Bullard.

Next year’s meeting is planned for Washington (probably in Seattle) in the November time frame.