Task Force 13 Minutes

Seattle, Washington
Red Lion Hotel
September 10,11, 2007

TO DO LIST

1. Do not overlap SubComm #2 and #5 so that Mac Ray can address both groups.
2. **Bligh** to summarize the info he got from TTI on questions of cost and access for database table management.
3. **Kessler** was asked to develop a list of questions and concerns that we have for the continuation of our website. Responses on computer questions requested by middle of October.
4. **All Task Force 13 members** shall visit the ProBoards site and review the latest drawings for comments. http://barrierguide.proboards31.com/ Subcommittee No2 asked members to enter any missed or additional comments from the review session on to the TF 13 Proboards drawing site and to continue the important step of the online drawing review process
5. The entire amended Mission Statement of SubComm 2/Barriers as presented in TF13 fall meeting in Seattle, Washington is intended to be voted upon at the spring 2008 meeting.
6. Pathak wants a flow chart showing the Publications Maintenance SubComm responsibilities.

Monday, September 10, 2007

Co Chair **Pat Collins** welcomed the participants to sunny Seattle and expressed his appreciation to **Dick Albin** and his colleagues at Washington State, DOT for the arrangements, and to Gregg Frederick for assisting with meeting registration. He introduced Task Force Co-Chair **John Durkos**, **Mike Stenko** representing Transpo and **Art Dinitz**, chairman emeritus who was unable to attend. He also welcomed our TCRS members who will join us until their meeting begins with a joint session on Tuesday afternoon.

Collins noted a schedule change, will switch SubComm#5 to 2:15 and SubComm#8 to 1:00 in order to accommodate presentations by **Mac Ray** to both groups. The secretary notes that we ought to MAKE THIS A PERMANENT CHANGE.

Durkos discussed dinner plans, located across the street at the Palomino.

After a round of introductions, **Collins** thanked all participants for their interest in highway safety, and asked that the Minutes of the spring 2007 meeting in Jackson Hole, Wyoming, be approved. **Durkos** so moved and **Stenko** seconded. The minutes were approved by acclimation.

Task Force Secretary **Nick Artimovich** reviewed the Jackson Hole subcommittee minutes, apologizing if any members found them too long. If he had more time, he could make them shorter. The minutes of that meeting, indeed all Task Force meeting minutes of the 21st century may be found on the Task Force's web site at http://www.aashtotf13.org/News-Bulletins.asp

Collins outlined the TFs subcommittee breakdown as generally following our publications. Both Bridge Rail and Transitions, and the Drainage Hardware SubComms need state Co-chairs. SubComm #7 has been immensely successful, accomplishing standardization of many facets of crash test measurement and analysis.

Minutes of Subcommittee Meetings

SUBCOMM # 2 BARRIER HARDWARE

Co-Chairmen: **Will Longstreet** (PENNDOT) and **Bob Takach** (Trinity Highway Products LLC)

I. Review of Mission Statement:

First order of business was to review Mission Statement. It was suggested that mission statement be amended to mention membership use of electronic drawing review. The following proposed statement as follows: "To carry out a two-fold mission in promoting membership use of electronic drawing review and procurement of state of the art software updates." This amended verbiage to the existing Mission Statement was presented to the General Session only and not voted upon. The entire amended Mission Statement as presented in TF13 fall meeting in Seattle, Washington is intended to be voted upon at the spring 2008 meeting.

II. Review of Spring 2007 Minutes & ProBoard Registration:

Drawings **SGR24**a-**b, SGR25, SGR26a-b, SGR27a-b, SWM08 and SWM09** were first reviewed and comments recorded at spring meeting.

Will **Longstreet** briefly went over the comments and how they were resolved by the drawing owner. Will reviewed the registration process on Pro-boards to encourage member registration and member drawing review. During this review there were questions concerning online registration and some mentioned they were having problems getting a confirmation from the Pro-Boards after they had registered. Problem was noted by the **Longstreet** and **Takach** and will be investigated and resolved.

The following registration information was presented:
ProBoard registration as of September 5, 2007:
- TF13 Total registrations: 43
- Review Group Members: 12 (36% of members)

III. Voted to Move Drawings from "in progress" to "ready":

With all comments resolved it was time to vote to move the following drawings from "in progress" to "ready":

SGR24a-b, SGR25, SGR26a-b, SGR27a-b, SWM08 and SWM09

It was agreed by vote that drawings could be moved to "ready".

IV. First Review of New Batch of "In Progress" drawings:

Just prior to the fall 2007 meeting MwRSF requested drawing designators for 10 systems and 10 components. Due to time constraints all drawings could not reviewed during our meeting. The following pre-selected drawings were chosen to be reviewed and hard copies were passed out to the membership; **SET03, SGR28a-c, RTM07a-c, PTE06-07, PDB13a-f** and **PDE17a-c.**

Member comments are as follows for each drawing reviewed. It is the intent of both Subcommittee No2 co-chairs that each of the following comments will be placed onto the pro-board for commenting archive purposes. Subcommittee No2 encouraged the group to enter any missed or additional comments of this review session upon TF 13 Proboards drawing site and to continue the important step of the online drawing review process.

SET03, Thrie-Beam Bullnose End Terminal

1) Change drawing designator to SET03 from MBN01 on all sheets.
2) Show dual dimensions on sheets 5 & 6 and enlarge font size.
3) Show radius info on rails on sheet 1
4) Where does bullnose end, post 8 or 9? Add dimension between 8 & 9.
5) Remove inch (") hash marks on all sheets.
6) Maybe use a designator **SET03a-b** to differentiate between symmetrical and non symmetrical bullnose layouts.
7) Sheet 6, Note on lower layout mentions "post spacing across barrier" as measured perpendicular, perpendicular to what? Please clarify. Layouts are labeled as "FHWA Approved", change to "FHWA Accepted"
8) Sheet 3 of 6, Section A-A, should indicate 3-8, not 3-6? Fix metric height dimension for 31 5/8" to be same in all views. Remove hidden lines that cross upper portion of wood post on detail labeled "Post No.2".
9) Sheet 5 has layouts labeled as Design No 1, No 2 & No 3. Sheet 6 has layouts labeled as Design No 1 & No 2.. Are designs 1 & 2 the same on both sheets? They look different, please clarify.

10) Sheet 5, dimension for width indicates 10 meters for all three layouts, but each layout is labeled with widths of 4500 mm, 5807mm and 7283mm?Please clarify.

RTM07a-c, Slotted and Bent Thrie Beam Guardrail

1) Remove inch (“) hash marks on all sheets.
2) Sheet 1 of 4, clarify that 162.5 long is typical for all three details, fix callout on each detail that indicates RTM??a. Callout 10ga or 12ga as material thickness.
3) Sheet 3 of 4, under each detail the drawing indicates “Bend Radius No 1, Slot Pattern No 1” and “Bend Radius No 2, Slot Pattern No 2”. How does this relate to three details on sheet 1? Clarify the “a” & “b” callout, perhaps this should be RTMa & RTMb.
4) Length of slot dimensions on sheet 1 not real clear, measurement of slot length should be overall length of slot, not from center of radius to center of radius.

PTE06-07, MGS and Thrie Beam Foundation Tubes

1) Sheet 1, Remove inch (“) hash marks. Callout holes as through holes. Remove note below detail.
2) Sheet 2, Correct metric callout of tube thickness in paragraph under SPECIFICATIONS, make it equivalent to 3/16”.
3) Sheet 1, Is it necessary to have W, D & T as columns in table? These dimensions are same on PTE06 and on PTE07. Consider removing W,D & T from table and dimension on top view or use a callout on drawing front or side view as TS 8 x 6 x 3/16” and eliminate top view.

SGR28a-c, MGS for use with Round Posts

1) Sheet 1, Remove inch (“) hash marks. Move section A-A closer to splice since section view shows splice hardware. Remove 24 7/8” dimension and only use 31” height dimension. Verify block designations called out on Section A-A with built up blocks, should it be PDB13d, PDB13e and PDE13f?
2) Sheet 2, fix component list to reflect PDB13a-c & PDBd-f (built-up block). Also fix SYSTEM column callout for PDE17a-c.
3) Can plastic blocks be used?
4) Can Douglas Fir Posts be used with Ponderosa Pine or Southern Yellow Pine blocks? Can other post wood types be mixed with wood blocks that that do not match post wood types?

PDB13a-f, MGS Blockouts for use with Round Posts

1) Sheet 1, Remove inch (“) hash marks. Why callout “W” & “H” in table?

It is same for all blocks, just show dimensions right on drawing. Callout hole size. Avoid using dimensions like 6.0, 13.0, 4.125. This may insinuate significant digits should be held, fractional dimensions should be used. In table should last column read "Wood Block Type" rather than "Wood Post Type?

2) Sheet 2, Component list should show all six components PDB13a, b, c, d, e, & f. Under INTENDED USE remove ??? from post designators and use correct designators for posts. Correct system callout to SGR28a-c

PDE17a-c, Round Posts for MGS Guradrail System

1) Sheet 1, Remove inch (") hash marks. Why callout "L" table? Show 69 inch length on drawing view.
2) Sheet 3, Timber Spacers, should be changed to Timber Blockouts?

Due to time constraints of the meeting this is by no means a conclusive list of comments and corrections. **Takach** did his best to record every comment.

Per Standard Operating Procedure the review process should be done online. The appropriate Technical Review Group, see website link http://www.aashtotf13.org/Work-in-process.asp and the general membership should **continue** the review process via the Proboards discussion board site.
http://barrierguide.proboards31.com/

System and Component Drawings submitted by MwRSF that were not reviewed in Seattle are as listed below. These will also require Tech Group /General Membership review, via the discussion board drawing site.

(8) SYSTEMS
SGR29a-b, SGR30, SGR31, STC01, SWC09, SWC10, SWC11 AND SWC12

(6) COMPONENTS
FBB08-09, FMW02, FMW03, PDB12, PDB16 AND PDF04

Please review these drawings yourself and make additional comments as appropriate. **Artimovich** noted the following comments which, in some cases, may overlap the ones provided by the subcommittee, above. However, they are included to more fully document the discussion.

SET03 Thrie Beam Bullnose End Terminal. **Durkos** suggested English units be used along with metric on all sheets. Can our drawings include recommended "pay limits" for ease of specification? **Carl Ochoa** commented on bend radius #1 does not see a clear

connection – should reference details on last sheet. Last sheet should have a line of symmetry, if appropriate. Note 1 refers to 'perpendicular' distances but they are just straight line distances. Sheet 3/6 Section A-A should apply to posts 3-8. FHWA "Approval" ought to be "Accepted" and it is not redundant to mention that for any drawing. The five drawings on pages 5/6 and 6/6 are all different and should be numbered differently. Sheet 1 applies to those on 5/6, the validity of this fact was questioned as being unclear. **Heimbecker** noted that some nose pieces are 12 foot sections while others are 25. Sheet 3/6 ought to note that these numbered posts apply to all the thrie beam Bullnose layouts in the set. Other comments on dimensions were made.

RTM07a-c Slotted and Bent Thrie Beam Guardrail. Show a, b, or c for each item on sheet 1 of 4. Dimension of 162.5 inches applies to all 3 rails on 1 / 4. Spell out whether these are 10 or 12 ga. The manufacturing note regarding the manufacture of the slot is just how it was made for the test lab. If you can roll the radius after completing the slot, and without kinks, more power to you. Sheet 3 of 4 will need to include more dwgs to match those shown on SET03. Method of dimensioning the slots/tabs was questioned, and **Dean Sicking** pointed out that the length of the tabs is the critical element.

PTE06-07 MGS and Thrie Beam Foundation Tubes. Note should indicate holes are thru. Since dimensions W, D, and T are the same for both post lengths is there a need to include them in the table at the top of the page? Perhaps for consistency sake…

SGR28a-c MGS Guardrail System for use with Round Posts Dimension of 24 7/8 is unnecessary in addition to being too specific. Designations a, b, and c refer to different woods and only two of the three have the same radii. Ponderosa pine is softer and post is a larger diameter. Galvanized, double headed nails should be spelled out wherever the nails are used.

PDB13a-f MGS Blockout for MGS Round Post Applications Ok, is it "routed" or "routered" as spelled on a previous drawings? Is the nail critical and should it be replaced with a screw? **Sicking** indicated that bogie testing showed that rotation was not a problem, even so the nail should be satisfactory to keep the block in proper orientation. Real world observation is that wood/wood GR is not seen with rotation, and you only see rotated wood blockouts on steel posts. Dimensioning should be consistent from front to back of this sheet. What should wood dimensioning be S4S or rough cut? Blockout width tested was 6.0 inches, S4S would give you a 5.5 inch wide block. Proposed to drop W and H columns on page 1 of 2. Other dimension alterations were suggested. Should blockout heights be 14 or 14.25 inches?

PDE17a-c Round Wood Post for MGS Guardrail System. We specify diameter of the block's routing because the posts are specified by diameter. However this will be changed to reference the radius of routing. Should "Timber Spacers" on 3 of 4 be revised to blockout?

<u>SUBCOMM#1: PUBLICATIONS MAINTENANCE.</u> There are 5 guides that have been published by the task force:

Drainage
Luminaire Supports
Sign Supports
Bridgerail Guide
Barrier Guide.

As technology moves on, we find that what we have being developed may need to be converted to different programming languages and the costs of these conversions need to be considered in the planning and funding of the Task Force.

SUBCOMM #3 BRIDGE RAILINGS AND TRANSITIONS

Funding for **Ray**'s work comes from NCHRP 20-7 project. Is being revised to illustrate with drawings and photos, as well as incorporate search features. **Ray** used PPT for his update. Material for approx 130 railings has been received. Next step is to work on transitions. This document should be reviewed by members and any comments should be sent directly to **Ray.**

Ray asked if there was a way we could automate the approval of drawings on-line? How many votes do we need to move it forward? L**ongstreet** noted that their SubComm brings drawings that have been reviewed to the meetings for further discussion, motion to adopt, and vote by the membership. Decided to have a BridgeRail Review Committee and a Transition Review Committee. **Roger Bligh** will be the TechRep for railings.

Ray showed the current web site, and discussion ensued over the status of approval. New drawings will be posted with a notation that they are not approved [it was recommended that this be called "under review" and avoid a very negative term] and open for comments. Once comments have been resolved and dwg gets approved, it will be shown as an approved railing.

Would like to get this review process underway in time for the Spring meeting in Hershey. PLEASE SUBMIT ANY BR THAT ARE NOT YET IN THE GUIDE. ALSO SUBMIT TRANSITIONS. NEED A PIC, DRAWING, AND FHWA ACCEPTANCE REFERENCE. Additional state bridge rails are welcome, too. The web site is located at: http://civil-ws2.wpi.edu/Documents/Roadsafe/BridgeRailGuide/BridgeGuideNewSubmissions/index.php

SUBCOMM # 4 DRAINAGE HARDWARE

Had four attendees, **Chuck Patterson** of VDOT is the state co-chair. They discussed survey and the feedback they got from several states. States are willing to help but cannot attend meetings. Discussed SOP and continuing recruiting efforts. Also looking towards incorporating stormwater mgt people into the subcommittee. Seeking sources of funding.

Collins mentioned that he would try to get them a toehold in the AASHTO Subcomm on Drainage.

SUBCOMM #5 SIGN AND LUMINAIRE SUPPORTS

Co Chair **Fredrick** opened the subcommittee meeting and reviewed the minutes from the spring meeting.

Co Chair **Stenko** indicated that he had sent out the letter to those individuals that had indicated that they had not received the request for drawings, specifications, intended use, and contact information for components to be included in "A Guide to Small Sign Support Hardware." Co Chair **Stenko** introduced Dr. Malcolm **Ray** to give an update on the status of the update to "A Guide to Small Sign Support Hardware."

Dr. **Ray** noted that the draft pages can be seen at the following web address:

htpp://civil-ws2.wpi.edu/Documents/Roadsafe/SignGuide/Submitted/index.php.

Dr. **Ray** noted that the non-proprietary system drawings and specifications are complete, as are the non-proprietary component drawings and specifications, with the exception of the fasteners. Of the proprietary systems, Dr. **Ray** noted that Marion/Newcor, Tapco, Designovations, Safety Base, Ultimate, Dent Breakaway, and Transpo had submitted their information. Dr. **Ray** is currently working with Northwest Pipe to get their information into the system. Dr. **Ray** indicated that many of the manufacturers in the old guide had not been heard from. It was noted that several of these had changed names or are no longer in business. All totaled, over 40 systems and 50 components are complete. Dr. **Ray** encouraged the group to continue to submit the information to him at mhray@wpi.edu and he would provide instructions as to the submittal process.

Dr. **Ray** thought he had over 95% of the material and hoped that this project could be wrapped up by the 2008 Spring meeting. Dr. **Ray** noted that the next step is to begin the review process which would start the week following the meeting. He asked each of the manufacturers to review the web site, check their material, and submit comments, changes or omissions directly to him through the web page. This generates an email to him and those comments along with the resolution would be posted on the web as well. Once all of the comments are resolved, the information will be brought forward for approval.

Dr. **Ray** indicated that he checks the font sizes, styles, weights, arrow heads etc and if they meet the style guide, he passes the drawing along to the gate keepers. For this project, Co Chairs **Fredrick and Stenko** will serve in this role. Once they receive an email from Dr. **Ray**, they will pass the drawings along to a group of technical reviewers. The group discussed the breakout of the guide and agreed that the material would be categorized as frangible posts, slip bases, and frangible bases. In order to be complete by the 2008 Spring meeting, all of the technical reviewers comments will need to be received by the beginning of February 2008. Co Chair **Stenko** asked for volunteers to complete the technical review of the documents in each of these categories. Ideally, the more reviewers, the better, but a minimum of two to three in each would be desirable.

Fasteners were not included as we are looking at the system rather than the components, and many of these are non proprietary and already covered. **Stenko** thanked **Matt Leahy** (mleahy@x-sqrd.com) for volunteering to review slip bases, Frazzetta (jfrazzetta@x-sqrd.com) for reviewing the frangible posts, and **Anderson** (jim@designovations.com) for serving on the frangible base review group.

It was suggested that we refrain from completing an individual document review in the main meeting, but have the technical reviewers present the drawings in the subcommittee meeting for discussion and make one motion in the main meeting to accept the drawings. This will be pursued.

There was some discussion to include sign size and wind loaded area. This was also discussed at the Spring meeting, and the resolution at this meeting was that the Guide is illustrating an approved breakaway or crashworthy device and not identifying the structural adequacy of the support. There was more discussion regarding the modification of approved devices. This is not allowed unless crash testing with the revised configuration is completed. Finally, it was mentioned that the soil parameters and embedment depth affect the crash worthiness characteristics. The FHWA is beginning to add soil characteristics used in the crash test as part of the approval letter for guardrails. **Artimovich** will ensure that this language is included in the approval letters of small sign supports and is consistent between the approval letters. The group agreed that it would be good to add a disclaimer to each page noting that post embedment, and site specific design parameters should be referred to the manufacturer. They agreed that a link to the manufacturer's web site would be beneficial in addressing this concern for the proprietary hardware.

Co Chair **Fredrick** noted that the Wyoming Department of Transportation had received five very good proposals to update "A Guide to Standardized Highway Lighting Pole Hardware." He indicated that the agreement had been executed and introduced Dr. Mac **Ray** as the contractor selected to complete this work. Dr. **Ray** indicated that the update would follow much of the same process as that to update "A Guide to Small Sign Support Hardware." He would begin with a mock web page, determine the searchable criteria, what we want in the Guide, and where we are getting the hardware. He noted that much of the content has already been shown to the group and looks forward to working on this project.

The subcommittee meeting was adjourned.

SUBCOMM # 6 WORK ZONE TRAFFIC CONTROL DEVICES

1. Call to Order: Meeting called to order by co-chairs **Barry Stephens** and **Paul Fossier** at 1 pm.

2. 21 persons attended. Committee Minutes from the May 21, 2007 spring meeting in Jackson Hole was distributed and approved.

3. Mission Statement for committee was reviewed.

4. Old Business:

a. Plastic Water-Filled Longitudinal Channelizer warning label guideline has been completed by the committee. Copy of guideline has been submitted to Jim Kalchbrener with the Temporary Traffic Control Committee for ATSSA. ATSSA has not completed the review of this document and it is anticipated this may not take place for some time. Thus, the committee considers the warning label complete at this time until further ATSSA input is received.

b. **Stephens** discussed that the committee had previously approved the use of "Longitudinal Channelizing Devices" instead of "Longitudinal Channelizing Barricades" at the May Meeting. However **Dean Sicking** commented that MUTCD still currently uses the term barricades and not devices. ATSSA is still reviewing this issue along with the warning label guideline.

5. New Business:

a. Vertical panels or temporary lane separators are currently not listed by MUTCD as a category 1 device (no attachments such as flashing lights). It appears that it will go to ballot by MUTCD next year.

b. Discussion on maintenance and end of service life for temporary concrete barriers. Very few State DOT's have any policies concerning this issue and when they should be repaired or taken out of service. It was stated that three current policies are existing in Canada, the Virginia DOT, and with Barrier Systems, Inc. (**Owen Denman**). A new action item for the committee is to obtain copies of these policies in order to initiate a possible TF 13 guide to set the criteria on how to maintain these devices.

c. A similar topic was also discussed concerning the maintenance of other work zone devices such as cones, barrels, channelizers, etc such as fading of safety colors or physical defects to these devices. An action item for next meeting was initiated to develop a format to determine how a user or owner will perform corrections for deficiencies due to operational use. It was suggested that any rules developed could be showcased on the TF 13 website and used on a voluntary basis.

d. Discussion on TMA's and if any standardization could take place on attachment hardware for the devices. It was determined this was not a area for standardization.

6. Action Items:

a. Develop guideline for temporary concrete barrier maintenance. Obtain existing policies from Canada, Virginia DOT and Barrier Systems.

b. Develop guideline for other workzone hardware maintenance (cones, barrels, etc.).

7. Adjourn: Meeting adjourned at 2 pm.

With **Paul Fossier** stepping down as co-chair, **Will Longstreet** gracefully volunteered to act as co-chair until someone else steps up to the plate. So, for now, we're covered.

SUBCOMM#7 CERTIFICATION OF TEST FACILITIES

The results from the last interlaboratory comparison (ILC) exercise were discussed. Labs processed test data sets and the results were tabulated. The seven domestic labs participating provided answers that were consistent and tightly grouped. This exercise will continue at least twice a year to satisfy the ISO17025 ILC requirements.

Nick **Artimovich** gave an update of the FHWA progress in requiring all to be accredited to ISO 17025. If things go as planned, the proposed rule will be approved in a month or two and at that point labs will have 2 years to attain accreditation. If all goes as planned, the requirement will go into effect in late 2009. After that time, FHWA will only accept test reports from accredited labs. [Secretary's note: The FHWA Laboratory Accreditation Final Rule was published in the Federal Register on Monday, September 25:

http://a257.g.akamaitech.net/7/257/2422/01jan20071800/edocket.access.gpo.gov/2007/pdf/E7-18725.pdf

The group discussed the issues and challenges that labs are experiencing in trying to get the new crash test vehicle (2270P truck) to the proposed CG height requirement of a minimum 28". It looks like the trucks will need to have the largest optional tire set installed and/or the optional larger rims to get to the height. There was further discussion as to the possibility of collecting enough data to eliminate the need to test the CG of every vehicle. A reference point and measurement procedure will need to be agreed upon ASAP so that each vehicle that is now being verified at the correct CG will also have this reference measurement. Perhaps a measurement between the bottom on the differential and the ground plane. A go-no go tool could then be used to establish an acceptable height.

The group then discussed issues surrounding the mounting of accelerometers and rate gyros. The group was polled and it seemed that further study and experimentation with mounting could be beneficial to the group, but was not a cause for immediate action.

(Above notes submitted by **Shewmaker)**

SUBCOMM #8 RAIL HIGHWAY CROSSINGS

Co-Chairs

Mike Hare	mhare2000@yahoo.com	Qwick Kurb
Mike Ayton	mark.ayton@ontario.ca	Ontario Ministry of Transportation

Stenko proposed that we revitalize the committee by challenging it with the task of achieving a goal. The goal that was originally proposed was modified to the following:

Start dialog with specific FRA and State DOT personnel to affect change of current practices for highway safety hardware and roadway designs at RR grade crossing.

Specific highway safety items at RR Grade Crossings that have the opportunity to be standardized are:

- Hardware Items
  - Signals, Cross Arms
  - Guardrail & End Treatment
  - Cross Bucks & Sign supports
- RR Grade surfaces
  - Pavement / Elevation & surface material
  - Canalization
- Design
  - ADA & Pedestrian
  - Guardrail Placement
  - Clear Zone as it relates to RR property

Mike Stenko and **Mike Hare** will contact a limited number of State DOT Grade Crossing personnel and ask their opinion on best how to achieve our goal. Contacts will be queried for any statistical data sources for vehicle crashes with RR Grade Hardware.

The Email Contact List needs to be updated. **Rick Mauer** will ask the old Chair, Dean Alberson, if TTI will send out the mass emailing.

The next meeting will be at the Spring Taskforce meeting in Hershey, May 5 and6, 2008.

Attendees:

Rick Mauer	RMauer@NSMarion.com	Nucor Steel Marion Inc
Mike Stenko	mstenko@transpo.com	Transpo Industry
Mike Hare	mhare2000@yahoo.com	Qwick Kurb
Mark Ayton	mark.ayton@ontario.ca	Ontario Ministry of Transportation

There was no activity to report in the Marketing and New Standardization areas.

Executive Board Meeting.

Present were Collins, Durkos, Longstreet, Takach, Ray, Paul, Bligh, Cota, Shewmaker, Stenko, Stephens, Artar, Frederick, Fossier, Hare, Heimbacher, Kessler, Pathak, Albin, Artimovich

Co-Chairs. **Fossier** has been appointed Assistant Bridge Engineer for Louisiana, and now is a member of AASHTO TCRS, now must move along and recommends that **Kurt Brauner** of LA DOTD join TF 13 on the Bridge Railing committee as Co-Chair. There are currently no other state people on WZ Subcommittee #6 so the position will remain vacant. Rail Highway Crossing hardware co-chairs are **Mark Ayton** and **Mike Hare**

New Standardization – it was recommended that we drop this as a Special Subcommittee and handle this task under the executive committee. A suggestion was made that a new subcommittee be established to consider connections to top of existing barriers for features such as signs, lights, noise walls, glare screens, etc. Should they be solid or breakaway? **Collins** feels there is enough on our plate for now.

Durkos discussed funding of our web site which was the subject of a dinner meeting on Sunday evening. We have learned a lot from the Barrier Hardware and BR/Transitions documents. Decisions we made on Barrier Hardware guide may mean that there will be a transition cost to convert the document to be compatible with TTI site if TTI is the ultimate home of our website.

Bligh: Hosting web site at TTI is slightly more expensive than outside sources, ie $20 per month for the space the TF needs. TF 13 (Publications SubComm) could be given access to TTI site using HTML editor at no cost, other methods could be more user friendly at greater expense ($6000 to $7000).

The Task Force could create and maintain a SharePoint site to replace ProBoards. The estimated cost of this service is $300 per year. May be getting away from ProBoards method and instead post the new page in the manual for soliciting comments. This will be tried using BR&T guide.

Publication hosting: TTI does not use the MYSQL open source database which is what the current versions are written in, rather they use Oracle instead. The conversion cost would be a week's worth of work. **Ray** will look into possibility of converting to Oracle at their end before contract is over. This should be at a minimal cost to TTI.

Maintenance of publications by TTI: This should cost on the order of $100+ per document. Will be cost for adding search capability as we come to use these documents and learn what we need.

Heimbacher was responsible for putting the question before us which was of great value. His proposal last year included gatekeeper, continued support, hosting service, etc. He reevaluated what we need and estimates a few thousand dollars would be needed and it could be hosted by VDOT, TTI, commercial server, etc. Agreed **Bligh** did a good job summarizing the needs.

If we continue to keep our publications on separate websites and use volunteer help [that is variable] Pre HypertextProcessor (PHP) may be more complex and we need to use a commercial webmaster.

Discussion ensued over how changes could be made by the Task Force, either "live" changes by authorized TF members or by the hosting webmaster as requested by TF.

Durkos: What are the top decisions we need to make to move forward:

1] Where will it be hosted? **Ray** believes access is most important, not location. **Kessler** thinks VDOT or TTI will have same problems with access. A commercial server like GoDaddy gives us our own access. **Bligh** notes that TF can be granted access.
We have no formal agreement with VDOT for hosting the TF site, so we need to move it.

2] Do we need to change the site format or stick with HTML?

3] What are the deliverables? What will be the cost?

Ray noted that they went to ProBoards because WPI would not allow comment and discussion venue on their server.

Durkos asked **Bligh** to summarize the info he got from TTI on questions of cost and access for database table management. **Kessler** was asked to develop a list of questions and concerns that we have for the continuation of our website.

Future Meeting sites: **Keith Cota**: said that TCRS will meet in the Fall of 2008 in Savannah, Georgia, and New England or New York in 2009. Spring 2008 Will **Longstreet** has set up Hershey PA.

Traditionally the spring meeting was Th. and Fr. For 2008 tentatively set up for Monday and Tuesday due to availability in Hershey. May 5 and 6th. We will sign contracts. Discussed dinner options. Costs range from $55 to $65.

We are still looking for a site for our Spring 2009 meeting. TTI or MWRSF have offered in the past, but we will entertain suggestions for other host cities.

Action items.

By middle of October with responses on computer questions.

To Do list from May 2007 meeting

Publications sold by AASHTO **Gregg Frederick** has list. Roughly $3000 per year.

FHWA will add 350 or 350 Update info to FHWA's website.

Can pooled fund states contribute to TF 13 publications?

Pathak wants a flow chart showing the Publications Maintenance SubComm responsibilities.

Tuesday, September 11, 2007

Durkos thanked **Cota** for allowing TF-13 to meet in conjunction with TCRS. **Durkos** noted that it has been 6 years to the day from the terrorist attacks on September 11 and asked for a moment of silence.

Monday's dinner venue got rave reviews, especially the lobster ravioli.

Brauner of LA DOT will take over from **Fossier**, but will take Mark Bloschock's position as co chair for Bridgerails. Co chair for WZ subcommittee is still needed. **Durkos** expressed our thanks to all subcommittee co chairs, and to the Washington State DOT people, especially **Dick Albin**, for putting together an excellent meeting.

Chuck Niessner, Update on Relevant NCHRP Projects

For the status of these projects please visit the NCHRP web site at:

http://www.trb.org/CRP/NCHRP/NCHRPProjects.asp

List of projects: see handouts for status.
12 full NCHRP projects in the roadside area plus 3 20-7 projects (b rail and small sign supp)

16-04 Just about complete. Draft final report in next few weeks.
17-22 Incorporated data from earlier projects.
17-43 Continuation of 17-22 RFP pending the completion of 17-22. Should be released in next few months.
20-7 (210) Final report available. Alberson's cable barrier report raised more questions than it answered as it was a state of the art review.
22-12(02) guardrail warrants. Preparing draft final report.
22-14(02) 350 update final report has been delivered. Will become an AASHTO publication. Balloting should begin end of this week by TCRS.
22-14(03) To evaluate additional non proprietary products. Want to ensure current devices meet criteria. Interim report being prepared of list of devices to be crash tested.
22-20 Barriers on MSE walls. Deciding on full scale truck test.
22-21 Rural median design. Placement of barriers in the median. Doug Harwood at Midwest Research)
22-22 Placement of barriers on slopes. Bligh of TTI. Close coordination with 22-21
22-23 Restoration of longitudinal barriers. Clay Gabler of VTI. Guidelines for when a rail needs to be repaired, now looking at crash testing.
22-24 Verification and Validation for FEM.
22-25 New Project, continuation of the related 22-7 project. Guidelines for selection, use, and maint of cable barriers.

All NCHRP Projects are up on the web and available for review/status.

Mentioned FHWA effort to update the guide on guardrail maintenance for local agencies, will be available in the near future. **Artimovich** noted this would be publicized to all TF13 members with ordering information.

Durkos gave AASHTO Update info that we received from **McDonnell**.

Discussed AASHTO terminology for titles of their documents. The rewrite of 350 is currently being referred to as a "Manual." This draft 350 update is still in revision status, but balloting by TCRS will be done this week. Then goes to SubCommittee On Design then Standing Committee on Highways.

Durkos then went through the tenants of the FHWA/AASHTO Implementation Plan.

Below is the DRAFT FHWA \ AASHTO IMPLEMENTATION PLAN as approved by the TCRS. This plan will now be voted on by the AASHTO Subcommittee on design.

Draft AASHTO/FHWA Joint Implementation Plan for the AASHTO Manual for Assessing Safety Hardware, 2008

Background

NCHRP Report 350: Recommended Procedures for the Safety Performance Evaluation of Highway Features contains the existing guidelines for evaluating the safety performance of highway features, such as longitudinal barriers, terminals, crash cushions, work zone elements, and breakaway structures. This document was published in 1993 and was formally adopted as the national standard by the Federal Highway Administration (FHWA) later that year with an implementation date of late 1998.

The American Association of State Highway and Transportation Officials (AASHTO) created a Task Force on NCHRP 350 Implementation and in July 1998, AASHTO and FHWA agreed that most types of safety features installed along the National Highway System must meet the safety-performance evaluation criteria contained in *NCHRP Report 350*. One outcome of these task force efforts was the recommendation that AASHTO play a stronger role in the future development, approval, and maintenance of the evaluation procedures. The process of accepting hardware under NCHRP Report 350 on the National Highway System has been undertaken by FHWA. AASHTO, through its Technical Committee on Roadside Safety, has undertaken the role of establishing and updating the evaluation criteria.

The draft AASHTO *Manual for Assessing Safety hardware, 2008* (*MASH 2008*) has been developed under NCHRP Project 22-14(02), "Improvement of Procedures for the Safety-Performance Evaluation of Roadside Features." *MASH 2008* contains revised criteria for safety-performance evaluation of virtually all highway safety features, based primarily on changes in the vehicle fleet, and will replace *NCHRP Report 350*.

Requirements in Section 1408 of SAFETEA-LU state that "The Secretary, in cooperation with the Association [i.e., AASHTO], shall publish updated guidance regarding the conditions under which States, when choosing to improve or replace highway features on the National Highway System, should improve or replace such features…".

Implementation Plan

Implementation of the *MASH 2008* on the National Highway System will be as follows:

- The AASHTO Technical Committee on Roadside Safety is responsible for developing and maintaining the evaluation criteria as adopted by AASHTO. FHWA shall continue its role in the review and acceptance of highway safety hardware.

- All highway safety hardware accepted prior to adoption of *MASH 2008* using criteria contained in *NCHRP Report 350* may remain in place and may continue to be manufactured and installed.

- Upon adoption of *MASH 2008* by AASHTO, any new highway safety hardware not previously evaluated shall utilize *MASH 2008* for evaluation and testing.

- Any new or revised highway safety hardware under development at the time the *MASH 2008* is adopted may continue to be tested using the criteria in *NCHRP Report 350*. However, FHWA will not issue acceptance letters for new or revised highway safety hardware tested using *NCHRP Report 350* criteria after January 1, 2010.

- Highway safety hardware installed on new construction and reconstruction projects shall be those accepted under *NCHRP Report 350* or *MASH 2008.*

- Agencies are encouraged to upgrade existing highway safety hardware that has not been accepted under *NCHRP Report 350* or *MASH 2008:*
    - during reconstruction projects,
    - during 3R projects, or
    - when the system is damaged beyond repair.

- Highway safety hardware not accepted under *NCHRP Report 350* or *MASH 2008* with no suitable alternatives available may remain in place and may continue to be installed.

Gregg Frederick gave us an update on the AASHTO Subcommittee on Bridges and Structures which most recently met in Delaware:

Technical Committee T-7 on Bridgerails. He showed a mock up of our on line publication. Also told them what TCRS does and the proposed FHWA AASHTO implementation plan. Was well received, and he was asked to present this to the full subcommittee. They had some concerns over the implementation plan, especially the 32 inch high NJ parapet with respect to the TL-4. It is questionable as to whether it will pass under the revised Single Unit Truck. Crash test of this revised truck into 32 inch NJ is needed. Subsequent to this meeting it was decided to conduct this test under NCHRP Project 22-14(3)

Minneapolis bridge collapse. Was it due to fatigue cracks? Construction Loads? This is still under investigation. What is the condition of bridges nationwide? Are they constructed safely? Are they being maintained adequately? **Frederick** outlined the history of National Bridge Inspection Program.

A trucker in Wyoming conducted a full scale inadvertent crash test on August 31, 2007. Dragnet truck arrestor system was in place in the arrestor bed. Downhill has canyon on one side, rock wall on other. Dragnet system of 8 nets placed on canyon side. Tanker

truck lost control at 40 mph and entered system. Engaged five nets a distance of 330 feet. Driver backed the truck out of the system.

ATSSA update by **Durkos** with **Donna Clark's** presentation. Guardrail Committee is focusing on Membership recruitment, webinars, Reauthorization, the annual meeting in New Orleans in 2008, and Training. Events include:

ATSSA ADA show and tell in Hanover, MD.
Work Zone Awareness Week
Poster contest, work zone memorial, scholarship contest
MidYear meeting in conjunction with legislative fly in Sept 24-27 2008.
WZ safety grant. $11.9 million.
ATSSA Vision: Towards Zero Deaths. Will be submitted to Capitol Hill as part of reauthorization. Aim to grow funding for highway safety efforts.

Durkos noted that Dr. **Dean Sicking** was a recipient of the National Medal of Technology. For info on that medal and the presentation at the White House see http://www.technology.gov/medal/

New and Old business. Spring Meeting May 5 and 6, 2008, in Hershey PA thanks to **Will Longstreet**. Fall in Savannah, Georgia, with TCRS.

Executive Board Meeting:
Long discussion on publication funding and website hosting. See the ExecBoard minutes above.

Technical Presentations:

William Williams: Texas Transportation Institute. Overview of Recent Design and Testing of TxDOT Bridge Railings

Carl Ochoa, Vista Engineering. Guardrail System Critical Impact Points.

Ochoa's background includes analysis methodology development, testing theory, and barrier hardware. He developed the GMS Guardrail system. Selection of CIP (critical impact point) is important for "worst case scenario" testing. LS-DYNA may be quite costly and thus impractical to use for CIP selection (see 350 Update 2.3.1), while Barrier VII may rely on unconventional physics adjustment "friction factors" to tune answers. CIP is a very narrow window, since once the vehicle passes the corresponding narrow CP (critical point: splice or post) it is exiting the system and is thus no longer bearing down on the rail in the same way. "Maybe Guardrails know much more about what they are doing than we do?" Ochoa believes that his proprietary analysis method is far more simple to use, yet does a better job of ensuring the real CIP is selected. Ochoa also believes that mid-span splice guardrails may require separate CIP's- one to test the post and another to test the splice (per 350 guidance).

Brian Stock Easi Set Industries. (License JJ hooks precast concrete barrier system.) Use of precast transition segments eliminates need for nesting barrier segments. Pin and loop end is 22.5 inches wide at the base and 8 inches at the top to a NJ JJ Hook that is 24 inches at the bottom and 6 inches wide at the top.

Dan Hubble Structures of Ironwood. All use of CorTen (A-588) steel is suspect wherever moisture or environment promotes corrosion. NH and USFS study showed significant section loss. NYS evaluation resulted in discontinuation of CorTen. Ironwood product uses larch backed up with galvanized c-channel. Is a weak post system with round fascia wood post.

Chad Heimbecker representing Nucor Marion steel. GET PPT from Chad.
Cablebarrier system tested to TL-4. 20 foot post spacing. 4 ppf u-channel. 7.5 foot deflection of 110 meter installation. Validated with small car, too. 15,25,33 inch cable heights. 4.6 foot deflection.
W-beam 27 inch height with plastic block. (14" tall, 8" deep) 3 ft 9 inch deflection with 2000P.
W-beam 31 inch height with OUT block. Small car on double faced median barrier version and 2270 P test passed. 3 foot 5 inch deflection with truck. All posts are SP80 5 PPF u-channel posts.

Dick Albin Washington State Low Tension Cable Barrier Connections. Survey shows that more TF13 attendees graduated from University of Wyoming than University of Washington. Focused his discussion on the wedge type connection inside the cable compensator. Washington State DOT has seen cables pulling out of the wedge in the spring compensator. Are there better connections? What is the proper installation of wedge connections? Is this pullout issue a problem with high tension cable as well? Is there a need to improve the standardized hardware? Later **Sicking** noted that under 350 Update a splice must be included in the CIP.

Dean Sicking MWRSF

Three projects at Lincoln. TL-5 median barrier 42 inch height to peak. Nearly vertical sides with pointed top. Wished to reduce head impacts on barriers with vertical faces. Dowel into aggregate base, place steel case then slipform the concrete barrier. Asphalt overlay 3 inches on each side .

Anchor for temporary concrete barrier. Got 2 meter of deflection but barrier kept truck from rolling over.

Short radius guardrail. Thriebeam, slotted, pick up deflected nose but truck backed completely over once the rear wheel went over the rail. Would have passed TL-2 "no question." MWRSF pooled fund is probably going to pull funding for any further work on this design. Albin: their pooled fund effort is working on a TL-2 at TTI.

Tuesday Afternoon Joint Session with TCRS.

Ken Opiela FHWA NCAC Research Efforts to Improve Roadside Safety

W Beam Guardrail Height
W Beam Guardrail Height on low shoulders
Cable Median Barrier studies

350 Update – May have 2270 truck model completed by our next meeting in Hershey. Modeling impact of SUT with the NJ barrier.

Albin introduced **Roger Caddell** and Washington State Roadside Features Inventory Program. After FHWA's 1994 guardrail policy memo WSDOT realized they did not have a handle on how much hardware they had or where it was. Developed the subject inventory program. Data collection began about a year ago. **Jason Stambaugh** is the data steward responsible for data quality. Impressive display of data collection and review capabilities.

Ken Opiela on FHWA Digital Highway Measurement (DHM) System (Roadside Applications.)
Get Ken's table of 17 separate functions.

Joint Session with TCRS and TF-13

Durkos: Do any of your states have inventory systems?
Walker: Pavement mgt system does not collect slope, cross slopes, or superelevation info.
Albin: WSDOT system is for roadside. **Opiela** said the FHWA system can collect these data.

Greg Schertz: FHWA has been working with USFS and NPS. Began an inventory of all roadside barriers in national parks, condition, upgrading priorities, historical or cultural significance of barrier. Safety priorities will be weighed against historical significance.

Albin: project to replace wood rail placed by CCC in Deception Pass. Met the park owner's needs for aesthetic and passed TTI crash testing.

Durkos recalled Georgia's project some years ago to inventory all their crash cushions. Also noted EASI's hardware that reported crash cushion impacts to the owner.

Albin: Washington tried some of those in Seattle but got a lot of false positives due to vibration. Attenuators in the urban area may not have been the best scenario.

Jeff Smith looked into similar hardware for their products but found too many pitfalls to make it practical.

Durkos: From an inventory perspective, a manufacturer does not know where their products are installed by the contractor so they only learn of problems when notified.

Takach: Agree we don't know where units are. Push on in-service performance evaluation has gone nowhere, but the Washington State inventory system provides a means for knowing where hardware was.

Smith: Early on the contractors wanted his help in conducting repairs on their products Now the contractors know what to do, and the manufacturers don't know how they are performing.

Durkos. In service performance evaluation was a hot topic in the 350 update, but since manufacturers and DOTs don't have quick access to crash data there was opposition to making ISPE mandatory.

Matt Shorb, a contractor from VA: State tells us what's been hit to go out to fix it. They get fax or email from inspector on the job and they go out to fix. He gave the state's inspectors digital cameras and GPS units so they know exactly where it is and what its condition was after impact.

Durkos: I don't believe that most repair contracts have that level of sophistication for identifying repair locations.

Julian: SC now has a detailed database of cable median barrier hits. States with contract maintenance, like Virginia, have an easier time recording this info. Several states review fatal accident locations but do not publicize this information. They keep the info for liability purposes to defend themselves when there is a lawsuit down the road.

Richard Butler from Brifen. The info they receive on impacts is spotty.

Dave Little. Iowa knows how much damage is done and how much is repaired because they go after the insurance company. In Iowa it goes back to a statewide maintenance fund.

Smith: Neither this maintenance info nor money get back to the state dot in most cases. The design people who need this info do not get it from maintenance because it is not organized well enough.

Durkos: Was Washington's inventory reporting system generated because of SafetyLU?

Albin, No, we began this in the 1990s when the FHWA requirement came out.

Julian: 8 states are HSIS states with roadway inventory data and traffic data that can be linked to crashes. WA, CA, IL, CO, UT, NC, ME, MI. See http://www.hsisinfo.org

Mary McDonough: FHWA has 5 working groups looking at reauthorization. One on rural roads, one on data among others. It is real frustrating to focus money on safety problems because we do not have reliable crash data.

Durkos: Ohio focused on WZ data. Had an agreement with emergency response groups and got daily input on crashes within the duration of the project. Made changes to WZ traffic control based on these crashes that had a positive effect on safety. Contractors and DOT personnel had to physically travel to police to get info.

Sicking: Info is continually being collected, but need to make the effort to build the databases so they can be linked, and someone interested enough to query the system to look for the problems.

Albin: All his maintenance regions have different ways of reporting repairs. Hopes that this will eventually be organized so that this info will be on the WSDOT inventory program.

McDonough: Another reauth group is Performance Incentives. Please send her suggestions for including incentives in the next highway act. [Secretary's note, you may send these suggestions to me at nick.artimovich@dot.gov]

Julian: Requirements for crash reporting is very minimal in Georgia. State police only fill out about 10 percent. Locals just don't have the incentive to send in report.

Durkos: 4 scenarios for crashes:
Reported and repaired
Repaired, but no report.
Reported but NOT repaired.
Neither reported nor repaired.

Durkos: Tennessee cameras filmed crash cushion hits where there were no injuries and car backed up and drove away. Performance like that is what we all hope to see from our safety hardware.

Alberson would like to hear from states about their needs in this area. How do we overcome the problems?

Montana: FHWA and NHTSA have been encouraging traffic records assessment. MT did one 3 years ago. Got a "B" on the highway aspects, but got bad grades on police and EMS. So Montana will have to bring up those bad grades in the other areas before they can expect more improvements to the highway inventory data systems.

Albin: A state needs a champion or a critical mass of needs to convince those in charge to fund such a program as being cost effective. Highway Safety Issues group was behind WSDOTs current inventory successes.

Cota: Have been working for 12 years with the various police agencies in NH to get a common crash form. They have a digital highway system but do not know where the hardware is. NH does not have enough $$$ to fulfill safety needs to go beyond that to inventories.

Meza: Texas has been working on a traffic and inventory data system for years.

Durkos. WS State noted that they were told that their highway inventory system would fail unless it could be maintained. Also said he programmed Google to tell him when there were new articles on "guardrail" most of which are crashes.

Ayton: We've been talking about state routes, what about local jurisdictions? No hope there.

Durkos: Any final wants or needs?

Cota: Even tho we struggle with data, we have made a lot of progress in ten years. Hopefully ten years from now we will be much improved.

Little: The benefits of these inventories are not worth the costs. It is a huge investment to build inventory systems. Unless we have a good idea of what we need and that it will be cost effective, we should spend that time and money repairing guardrail and painting lines.

Albin: Once the structure is in place, the collection of the data is very easy. Mentioned catch basin cleaning, sign inventories.

Brian Stock: Showed USA today article that 11 percent of fatalities are motorcyclists.

Durkos: That is recognized now and some $ is heading towards that aspect.

Cota: TCRS meeting will be here registration begins at 7:30.

The Task Force 13 meeting adjourned at approximately 4:00 pm.

Roster of Task Force 13 Subcommittee Co-Chairs:

#1 Publication Maintenance - Divyang Pathak (PA DOT), Steve Kessler (GSI Highway)

#2 Barrier Hardware - William Longstreet (PA DOT), Bob Takach (Trinity)

#3 Bridge Railing & Transition Hardware - Kurt Brauner (LA DOT), Roger Bligh (TTI)

#4 Drainage Hardware - Chuck Patterson (VA DOT), Nathan Paul (ABT, Inc.)

#5 Sign, Luminaire & Traffic Signal Support Hardware - Gregg Fredrick (WY DOT), Mike Stenko (Transpo)

#6 Work Zone Hardware - William Longstreet (PA DOT) / temporary, Barry Stephens (Energy Absorption Systems)

#7 Certification of Test Facilities - Jeff Shewmaker (Safe Technologies, Inc.), John LaTurner (E-TECH Testing Services)

#8 Rail Highway Crossing Hardware - Mark Ayton (Ontario Ministry of Transportation), Michael Hare (Qwik Kurb, Inc.)

Special Subcommittee - Marketing - Andy Artar (Gregory Industries)

TF13 Officers - Pat Collins (Wyoming DOT), John Durkos (Road Systems, Inc.)
TF13 Secretary - Nick Artimovich (FHWA)
TF13 Chairman Emeritus, Arthur Dinitz (Transpo)

Supplemental information subsequent to the meeting that may be of interest to members:

New publications at the AASHTO bookstore:
https://bookstore.transportation.org

1.) Asset Management Data Collection Guide, AASHTO-AGC-ARTBA Task Force 45 Document

This Asset Management Data Collection Guide contains information on several highway right-of-way assets including pavements, bridges, culverts, guardrails, and drainage structures. This guide describes the functional characteristics of each asset type, the data that are usually collected about the asset, general data collection methods, equipment and/or technology that is employed to acquire the data, the formats and standards applied to data transfer and storage, and how the information is used for condition assessment, and suggests performance and condition standards.

Search item code TF45-1 at the AASHTO Bookstore, https://bookstore.transportation.org

2.) Highway Drainage Guidelines

The Highway Drainage Guidelines provides a consolidated overview of highway hydraulic design and discusses possible hydrology problems.

Search item code HDG-4-M at the AASHTO Bookstore, https://bookstore.transportation.org