AASHTO TECHNICAL COMMITTEE ON HYDROLOGY AND HYDRAULICS
SPRING 2008 MEETING MINUTES
April 8-10, 2008
Hanover, Maryland

AGENDA

Meeting Objectives: Review manual revision progress. Correlate work progress and needs with the team. Review research’s progress and other assignments. Communicate, share, inform.

Tuesday, April 8, 2008

8:00 Michael Fazio – Call committee meeting to order – Introductions and housekeeping

8:15 Welcome – Karuna Pujara

8:30 Jorge Pagan – FHWA Update

9:00 Meet with TCED

10:00 Break

11:00 David Reynaud – NCHRP Updates

11:30 Chapter review: General – discussion on combining chapter or renaming chapters, i.e. riverine engineering, urban drainage

12:00 Lunch

13:00 Review chapter 11, Energy L1 – Richard Phillips (Group 1)

Review chapter 12, Storage L1 – Merril Dougherty (Group 2)

14:00 Review chapter 19, Construction L1 – Matt O’Connor (Group 1)

Review chapter 20, Maintenance L1 – David Henderson (Group 2)

15:00 Break

15:15 Review Chapter 13 Strom Drains L1 – Bill Bailey (Group 1)

Review Chapter 1, Introduction – all

17:00 Break – Dinner

Notes:
Wednesday, April 9, 2008

8:00  Michael Fazio – Call committee meeting to order – review agenda

8:15  Part 2 review General Discussion

8:30  Field trip: Visit the Woodrow Wilson Bridge

9:00

10:00 Board boat

10:15

11:00  Back at the dock - Travel to Turner-Fairbanks lab

12:00  Turner Fairbanks Lab – Lunch/presentation

12:45  Lab tour and workshop – Kornel Kerenyi

14:30  Board bus – AASHTO Presentation – Kelley Rehm

15:30  Chapter review: General – discussion on combining chapter or renaming chapters, i.e. riverine engineering, urban drainage, storm drainage

16:00  Review chapter 8, Channel L2 – Brooks Booher (Group 1)
       Review chapter 9, Culverts L2 – Tee Ngo (Group 2)

16:45  Break

17:00  Review chapter 10, Bridges L2 – Roy Mills (Group 1)
       Review chapter 11, Energy L2 – Richard Phillips (Group 2)

18:00

17:45  Break – Dinner at 18:30 at....

Notes:
Thursday, April 10, 2008

8:00  Michael Fazio – Call committee meeting to order

8:15  Chapter Review General

8:30  Review Chapter 12, Storage L2 – Dougherty (Group 1)
      Review Chapter 16, Erosion and Sediment Control L2 – Henderson (Group 2)

9:15  Review Chapter 21, Wetlands L2 – Hendrickson (Group 1)
      Review Chapter 22, Groundwater L2 – Pujara (Group 2)

10:00 Break

10:15 Concerns of the states – Round Table

11:15 TCHH Business

12:00 Adjourn to the next meeting
<table>
<thead>
<tr>
<th>TECHNICAL COMMITTEE MEMBERS</th>
<th>STATE</th>
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<tr>
<td>Bill Bailey</td>
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<td>Brooks Booher</td>
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<td>Hani Farghaly</td>
<td>Ontario</td>
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<td>Mike Fazio, Chair</td>
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<td>Dave Henderson</td>
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<td>Te Ngo</td>
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<td>Matt O'Connor</td>
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<td>Jorge Pagán-Ortiz, FHWA/Secretary</td>
<td>Wash., D.C.</td>
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<td>Richard Phillips</td>
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<td>Karuna Pujara</td>
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<td>Rae Van Hoven</td>
<td>New Mexico</td>
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A) WELCOME AND INTRODUCTION:

1. Chairman Mike Fazio welcomed members and friends of the AASHTO Technical Committee on Hydrology and Hydraulics (TCHH) to the Spring 2008 meeting and thanked Karuna Pujara for doing all arrangements and coordination for this meeting in Hanover, Maryland. This is the TCHH meeting number 74. Chairman Fazio mentioned that we will have a field trip on Wednesday – visit of the Woodrow Wilson Bridge, the FHWA Research Facilities at TFHRC and the Philip Merrill Environmental Center in Annapolis, Maryland. Chairman Fazio introduced new members of the TCHH – Steve Sisson of Delaware DOT and Douglas Morse of New York DOT.

2. Chair Fazio passed around the committee roster and asked committee members to update it. Also, he passed around the visitors’ sign-off sheet (see TCHH roster and visitors list in Appendixes A and B, respectively).

3. Karuna Pujara welcomed the TCHH members to Maryland. She indicated that the MDSHA Administrator will be joining us in the afternoon. She indicated that the AASTO Technical Committee on Environmental Design will be joining us during the field trip on Wednesday.

4. Chairman Fazio indicated that so far there been seven states that have committed funds for the pooled-fund for completion of the manuals that we are working on. The contribution is $10K per year for 2 years.

5. The TCHH was welcomed by the Maryland State Highway Administrator, Mr. Neil Pedersen, whom is also a member of the AASHTO Standing Committee on Highways. Mr. Pedersen complimented the member of the TCHH as he said that the TCHH is proactive and is a productive technical committee. He highlighted the MDSHA has had various staff serving in the TCHH: Kirk McClelland, Raja Veeramachaneni (former Chairman); Stan Davis (former Secretary) and Karuna Pujara who is currently an active member of the TCHH. Mr. Pederson indicated that one of his goals is to have the MDSHA be one of the cleanest highway agencies in the country. The MDSHA is working closely with environmental resource agencies as they have become more environmentally conscientious, especially on drainage related issues that may impact the Chesapeake Bay. Mr. Pedersen is also the vice-chair of the subcommittee on asset management and they have started an NPDES program that supports an asset management approach.

6. Mr. Raja Veeramachaneni also welcomed the TCHH to Maryland. Mr. Veeramachaneni is a former member of the TCHH and former chairman as well. He indicated that the TCHH is still very close to his heart and valued his participation in the committee as there were always discussions taken place on issues pertaining to our profession, which helped everyone advancing our profession.

B) FHWA PERSPECTIVE:

7. Jorge Pagán-Ortiz made a presentation on FHWA Update (see power point presentation in Appendix C).

C) SOFTWARE DEMONSTRATION:

8. Larry Arneson made a presentation on the FHWA Hydraulics Toolbox.
   a. Larry worked with Bart Bergendahl, hydraulics technical discipline leader for Federal Lands Highway Program Offices (FLHPO) on developing this toolbox.
   b. The toolbox was developed to meet the needs of FHWA’s FLHPO roadway designers.
   c. The toolbox consists of various engineering programs used to calculate the following:
      1. Channel lining protection
      2. Weir flow calculations
      3. Curb and gutter flow calculations
4. Flow discharge using the Rational Method
5. Detention basin analysis

9. Larry Arneson made a presentation on animations that FHWA is being working on to make visual demonstrations of abutment scour and countermeasures, as well as pier scour and countermeasures. These animations will be used as part of the training tools to be used in the updated NHI course 135048, Countermeasure Design for Bridge Scour and Stream Instability, which should be available in Summer 2008.

D) NCHRP:

10. David Reynaud presented a status report on the NCHRP projects. Please visit NCHRP web site for more information on these projects at: http://www.trb.org/CRP/About/DivD.asp

11. Highlights of the status of some of the NCHRP projects discussed during our meeting follows:

   a. 24-15 – Dr. Briaud is getting good results on this research.
   b. 24-18 – There have been some issues with coordination amongst the research team.
   c. 24-20 – Draft final report needed work; contractor working on second version of report.
   d. 24-27 – First two faces of this project are underway; third phase got funded for FY 2009 (continuation of funds for 24-27). RFP for this phase is almost ready.
   e. 24-32 – Just started with the research plan – it was improved after the first meeting.
   f. 14-19 – Contractor was selected recently – it will provide tools to states on culvert maintenance; the contractor will develop a program with a matrix on how to analyze culverts. Rick Renna mentioned that there is an FHWA publication with a matrix on culvert rehabilitation and that there is no investigation on how long culvert repairs would last. There was a discussion on this
   g. 24-33 – There are plans to have a workshop/meeting with the principal investigators (PIs) (Ettema, Stern and Briaud) as well as the panel members in June 2008 as there is a concern about research overlapping between these two projects. The goal will be to reach an agreement on what each PI would be working on.

E) AASHTO:

12. Kelley Rehm, AASHTO liaison to the TCHH, made a presentation on AASHTO Updates (see power point presentation in Appendix D). Highlights of her presentation follows:
   a. New AASHTO president, Pete Rahn, gave overview on emphasis areas.
   b. SAFETEA-LU expires on 09/30/09
   c. Task Force on wave forces will be meeting in Omaha, Nebraska during the AASHTO Bridge Meeting in May 18-22, 2008.
   d. Decisions will be made on NCHRP 20-07 projects during the AASHTO Spring Meeting
      1. Need proposals ASAP (by middle of week starting on 04/13/08).
      2. The Wave Force problem statement will be submitted as an NCHRP 20-07 project. This problem statement was originated by Kornel and Rick Renna – it was suggested to have this problem statement endorsed by the TCHH and then be submitted to T-11 (subcommittee on bridges). Another option that should be considered is to submit it to the Standing Committee on Design; however, it was voiced that this problem statement is a bridge project.
   e. Kelly provided a list of NCHRP projects with continuation of funding, NCHRP projects funded for FY 2008, and NCHRP contingency projects (see Appendixes E, F and G).
F) RESEARCH PROBLEM STATEMENTS:

13. The TCHH members reviewed its research problems statements and decided to proceed as follows:
   a. Problem Statement on “NEXRAD Reflectivity for use by Highway Engineers” will be submitted as a synthesis project proposal 20-05 as it is related to highway project.
   b. Problem Statement on “Guidelines for Design and Selection of Culverts” will be submitted as a synthesis project proposal 20-07.
   c. Editing work for the new drainage manuals will also be submitted as a 20-07 project proposal.

14. The TCHH members proceeded to vote on problem statement priorities. The balloting results are presented in Appendix H.

15. Rick Renna offered another topic for consideration on “Effect of Suspended Sediment on Pier Scour.”

16. A discussion took place on the problem statement on “Pipe Design Selection Standards.” Its main purpose is on material guidance for selection. AASHTO TCHH presented this problem statement with a material wording on its title to the SCOR and they scrapped it out as they said that there are guidance already available for selecting materials. The TCHH went back and used the word design on the problem statement. The TCHH decided that instead referring to “standards” in the problem statement it will use “guidance.” The new title of this problem statement is “Guidance for Design and Selection of Culverts.”

17. A discussion took place on the “Best Management Practices . . .” problem statement. Committee members questioned whether or not we are improving water quality by storing water on underground culverts. The effect of temperature on BMPs should be a topic that needs to be studied as temperature has more effect than nitrogen and phosphorus. Also, it seems that sand filters do not reduce water temperature as it has been thought to do. We should be looking at other BMPs that would reduce temperature. The TCHH decided to add a problem statement on “Develop Guidance in Selecting BMPs for Temperature Control.”

G) OPEN DISCUSSION ON DIRECTION, CONCERNS AND IDEAS:

18. The committee discussed issues pertaining to the pooled-fund project to hire a consultant to help us out with the review of the Level 1 and Level 2 documents that the committee is currently working on. Chairman Fazio indicated that he knows the names of the state DOT contacts that committee members need to talk to initiate the process of commitment of funds for this pooled-fund project. So far, IN, IO, KS, MT, NY, TX and UT have made commitments of $10K per year for the next two years. Chairman Fazio indicated that the pooled-fund solicitation will be posted until June 2008. Chairman Fazio said that if a state cannot make a commitment for 2008, then try to make a commitment for 2009 and 2010.

19. Kornel briefed the TCHH on a meeting that FHWA had with members of the ACPA, who claim that plastic pipes deflect under load conditions and this created corrugations on this pipes, which in turn could reduce the hydraulic capacity of this culverts as the Manning’s “n” value will change. If there is to be any testing done on this subject, it would have to be at an independent facility and it will need a system of tests that will provide the hydraulics community with the information needed under certain conditions. This discussion led the TCHH to revisit the problem statement on “Guidance for Design and Selection of Culverts” to add a statement that would require the need to review and provide updated guidance on minimum and maximum cover, and bedding requirements for pipes.

20. A discussion took place regarding the TCHH bylaws.
Action Item no. 1: Chairman Michael Fazio and Dave Henderson to review bylaws and draft suggested revisions if necessary for review at next meeting.

21. Andrea Hendrickson provided an update on the Hydraulic Engineering Conference scheduled for Portland, Maine on August 26–29, 2008. The conference agenda was distributed to all members in attendance. Specific action items were addressed as follows:
   a. Need volunteer host of next conference in 2010, interested parties should contact Cynthia Nurmi at (404) 562-3908. Prefer Midwest or Northwest location. Coeur d’Alene, ID was the group consensus for a preferred location and Chairman Fazio said that he would contact Lotwick Reece to see if he would be interested in hosting the conference in Idaho.
   b. Looking for more sponsors. Everyone was reminded to contact consultants, software vendors, suppliers, or others who might be interested in setting up an exhibit at the conference. The Registration form attached to the agenda should be used to submit sponsor information or they may call Jackie Guimond at (207) 624-3017, or they can contact Cynthia Nurmi. Kelly Rehm advised that she would provide the list of sponsors from the Bridge Conference.
   c. Volunteers are needed now for the Planning Committee for the 2010 conference. Andrea Hendrickson and Karuna Pujara volunteered to remain on the Planning Committee for the next conference. Brooks Booher said he was not volunteering to remain on the Planning Committee, however if no other volunteers came forward he would consider another term. Volunteers from AASHTO Regions 2 and 4 are needed for the committee.

22. Te Ngo brought up the issue of two registration fees for the same trip presenting a difficulty in getting travel approval. Chairman Fazio said that he would see that the letter announcing the conference and the next meeting were clear as to there being two separate events and that separate agendas would be provided for each so that it was clear what the registration fees were for and so that people only attending one of the events (TC meeting or the conference) could identify the correct fee.

23. There was discussion on the merits of having some type of apparel with a logo of the AASHTO TCHH similar to that displayed by the Environmental TC. There was unanimous agreement on having identifying apparel. Some type of shirt versus jackets or hats was preferred and it was agreed that a polo or button down shirt should be available for purchase by TCHH members. It was suggested that we should develop a unique TC logo and that the new AASHTO letterhead logo would be shown below the TCHH logo. Since the shirts will become an identifying trademark for the TCHH they should all be of the same color.

Action item no. 2: Suggestions for a TCHH logo and shirt color are to be sent to Michael Fazio by May 10, 2008. Dave Henderson is to get a price quote on cost of shirts with logo.

24. Chairman Fazio said he wanted to initiate publication of a TCHH Newsletter which would be distributed semiannually (following each TCHH meeting). The newsletter is to be distributed electronically to the entire engineering community with an interest in highway hydraulics. Kelly Rehm advised that AASHTO would have no publication issues with distribution of a newsletter. Andrea Hendrickson and Te Ngo volunteered to assist with publication and distribution. Kelly Rehm also said she would assist with distribution.

25. Kelly Rehm advised that AASHTO has web meeting capabilities for committee usage and she encouraged the chapter chairs to use this web capability to conduct internal committee reviews of their chapters or for any other TCHH related work. She is our contact person to set up a web meeting and to obtain call in numbers.
26. Several people identified the need to maintain a running list (log) of decisions that have been made regarding the format, content and other decisions resolved regarding the new AASHTO Drainage Manual. The TCHH resolved, as suggested by Chairman Fazio, to keep the running log of decisions made by the TCHH members such as those presented under Section H, items 31-36. Andrea Hendrickson and Te Ngo agreed to be responsible for maintaining a running list of decisions made regarding the manual. This job will include a research of old minutes for the history of past decisions.

27. Chairman Fazio entertained a discussion of software needs. No new needs were identified. Larry Arneson addressed the need for the TCHH to stay informed of software updates and new internet data available such as GIS data. The TCHH agreed to regular, future updates from Larry on changing computer technology. Larry agreed to take the lead on facilitating a group discussion or presentation on available software tools on the current market at future meetings. It was also agreed that the new newsletter (discussed on Item 24) have a section titled Technology Corner by Larry Arneson.

28. Chairman Fazio led a very constructive discussion of the benefits of timely distribution of minutes following meetings. The current minutes were described as very good, thorough, well organized, and presented in a very useful format. The only issue is timeliness which is especially important to those who are not in attendance. A motion was made and approved that the secretary is to send out draft minutes within 30 days after each meeting and that the TCHH Chair is to send a reminder to the secretary within 20 days after each meeting. Suggestions were made for facilitating a reliable system of distributing minutes that included the host state providing a consultant to take notes on decisions and action items, tape recording of sessions and having the recording transcribed and sent to secretary, or designating a member or other FHWA attendee to assist secretary by taking secretary’s notes and transcribing into the minutes.

29. Several members advised that they were having difficulty accessing the ftp site and requested that Joe Krolak re-distribute the link provided earlier. This is also necessary to facilitate new members who did not previously receive the link.

Action Item no. 3: Ask Joe Krolak to re-distribute the link to the ftp site that he provided earlier.

H) WORK SESSIONS:

30. Andrea Hendrickson stated that it is very difficult to look at a uniform format on a chapter and recommended to wait until the consultant takes care of format issues for each chapter of the documents that we are working on. Also, she questioned what would be our policy on acronyms. It was decided that the first time that an acronym is used it should be spelled-out. Joe Krolak found from the AASHTO web site that their policy is to define the acronym when they are first used and pointed out that there is more information on acronyms available from AASHTO.

31. A discussion took place regarding the subject on “design standards.” The AASHTO manuals that the TCHH is currently working on present minimum standards that, if changed to be below what is recommended, it will require approval of an exception to the design standard presented in the manuals. Also, if a State is in the process of developing a manual that presents minimum standards below those recommended by AASHTO, they should get approval for the minimum standard from FHWA. The TCHH agreed to add a statement in the manual that would read as follows: “This manual has been written to provide recommended minimum desired criteria.” The TCHH agreed to use “criteria” instead of “standard.” Also, it was agreed to specify when we are using general guidance and when we are referring to “criteria” to avoid confusion. General
guidance is based on general knowledge on a technical or specific area. Further, it was agreed that criteria in a subject may not have to be the same from state to state whereas design standards would have to and it will require approval from FHWA to change.

32. The TCHH agreed to retain the title on the Level 1 document as follows: “A Policy on Highway Drainage.”

33. With regards to the Level 2 document, the committee considered various options such as:
   a. Drainage Procedures
   b. Highway Drainage Design and Procedures
   c. Highway Drainage, Planning and Design Procedures
   d. Highway Drainage Procedures for Plan, design and Operation
   e. BMP’s and Procedures for Highway Drainage Design
   f. Procedures for Planning, Design and Operations of Highway drainage
   g. AASHTO Drainage Manual
      1. Volume 1, Policy
      2. Volume 2, Procedures

34. A motion was introduced to keep the policy volume as one document – not to be sold by chapters. This motion was seconded and unanimously approved.

35. The TCHH voted again on how to call each manual and it was agreed to call these documents as follows:
   a. AASHTO Drainage Manual
      1. Volume 1, Policy
      2. Volume 2, Procedures

36. The committee agreed to have a second introduction for the Volume 2 manual in order to keep it separate from the Volume 1 manual. Douglas Morse suggested that the TCHH should consider using the introduction that has been already developed for the Volume 1 document and that there will be a need to change only section 1.1.5 of this Volume for the Volume 2 manual.

37. Kelly Rehm indicated that AASHTO needs to make sure that their web site includes a contact person from AASHTO in case that people find errors on either one of the two volumes manuals once they are posted electronically in their web site.

38. A schedule for publishing the AASHTO Drainage Manual is presented in Appendix I.

39. The assignment of chapter chairs for the Policy and Procedures Manuals is presented in Appendix J.

I) FIELD TRIPS:

40. New Woodrow Wilson Bridge (WWB)
   a. The TCHH visited the new WWB in Washington, D.C.
   b. The Technical Committee on Environmental Design joined the TCHH on this field trip.
   c. Stan Davis of the MDSHA gave an overview on evaluating scour for the piers of the new WWB (see power point presentation in Appendix K).
   d. Michael Baker, a consultant that served as the environmental manager for the Woodrow Wilson Bridge, gave an overview of the environmental issues and considerations that went about during the planning and construction of the bridge.
      1. EIS was approved in 1997. A further finding of a bald eagle sanctuary and sturgeon fish required a supplemental EIS.
      3. Outer loop bridge was built first and was opened to traffic in 2006.
      4. Inner loop bridge is scheduled to be open to traffic in April 15, 2008.
      5. MDSHA built the bridge (VDOT built the bridge abutment on the Virginia side.)
6. There was quite a bit of community outreach efforts as representatives from MDSHA met with the community once a month for the last 7-8 years.

7. Air quality monitoring was also documented while an apartment complex on the Virginia side (outer loop) was torn down due to concerns with the air quality at a local school (St. Mary’s Catholic School) in Alexandria, Virginia.

41. Visit to the J. Sterling Jones’ Hydraulics Laboratory at the FHWA Turner-Fairbank Highway Research Center (TFHRC) in McLean, Virginia.
   a. Kornel Kerenyi hosted the AASHTO THCC and TCED at TFHRC. He organized presentations for the TCHH at the J. Sterling Jones Hydraulics Lab and the Aerodynamics lab.
   b. Kornel Kerenyi made power point presentations on the FHWA/TRB Advanced H&H Research Roadmap and the FHWA Hydraulic R&D Program for FY 08 (see Appendices L and M). He said that the FHWA/TRB roadmap could enhance quality control on hydraulics research as it could evolve into a comprehensive way to compile TRB AFB60 and AASHTO TCHH problem statements and prioritize with one word to NCHRP our top priorities for funding consideration.
   c. It was suggested to contact all states to attempt to compile all research being done. Also, it was suggested to contact cities and counties as they may not be aware of the research topics that we would like to move forward and they may even provide funding on a particular topic that they may be interested.

Action Item no. 4: Kornel Kerenyi will develop a web site to compile as much information as possible on research. Also, he will write letters to the states explaining our vision on this effort.

d. It was suggested that the 2008 National Hydraulic Engineering Conference would be a good opportunity to discuss our outreach intention for compiling all hydraulic and environmental research efforts and to present our research roadmap. Also, it was suggested to formalize something in writing to all individuals that have registered on the 2008 National Hydraulic Engineering Conference so that they can have something on this topic ahead of time.

Action Item no. 5: Kornel will send an updated roadmap to Chairman Fazio.

e. Chairman Fazio said that he would like to have Kornel Kerenyi review all AASHTO TCHH problem statements and to let him know for which ones research could be conducted at the J. Sterling Jones Hydraulics lab. The research projects could be funded through pooled-fund solicitations. Secretary Pagán-Ortiz advised the committee that while FHWA welcomes the idea of conducted research on problem statements at the FHWA facility, FHWA in no way should be viewed as competing or soliciting research work from the AASHTO TCHH. Therefore, we need to make sure that any research request should be initiated from the AASHTO TCHH. Also, he advised the TCHH that any national emergency that may require the use of the FHWA J. Sterling Jones hydraulics lab will become a top priority, which may cause to stop or delay any research activities being done at the lab for other institutions.

J) CONCERNS OF THE STATES:

42. Delaware – Stephen Sisson stated that the only real issue was with the performance of BMPs.
43. South Dakota – Richard Phillips said that his biggest issue today is some 300 bridges that were just dumped on his office for development of POAs. These bridges were identified by others within the DOT that used scour studies performed by USGS to determine which bridges should be coded scour critical.

44. Minnesota – Andrea Hendrickson said that her biggest concern right now is the decision by the Department to convert shoulders to driving lanes with limited drainage improvements. The department will rely on signage for speed control during rain storms. MnDOT has funded a position in DNR for a new liaison person to facilitate the review and issuance of permits for highway projects that helps facilitate permits. MnDOT has downsized and is looking to outsource bridge hydraulics work. Climate change is also seen as a potential future issue since many people are talking about it but it is not being quantified in terms of how to account for climate change in design.

45. New Mexico – Rae Van Hoven ask what other states are doing for their POAs on scour critical bridges. Her current plans are to call for monitoring and requiring that the inspector remain at the bridge site full time when the flood stage is two feet above the 50 year flood stage. Andrea Hendrickson advised that MnDOT marks the critical flood stage on the piers or abutment face and the bridge is to be monitored when floods reach that elevation. Rae Van Hoven also said that because of sediment transport problems an environmental agency is complaining about damage to endangered fish species. Larry Arneson suggested that this would be a good candidate for research and said he would work with Rae Van Hoven to write a research statement for agrading streams.

46. New York – Douglas Morse reported on several current concerns of the New York DOT.
   a. Aquatic organism and fish passage requirements for stream crossings (USACOE Nationwide Permits Regional Conditions) will need design information:
      1. Data to support simple reliable design methods for non-salmonid fish passage suited for use by local government entities as well as state DOT’s.
      2. Methods to coordinate DOT and resource agency priorities for constructing fish passage improvements (watersheds, species, etc.)
      3. Long-term inspection concerns for culverts with buried inverts.
      4. Data on stream bed material retention in depressed culverts.
      5. Design of grade control structures that promote fish passage.
   b. Case studies and engineering data on stability of rock vanes and other non-traditional and bio-engineering stream stabilization techniques.
   c. Continued field research in support of analytical methods for long term scour at bridge piers, abutments in a variety of stream bed materials.
   d. Development of AASHTO guidelines for when to use 2-dimensional modeling (as opposed to 1-dimensional HEC-RAS) as the appropriate analysis method for bridge and river hydraulics.
   e. Stormwater pollution phase II permit not issued by NYSDEC.
   f. Need updating of TP-40. New York has pledged funds for this research effort but other New England states have yet to act.

47. Virginia – Roy Mills said that his only concern at the moment is that he can’t get management to take EPA permits seriously.

48. Arkansas – Brooks Booher said that he had no real departmental issue and that the only concerns presently were of the heavy flooding being experienced in Arkansas. Using USGS gage data the recent flooding has been estimated to be around a 200 year frequency occurrence. He had no reported damage to state bridges but he thought that a couple of local agency bridges had been damaged in the flooding.
49. North Carolina – Dave Henderson reported that they are experiencing a transformation change in the business process of the Department of Transportation. This has resulted in a reduction in the paper work for hiring, promotions, and travel which is a big improvement. This transformation has also affected design decisions involving rehabilitation and replacement projects. The bridge maintenance replacement process has been changed to a preservation system designed to get longer life out of highways and bridges. Bridge replacement was turned over to the new bridge design sections and reduced criteria has been established for replacement projects. They have also gone to a clustering of contract lettings in localized areas to effect a better bid price. Several proposed criteria changes were successfully defeated such as increasing the spread on bridge decks and reducing the scour design on bridges from 100 year to a 50 year frequency.

K) FINANCIAL REPORT:

50. See Appendix N.

L) TCHH FUTURE MEETING LOCATIONS:

51. 2008 Fall Portland, Maine (In conjunction with the 2008 National Hydraulic Engineering Conference)
52. 2009 Spring Indianapolis, Indiana
53. 2009 Fall Denver, Colorado
54. 2010 Spring San Francisco, California
55. 2010 Fall TBD (In conjunction with the 2010 National Hydraulic Engineering Conference)

M) GROUP PICTURES:

55. Picture of the AASHTO TCHH members at the WWB site (see Appendix O).
56. Joint picture of the AASHTO TCHH and TCED at the WWB site (see Appendix P).
## Appendix A

### AASHTO TECHNICAL COMMITTEE ON HYDROLOGY AND HYDRAULICS

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## Appendix B

### VISITORS

**AASHTO TECHNICAL COMMITTEE ON HYDROLOGY AND HYDRAULICS**  
**SPRING 2008 MEETING**  
**HANOVER, MARYLAND**  
**APRIL 8-10, 2008**

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Appendix C

FHWA Update

Presented for:
AASHTO Technical Committee on Hydrology and Hydraulics
Baltimore, Maryland
April 8, 2008

By:
Jorge E. Pagán-Ortiz
Principal Bridge Engineer - Hydraulics
Leader, Hydraulics and Geotechnical Team
(e-mail: jorge.pagan@dot.gov)
Federal Highway Administration
Office of Bridge Technology
Washington, D.C.

FHWA National Hydraulics Team

Headquarters:
Jorge E. Pagán-Ortiz, Joe Krolak, Kornel Kerenyi and Louisa Ward

Resource Center:
Dr. Larry Ameezen, Cynthia Nurni, Dan Ghone, Dr. Eric Brown and Veronica Ghulbad

Federal Lands Highway Program:
Bart Bergendahl, Brian Beucler, Abbi Ginsberg, Dave Dajc, Ashok Panjabi,
Scott Haugen, Dr. Thiet Nguyen, Dr. Mark Browning, Sven Lean, and Catherine Sugnet

Division Office:
Steve Toillion, Kansas

Major Changes in FHWA Leadership

- FHWA Executive Director, Frederick "Bud" Wright, retired on January '08.
  - Mr. Joe Toole is serving as Acting FHWA Executive Director.
- FHWA Administrator Rick Capka announced January '08 that he was leaving FHWA - left in February '08.
  - Mr. Jim Ray is serving as acting FHWA Administrator.

Changes in FHWA Headquarters and Resource Center

- Headquarters:
  - Benjamin Tang, Bridges and Structures Team Leader, Office of Bridge Technology, retired January '08 - Jorge Pagán-Ortiz serving as acting Team Leader.
  - Research:
    - Steve Chase, Chief Scientist, retired November '08 - position advertised; no selection made, yet.
  - Resource Center:
    - Joyce Curtis, Resource Center Director, promoted to SES position as Director of Field Services - North, March '08.
    - Scott Anderson, Geotechnical Engineer, promoted to Geotechnical and Hydraulic Technical Service Team, January '08.

Innovative Bridge Research and Deployment Program

- Congress eliminated FY '08 funding for this program.
  - This action further "scoured" our already hurting funding for FY '08.
- Action also had an impact on:
  - Project proposals for the implementation of innovations submitted by State DOTs under this program - it included proposals for field installations of partially grouted riprap and scour instrumentation.
  - Eliminate funding of three laboratories at TFHRC - Hydraulics, Geotechnical and Aerodynamics.

Policy Memo on Scour Evaluations and POAs

- It addresses that, in order to be in compliance with the scour critical requirement of the NBIS regulation, 23 CFR 650.313(e), bridge owners have to:
  - Complete scour evaluation of all bridges over waterways (34,900) by a new target date.
  - Develop and implement POAs for scour critical bridges (20,904) by target dates presented in the memo.
- Memo disseminated to FHWA field offices and AASHTO TCHH members, January '08.
Policy Memo on Bridges with Unknown Foundations

- Addresses need to reduce or eliminate the number of bridges identified as unknown foundation (67,064) for Item 113 of the NBI.
  - Presents a process developed by FHWA’s HBT-20 staff (Hydraulics and Geotechnical engineers), which includes among other factors:
    1. Screen all U’s; geologic information, standards, information available at nearby bridges
  - FHWA is considering a revision to the NBIS regulation that would add language to address bridges that still coded “Unknown” after a target date, December ’10.
  - Memo was disseminated to FHWA field offices and AASHTO TCHH members, January ’08.

Hydraulics Engineering Website

- WWW.FHWA.DOT.GOV/ENGINEERING/HYDRAULICS
  - Structured by the “Functional Areas”
    - Scour Technology
    - Bridge Hydraulics
    - Culvert Hydraulics
    - Highway Drainage
    - Hydrology
    - Environmental Hydraulics
  - Identifies FHWA contacts and activities

Functional Areas Activities

- Continued to be limited due to lack of funding for FY 08 and beyond.
  - SAFETEA-LU did not provide discretionary funds.
  - Currently relying totally on NHI funding availability for updating HEC/HDS publications, software development and training courses.
  - Considering possibility of going into partnership with State DOTs through Pooled-fund solicitation for updating/software development and training courses.

Scour Technology

- HECs 18 & 20 Updates
  - Status: identified as #1 priority for updating with funding assistance from NHI.
  - To be updated with research at the FHWA’s J. Sterling Jones Hydraulics Lab on pressure flow and \( K_4 \) factor (armoring), and with results from NCHRP projects.
    - Do not use the pressure flow scour procedure currently presented in HEC-18
    - Use \( K_4 \) factor presented in Third Edition of HEC-18
  - Jorge E. Pagan-Ortiz, Principal Bridge Engineer – Hydraulics, FHWA Office of Bridge Technology, is leading this Task.

Scour Technology (Continuation)

- Revisions to the FHWA’s Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation’s Bridges (Coding Guide).
  - Status: Still on hold due to budget unknowns.
  - Proposed to be rename to “Specifications Guide.”
  - Reviewing all Items pertaining to bridge hydraulics and scour:
    - Items 60, 61, 62, 71, and 113
  - Proposing additional Items to capture other issues such as:
    - Plan of Action for a scour critical bridge (Item 114)
    - Stream instability upstream/downstream of a bridge (Item 115)
    - Scour countermeasure type and condition (Items 116 and 117)
    - Stream stability countermeasure type and condition (Items 118 and 119)

Scour Technology (Continuation)

- Module on Plan of Action for Scour Critical Bridges
  - Status: On hold - FHWA may complete this module.
  - Cynthia Naremi, Hydraulics Engineer, FHWA Resource Center, is leading this Task.
Scour Technology (Continuation)

- Scour and Protection of Bottomless Culverts: Phases I and II
  - Status: Research Completed
    - Conducted for MDSHA at the FHWA's J. Sterling Jones Hydraulics Lab
  - Research outcome:
    - Equations for estimating scour at bottomless culverts
    - Countermeasure (end treatment) for reducing culvert outlet scour
    - Procedure for estimating riprap size for protecting foundations of bottomless culverts - to be included in HEC-23
  - Final report completed - report number HRT-07-026 (available at the FHWA Hydraulics website).
    - Procedure to reside in HEC-18.
    - Dr. Kornel Kerenyi, Senior Research Hydraulics Engineer, FHWA TFHRC, led this Task.

- New Pressure Flow Scour procedure
  - Status: Research almost completed
    - Research conducted at FHWA J. Sterling Jones Hydraulics Lab.
  - Research Outcome:
    - New equations being developed for three pressure flow cases
    - Procedure to reside in HEC-18.
    - Dr. Kornel Kerenyi, Senior Research Hydraulics Engineer, FHWA TFHRC, led this Task.

- Second Edition of HEC-25
  - Status: Basically, it has been completed.
  - Contractor: University of South Alabama (Dr. Scott Douglas)
  - Joe Krolak, Senior Hydraulics Engineer, FHWA Office of Bridge Technology, is leading this Task.

- Bridge Failure Forensic Investigation Report
  - Currently, there is no system in place for collecting available information on bridge failures.
  - A forensic report could be the process for reporting bridge failures (hydraulic, overload, fire, earthquake, etc.).
  - National database for future reference that could lead to enhance ability to identify inadequacies on material specifications, design procedures, construction techniques and maintenance operations.
  - Dan Ghere, Hydraulics Engineer, FHWA Resource Center is leading this Task.

Bridge Hydraulics

- AASHTO/FHWA Task Force on Wave Forces
  - Status: Ongoing; Chairman: Mr. Greg Perfetti, NC DOT State Bridge Engineer.
  - FHWA Members (Hydraulics): Joe Krolak and Kornel Kerenyi.
  - Task Force currently working on two documents:
    - Guide Specifications
    - To be balloting by the AASHTO T-5 Subcommittee, May '08

- Unknown Foundation Synthesis
  - Status: Draft submitted
  - Contractor - Scott Sabol, Associate Professor, Vermont Tech
  - Target completion date May '08 (?)
  - Cynthia Nameri, Hydraulics Engineer, FHWA Resource Center is leading this Task
Culvert Hydraulics

- Develop HY-8 Graphical User Interface for Windows
  - Status: Phase I Completed!
  - Contract was EMS-I.
  - Phase II for HY-8 Version 7.1 -- awarded to EMS-I
    - To include module on energy dissipators, hydraulic jumps in the culvert barrel and broken-back culverts.
    - Beta version made available earlier this year; Version 7.1 should be released April ’08.
  - Joe Krolak, Senior Hydraulics Engineer, FHWA Office of Bridge Technology, is leading this Task.

Highway Drainage

- Develop new FHWA Storm Drain Software (FY ’08)
  - Joe Krolak, Senior Hydraulics Engineer, FHWA Office of Bridge Technology, will be leading this Task.
  - NHI should be assisting with the funding of this Task.

Hydrology

- Pooled-Fund studies to upgrade rainfall maps
  - Dr. Kornel Kerenyi, Senior Hydraulics Engineer, FHWA TFHRC, is leading this Task.
  - Policy memo being worked out to address what appears to be a growing national issue on request to use roadway embankments as levees.
  - FHWA Headquarters working on this issue with FEMA Headquarters.
  - Joe Krolak, Senior Hydraulics Engineer, is leading this Task.

Environmental Hydraulics

- Design of Fish Passage at Bridges and Culverts
  - Status: Synthesis completed in June ’07 -- posted in the FHWA Hydraulics web site.
  - Contractor was Dr. Rollin Hotchkiss (now with BYU).
  - Bart Bergendahl, Senior Hydraulics Engineer, FHWA Central Federal Lands, led this Task.
  - Phase II awarded to Kilgore Consultant Management for developing an HEC-level publication, Kilgore Consultant Management.
  - First two steps of the FHWA fish passage design procedure have been drafted being reviewed by technical review team.

NHI Courses to be Updated

- NHI 135047 – Stream Stability and Scour for Bridge Inspectors
  - Status: Ongoing
  - Update to include:
    - Prerequisite modules on basic stream stability and scour concepts and definitions
    - POA material
    - Animations on stream stability, scour and countermeasures
    - Field Inspector’s Handbook, which has been completed
    - New interactive inspection and coding workshop
  - Contractor is Ayres Associates.
  - Target date for completion is Summer ’08.
  - Jorge E. Pagán-Ortiz, Principal Bridge Engineer – Hydraulics, FHWA Office of Bridge Technology, is leading this Task.

- NHI 135048 – Countermeasure Design for Bridge Scour and Stream Instability
  - Status: Ongoing
  - Update to include:
    - New POA material
    - Prerequisite modules on basic stream stability and scour concepts and definitions
    - Animations on stream stability, scour and countermeasures
    - New technology and guidance from NCHRP projects on countermeasures and environmentally sensitive channel and bank protection
    - New and updated design guidelines
  - Target date for completion is Summer 2008.
  - Jorge E. Pagán-Ortiz, Principal Bridge Engineer – Hydraulics, FHWA Office of Bridge Technology, is leading this Task.
NHI Courses to be Updated (Continuation)

- NHI 135046 – Stream Stability and Scour at Highway Bridges
  - Status: Planned for FY 08.
  - Update with new POA material, new research on pressure flow, K4 factor and outlet scour countermeasure, and results from NCHRP projects.
  - Jorge E. Pagán-Ortiz, Principal Bridge Engineer – Hydraulics, FHWA Office of Bridge Technology, is leading this Task.

NHI Course Under Development

- 135082, Tidal Hydrology, Hydraulics and Scour at Bridges
  - Status: Pilot held in Gainesville, Florida, March ‘08.
  - Joe Krolak, Senior Hydraulics Engineer, FHWA Office of Bridge Technology is leading this Task.

- Online Pre-requisite Modules
  - Hydrology (already developed).
  - Basic hydraulics concepts and definitions (already developed).
  - Basic concepts and definitions on scour (already developed - final draft reviewed).
  - Basic concepts and definitions on stream stability (being developed - draft reviewed).
  - Dr. Larry Arneson, Principal Bridge Engineer - Hydraulics, FHWA Resource Center, is leading this Task.

NHI Courses to be Developed

- Floodplain Policy and Guidance (FY ’09?)
- Design of Fish Passage at Bridges and Culverts (FY ’09?)
- Tidal Hydraulics Modeling (?)
- Sediment Transport (?)
- Advanced HEC-RAS (?)
- Stream Stability and Scour at Highway Bridges for Bridge Inspector
  - Web-based training (?)
- Culvert Inspection (?)

Conferences

- 2008 National Hydraulic Engineering Conference
  - Planned for August 26-29, 2008 in Portland, Maine.
  - Keynote Speaker Invitee: Mr. Myint Lwin, FHWA Administrator.
  - Cynthia Nurmi and Dr. Eric Brown, Hydraulics Engineers, FHWA Resource Center, are FHWA representatives working with the AASHTO TCHH steering committee.

Questions???
Appendix D

AASHTO Update
Kelley Rehm, PE
April 2008

AASHTO President’s Emphasis Areas

- 2008 AASHTO President Pete Rahn’s “Emphasis Areas” include:
  - Strategic educational effort to illustrate critical role of transportation infrastructure, approaching severe funding shortfall
  - Expand use of performance measures by DOTs
  - Reduce number of fatalities due to lane departure crashes

Reauthorization of the Federal Transportation Bill

- SAFETEA-LU will expire September 30, 2009
- 10 AASHTO legislative policy teams are drafting proposed policies for presentation to Board of Directors in May and October
  - Highways
  - Project Delivery
  - Transit
  - Safety
  - Rail
  - Performance
  - Freight
  - Measures
  - Metropolitan
  - Research
  - Mobility
  - Finance

Reauthorization of the Federal Transportation Bill

- Policy teams will present proposals to our Board of Directors in May and October
- Topics under consideration:
  - Focus federal program on national goals, delegate other responsibilities to states and locals
  - Increased funding and flexibility
  - Economic development and global competitiveness
  - Develop performance goals/measures for asset condition, congestion, safety, freight mobility, rural accessibility, environmental issues
  - Recommendations on climate change issues
  - Speed up project delivery, innovative financing options

CSS Update

- The AASHTO Task Force on CSS was sunsetted in September 2007
- New 2-year task force was established to focus on project management and project delivery issues, while also continuing ongoing CSS efforts
  - Task Force on Project Management and Delivery, chaired by John Nord, Utah
  - Membership includes representatives from Standing Committees on Highways, Planning, Environment, and Quality, and FHWA
  - Charged with exploring the need to address cross-cutting project management and delivery issues and, if needed, recommend a structure within AASHTO to address these issues and provide technical assistance

New Publications

- Center for Environmental Excellence
  - Above and Beyond: The Environmental and Social Contributions of America’s Highway Programs
  - Practitioners’ Handbooks, which provide practical advice on a range of environmental issues that arise during the planning, development, and operation of transportation projects
  - Web site: http://environment.transportation.org/
Upcoming Meetings

- **AASHTO Spring Meeting**
  - Branson, MO
  - May 4-8, 2005
  - Standing Committee on Highways, Board of Directors, NCHRP 20-7

- **Subcommittee on Design**
  - Albuquerque, NM
  - July 13-17, 2008

- **AASHTO Annual Meeting**
  - Hartford, CT
  - October 16-20, 2008
  - Standing Committee on Highways, Board of Directors, NCHRP 20-7

AASHTO Bridge Activities

- **Meeting – May 18th, Omaha**

- **New Specifications – Manual on Bridge Evaluation, Guidelines for LRFD Seismic Design**

- **AASHTO is preparing a PR package for the “one year anniversary” of the MN bridge collapse**

Reminders

- **20-07’s**

- Any research proposals that we could submit jointly with Subcommittee on Bridges and Structures? (Scour)

- **Financial Report on meetings**

- **Questions??**
## Appendix E

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<td>Research for the AASHTO Standing Committee on Planning: Support for Improved Transportation Planning and Project Development</td>
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**Total** 10,550,000
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## Appendix I

### Schedule for Publishing Highway Drainage Manual

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publication
# Appendix J

## Assignment of Chapter Chairs and Team Members for the Policy (Volume 1) and Procedures (Volume 2) Manuals

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Chapter Chair 1</th>
<th>Team Members 1</th>
<th>Team Members 2</th>
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<tr>
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<td>Renna</td>
<td>Ronnfeldt</td>
<td>Fazio</td>
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</table>
Appendix K

Evaluating Scour for the Piers of the New Woodrow Wilson Bridge

Sterling Jones and Stan Davis

Original Bridge over the Potomac River

Functionally obsolete; major bottleneck
Deck on leaf bascule spans beyond fatigue life
- Designed for 75,000 VPD
- Today 195,000 VPD
- Future 295,000 VPD

Woodrow Wilson Bridge Monthly Scour Monitoring Plots

Original Woodrow Wilson Bridge

- Background
- Interdisciplinary Team
- Overall Hydraulic Design
- Scour Evaluation of Piers
Design of New WWB
Vital link in I-95/495 Highway Systems
- 2 parallel bridges, 12 lanes, 18 spans, 6052 ft long
- Capacity 300,000 VPD
- Provision for future mass transit
- Estimated cost ~ $2.4 B

The Scour Team
Recommendations regarding estimating procedures, scour depths and pier geometries were developed by a team of hydraulic, structural and geotechnical engineers.

PIER DESIGN PROCESS

Hydrologic Design of New WWB
- Drainage area at bridge site 11,860 mi²
- Tidal influence at bridge a secondary concern
- \( Q_{100} = 480,000 \) cfs
- \( Q_{500} = 700,000 \) cfs

Hydraulic Design of New WWB
- Used HEC-RAS for Riverine flow
- Used Maryland Tidal Analysis Program (based on the Neill method) for tidal flow
- Evaluated contraction scour and bend scour.

Local velocities for scour analysis determined by conveyance subdivision method in HEC-RAS.
Hydraulic Design of New WWB

- SMS-Flo2DH Analysis performed for Q_{100} and Q_{500}
- Ground & River elevations from 30 m DEM's and Estuary database
- n adjusted to match 1-D upstream WS Elevation

2-D Results for local velocities and angle of attack confirmed use of HEC-RAS was appropriate

FHWA coordinated flume studies and numerical modeling methods

- J. Sterling Jones Hydraulic Laboratory

Research Opportunities

- Small Scale Physical Model Tests
- Scour in Cohesive Soil (NCHRP 24-15)
- Gain Experience with Erodibility Index Methodology
- 3-D Numerical Modeling (GRF Project)
- Complex Pier Geometry

Techniques Used to Estimate Scour

- HEC-18
- Small Scale Model Studies at TFHRC Lab
- Large Scale Model Study at USGS BRD Lab
- Erodibility Index Method (George Annandale)
- SRICOS Method (Jean Louis Briaud)
- 3D Model (Xibing Dou)

Small Scale Tests at FHWA’s TFHRC Lab

- Recovery soil in mud-organic clay
- A1 & A2 = loose to medium compact silty sand
- A3 & A4 = very soft to medium organic clay
- A5 = medium to very compact silty sand
- P1 = hard plastic clay
- P2 = very compact clay or gravel
- P3 = very compact clay or gravel and cobbles and boulders

U.S. Department of Transportation
Federal Highway Administration
Large Scale Test at USGS BRD LAB in Mass.

Small Scale Vs Large Scale

<table>
<thead>
<tr>
<th>Scale</th>
<th>Ys max, Model</th>
<th>Ys max, Prototype</th>
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<td>1:100</td>
<td>0.248</td>
<td>0.105</td>
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<tr>
<td>1:28</td>
<td>0.708</td>
<td>0.414</td>
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</table>

U. FL. Pier Dia/Sed Dia SCALING

<table>
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<tr>
<th>SCALE</th>
<th>Ys max, Model</th>
<th>Ys max, Prototype</th>
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<td>1:100</td>
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<tr>
<td>1:28</td>
<td>0.708</td>
<td>0.414</td>
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</tbody>
</table>

Univ. Fl. Scour Function at U=U_C

Sheppard’s Function

GEOMETRIC SCALING

INHERENT ASSUMPTIONS
1. “Near max” scour occurs at the critical incipient motion velocity, v_c, in the approach flow
2. The scour depth scales as a length dimension

ADJUSTING SCOUR DEPTHS FOR DESIGN VELOCITY & DEPTHS

PROBLEMS: Recommended design velocities changed during study period.

Interested in Q100 and Q500 scour depths. That meant two sets of design depths and velocities for each model.
Adjusting Scour Depths (cont’d)

Used HEC-18 eq. as model for flow depth and velocity effects.

\[
\frac{y_s}{y_0} = 2.0 \frac{K_y}{K_x} K_x \left( \frac{b}{y_0} \right)^{0.5} \left( \frac{v}{y_0} \right)^{0.25}
\]

Then

\[
y_s = f \left( \frac{y_s}{y_0} \right)^{0.625}
\]

\[
\frac{y_s}{y_{\text{adjusted}}} = \left( \frac{y_s}{y_{\text{nond}}} \right)^{0.625} \frac{y_{\text{nond}}}{y_{\text{adjusted}}}
\]

Run 1: M1, 56’ CAP, w/ 3-45’ dolphins
Scour Depths: 53’ (Q100), 59’ (Q500)

Run 61: M1, 96’ CAP w/ Fender ring
Scour Depths: 29’ (Q100), 32’ (Q500)

• NCHRP 24-15 Scour in Cohesive Soils
  • Texas A&M (Briaud)

• Erodibility Index Method
  • George Annandale
Annandale’s Erodibility Index Method

Factors of Safety for Piers for 100-Year Flood (Scour Team Assumptions)**

<table>
<thead>
<tr>
<th>Pier / Dolphin Designation</th>
<th>At Base of Scour Tube Elevation (ft)</th>
<th>At Top of Crest Steele Layer Elevation (ft)</th>
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<tbody>
<tr>
<td>M10</td>
<td>15.5</td>
<td>10.4</td>
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<tr>
<td>M9</td>
<td>15.5</td>
<td>10.4</td>
</tr>
<tr>
<td>M8</td>
<td>15.5</td>
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<td>15.5</td>
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</tr>
<tr>
<td>V1</td>
<td>15.5</td>
<td>10.4</td>
</tr>
<tr>
<td>V2</td>
<td>15.5</td>
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*Note: Elevations are for scour analyses taken from the Washington Memorial Bridge.

Dou’s 3D Sediment Transport Model

3-D flow field for Q100 prior to scour formation. Velocity vectors at 78.6% flow depth from the bed. Flow at both upstream corners is contracted.

Shear Stress (SS), Stream Power Near Bed (SPbed) vs Scour Depth

- Complex Pier Procedure
  - FHWA HEC-18 4th Edition

Max. Scour Depth

After 113 Hrs: 21 ft.

3-D Sediment Transport Model

- FHWA GRF (Xibing Dou)
New Complex Pier Procedure for HEC-18

\[ y_s = y_{s\,\text{pier}} + y_{s\,\text{ps}} + y_{s\,\text{pg}} \]

\[ = K_{h\,\text{pier}} \cdot y_{so\,\text{pier}} + y_{ps} + K_{h\,\text{pg}} \cdot y_{so\,\text{pg}} \]

using \( b^* \) as pier width

Various Emerging Technologies Used to Evaluate Scour:

- Physical Models (Large and Small Scale)
- Different Scaling Model to Prototype Philosophies
- Ship Impact Structures (Dolphins Vs Fender Ring)
- SRICOS
- Erodibility Index Method
- 3-D Numerical Model
- HEC-18 Complex Pier Methodology
Appendix L

Current National Hydraulic & Hydrology Research

Historical Bridge Failures

National Hydraulic & Hydrology Research Activities

• NCHRP (TRB / FHWA / AASHTO) initiated H&H Research
• FHWA Hydraulics R&D Program
• Transportation Pooled Fund (TPF) H&H Research
• State funded/initiated H&H Research

NCHRP Projects (cont’d)

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<th>NCHRP Projects</th>
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NCHRP Projects

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NCHRP Projects

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NCHRP Projects

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NCHRP Projects

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NCHRP Projects

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## FHWA Hydraulics R&D Program (cont’d)

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## Objectives of the Forum

- Learn about capabilities of research facilities
- Share ongoing hydraulics research activities
- Discuss common problems
- Learn about instrumentation and other tools being used
- Identify needs for improving hydraulics research facilities
- Discuss possibility of teaming to resolve research issues
Expected Outcomes

- Identify research needs
- Identify short and long term challenges
- Capabilities of facilities and instrumentation
- Discuss role of industry
- Discuss future approach on physical/numerical/supercomputer modeling
- Discuss consideration of climate change (global warming)
- Develop short-, mid-, and long-term strategic plans

Participants

- State Hydraulic Engineers from MD, UT, NC, FL, CA
- Federal Agencies: U.S. Army COE, DOE, USGS, FHWA
- Academia: Texas A&M, UF, CSU, Utah State, Oregon State, Penn State, Michigan Tech, Univ. of Iowa, Univ. of Louisville, Univ. of Maryland, Univ. of Nebraska, Univ. of Minnesota

Sessions

**First Day**
- Improve communication between hydraulics researchers
- Federal Agencies, State DOT’s and National Academia’s Hydraulics Research Initiatives and Future Perspectives

**Second Day**
- Discuss future direction of hydraulics research in the following Focus Areas:
  - Coastal Hydraulics, Inland Hydraulics, Environmental Hydraulics and Communication, Partnership and Future Direction
- Breakout Session – Roundtable Discussion on Focus Areas

Summary of Roundtable Discussions

**Coastal Hydraulics**
- Failure mode analysis for road networks in coastal regions
- Scour equations for storm surge and wave action
- Bridge designs and countermeasures for bridges over coastal inlets

**Inland Hydraulics**
- Rapid-response data collection instruments
- Improved spatial measurement of rainfall, surface roughness, climate, etc.
- Scour equations for cohesive soils and common rock types

**Environmental Hydraulics**
- Spatial measurement of rainfall and other environmental datasets using next generation radar and unmanned aerial vehicles (UAV)
- Better models of watershed response to rainfall
- Environmentally-friendly bridge designs and materials

**Communication, Partnership and Future Direction**
- Creating a “National Hydraulic Research Center” Web site to house research data, and then organizing meetings
- Annual or biennial forums that may be scheduled consecutively with existing TRB meetings, AASHTO meetings, or FHWA Hydraulics Conferences

FHWA / TRB Advanced Research Plan

- Durable Hydraulic Structure Systems
- Advanced Hydraulics and Hydrology Design
- Environmental Sensitive Hydraulics and Hydrology
- Exploratory Advanced Hydraulics and Hydrology Research Program
TURNER-FAIRBANK HIGHWAY RESEARCH CENTER

Durable Hydraulic Structure Systems

- Develop and deploy high-performance, long-life, smart hydraulic hazard countermeasure materials that increase resiliency and reduce maintenance and reconstruction needs
- Development of hydrodynamic bridge systems to address flooding, overtopping, scour, surge, and wave action
- Development of advanced retrofit options for hydraulic structures

Advanced H&H Research Plan

Advanced Hydraulics and Hydrology Design

- Development of enhanced analytical and modeling capabilities (high performance computing) for predicting hydraulic hazard effects and for assessing & screening countermeasures
- Development of advanced hydrologic methods to estimate peak flow rates
- Development of enhanced scour analysis capabilities & countermeasures for inland and coastal bridges
- Development of intelligent remote sensing systems to capture hydraulic parameters during storm events

Advanced H&H Research Plan

Environmental Sensitive Hydraulics and Hydrology

- Development of retrofits and designs that facilitate fish and wildlife passage through hydraulic structures
- Development remote sensing to detect migration and habitat patterns
- Tracking of climate-change impacts and multiple hazards on hydraulics and flooding
- Development and deployment of material applications that provide for effective filtration of storm water runoff from highways and bridges before it is reintroduced into the surrounding watershed

Advanced H&H Research Plan

Exploratory Advanced Hydraulics and Hydrology Research Program

- Development of intelligent piers/abutments using biomimetic concepts (smart materials)
- Development of smart scour countermeasures using nano technology
- Development of intelligent remote sensing systems

Advanced H&H Research Plan

Questions?
Appendix M

FHWA Hydraulics R&D Program for FY08
presented by Kornel Kerenyi
at the AASHTO Spring 2008 Meeting
McLean, VA

FY08 Work Plan
- IBRD Program
- RITA
- TPF Studies
- EAR Program

IBRD Program
- Complete Research on Hydrodynamic Forces on Bridges
- Complete Research on Pressure Flow Scour
- Initiate Study on a ESTD and Cohesive Soils
- Initiate Study on an Adjustment Factor for Coarse Bed Material

High Performance CFD Modeling at ANL / TRACC
- Complete Analysis on Lift, Drag and Moments on Bridge Superstructures
- Analysis on Pressure Flow Scour
- Analysis on Scour Countermeasures using Fluidic Devices
- Analysis on Fish Passage in Large Culverts with Low Flows
- Analysis on Wave Forces and Moments for US Highway Bridge Decks
Transportation Pooled Fund Study Initiatives

- Fish Passage in Large Culverts with Low Flows (MD, AK, VT, GA, MI, MN)
- In-Situ Scour Testing Device (TX, NY, KA, NC)
- Junction Loss Experiments for Square/Rectangular Storm Sewer Junctions and StormCeptors (UT, Arlington County)
- Wave Force Response of Bridge Superstructures

Exploratory Advanced Research Program

- Volumetric Particle Image Velocimetry System for experimental Bridge Scour Research
- Flexible Skin Areal Shear Stress and Pressure Sensing System for experimental Bridge Scour Research

Outline

- New Pressure Flow Scour Prediction Method
- Drag, Lift and Moments on Inundated Bridge Decks
- Wave Deck Response Forces
- Scour in Cohesive Soils / ESTD
- Fish Passage in Large Culverts with Low Flows

New Pressure Flow Scour Prediction Method

Bridge Decks Tested

Scheme of Applying the Energy Equation for Case 1
Pressure Flow Scour – Prof. Guo’s Theory

Maximum Scour Depth for Case 1

- Energy Equation:
  \[ y_c = h_c = \frac{a_2 x V_c}{2 g b} \]
  \[ y_c = \frac{a_2 x V_c}{2 g b} \]
  \[ y_c = \frac{a_2 x V_c}{2 g b} \]

- Clear Water Contraction Scour Equation:
  \[ h_c = \frac{a x q^2}{b^2} \]

Scheme of Applying the Energy Equation for Case 2

New Pressure Flow Scour Prediction Method for Case 2 and 3

(Cont'd)

- Energy Equation:
  \[ h_c = \frac{a x q^2}{b^2} \]

- Continuity Equation:
  \[ V_c x \left( h_c + y_c \right) = V_c \]

Scour Design Equation for Case 2 and 3

(Cont'd)

- Energy Equation:
  \[ h_c = \frac{a x q^2}{b^2} \]

- Continuity Equation:
  \[ V_c x \left( h_c + y_c \right) = V_c \]

Scour Design Equation for Case 2 and 3
Pressure Flow Scour – Prof. Guo’s Theory

Maximum Scour Depth for Case 2 and 3

- Pressure Flow Scour Design Coefficients
  \[ Y = -0.0551x + 1.2115 \]
  \[ m = -0.0551 \text{ and } c = 1.2115 \]

- Pressure Flow Scour Design Equation for Case 2
  \[ b = \frac{h_c + h_s - h_{max}}{h_{max}} \]

- Pressure Flow Scour Design Equation for Case 3
  \[ b = \frac{h_c + h_s - h_{max}}{h_{max}} \]

Drag, Lift and Moments on Inundated Bridge Decks

Definition Sketch

\[ \text{Drag} = \frac{W}{V^2} \]
\[ \text{Lift} = \frac{V^2}{2} \]
\[ \text{Moments} = h_c + h_s - h_{max} \]

Velocity Flow Field using PIV

Drag, Lift and Moments on Inundated Bridge Decks

2D PIV for Pressure Flow

Velocity Flow Field using HP CFD Modeling
**Definition Drag, Lift and Moment Coefficients**

\[ C_D = \frac{F_D}{0.5 \rho x^2 V^2} \] for \( h^* > 1 \)

\[ C_L = \frac{F_L}{0.5 \rho x^2 V^2} \] for \( h^* < 1 \)

\[ C_M = \frac{M}{0.5 \rho x^2 V^2 \cdot L} \]

**Drag, Lift and Moments on Inundated Bridge Decks**

- **Drag Force Coefficients**
  - Fr=0.22, Rs=20292
  - Fr=0.32, Rs=28965
  - Fitting Equation: STAR-CD, Fluent-LES, Fluent-K-Epsilon

- **Lift Force Coefficients**
  - Fr=0.22, Rs=20292
  - Fr=0.32, Rs=28965
  - Fitting Equation: STAR-CD, Fluent-LES, Fluent-K-Epsilon

- **Moment Coefficients**
  - Fr=0.22, Rs=20292
  - Fr=0.32, Rs=28965
  - Fitting Equation: Fluent-LES, Fluent-K-Epsilon

**Wave Deck Response Forces**

Deck Response Displacements Recorded with High Speed Camera.
Wave Deck Response Forces

Assumption:

\[ F_{m} = m_{a} \cdot a_{y} \]

Wave Deck Response Stability Analysis (cont'd)

• Case 2:

Assumption was probably wrong:

\[ F_{a2} > F_{m} \]

Added Mass could be the Difference:

\[ F_{a2} = (m_{a} + m_{s}) \cdot a_{y} \]

Scour in Cohesive Soils / Ex-situ Scour Testing Device

Scheme of Three Boundary Conditions
Concept of the Ex-situ Scour Testing Device

\[ \tau = \mu \frac{V}{H} \]

Scour in Cohesive Soils

Ex-situ Scour Testing Device

Moving Belt on Rollers

Ex-situ Scour Testing Device

Shear Stress Sensor and Pressure Generator

Ex-situ Scour Testing Device
Fish Passage in Large Culverts with Low Flows

- Traditional design for culverts is for flood flows
- Immediate need for low flow hydraulics in culverts
- Need of determining the variation of local velocities
- How entrance and exit flows affect fish movement

**Project Description**

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1</td>
<td>Assemble a technical advisory committee</td>
</tr>
<tr>
<td>Task 2</td>
<td>Solicit information from participating states</td>
</tr>
<tr>
<td>Task 3</td>
<td>Develop detailed test matrix</td>
</tr>
<tr>
<td>Task 4</td>
<td>Fabricate models and conduct tests</td>
</tr>
<tr>
<td>Task 5</td>
<td>Procedure computing average and local velocities</td>
</tr>
<tr>
<td>Task 6</td>
<td>Full scale tests of commonly used corrugation patterns</td>
</tr>
<tr>
<td>Task 7</td>
<td>Prepare report, implement into FHWA procedures</td>
</tr>
</tbody>
</table>

**Scale Culvert Models (1 : 2)**

**New Culvert Flume**

**New Culvert Flume (cont’d)**

Research that is Essential, Indispensable, and Connected to our Customers
## Appendix N

### American Association of State Highway and Transportation Officials


#### Subcommittee on Design

#### Technical Committee on Hydrology and Hydraulics

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Cost per</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous Balance (Sep 07)</td>
<td></td>
<td></td>
<td></td>
<td>$3,155.75</td>
</tr>
</tbody>
</table>

#### Income

- Registration Moab, UT (Nov 07) 19 $95.00 $1,805.00
- Registration Baltimore, MD (Apr 08) 17 $100.00 $1,700.00

**Total Income $3,505.00**

#### Expenditures

- Checks New checkbooks 1 $19.00 $19.00
- Room Rate Refund Amy Ronfeldt 1 $135.16 $135.16

**Fall 2007 Meeting - Moab**

- Fall 07 Meeting Cost of Refreshements 1 $472.50 $472.50
- Fall 07 Meeting Meeting Facilities 1 $366.50 $366.50
- AASHTO SCOD Meeting Dave Henderson 1 $500.29 $500.29

**Spring 2008 Meeting - Baltimore**

- Bus Trip Karen Coffman 1 $700.00 $700.00
- Bus Driver Tip Cash Given by Rick Renna 1 $50.00 $50.00
- Hotel deposit by Hostees Karuna Pujara 1 $100.00 $100.00
- Catering Key West (Restaurant) 1 $710.03 $710.03

**Total Expenditures $3,053.48**

**Balance (May 2008) $3,607.31**
Appendix O
Appendix P