NCHRP 20-68A
“US Domestic Scan Program”

Domestic Scan 15-02
Bridge Scour Risk Management

Richard Marz, P.E.
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Wisconsin DOT
Domestic Scan 15-02
“Bridge Scour Risk Management”

- This scan was conducted as a part of NCHRP Project 20-68A, the U.S. Domestic Scan program

- The program was requested by the American Association of State Highway and Transportation Officials (AASHTO), with funding provided through the National Cooperative Highway Research Program (NCHRP)
The Program is a multi year project conducting 3-4 scans per year.

Each scan is selected by AASHTO and the NCHRP 20-68A Project Panel.

Each scan addresses a single technical topic of broad interest to many state departments of transportation and other agencies.

The purpose of each scan and of Project 20-68A as a whole is to accelerate beneficial innovation by:

- facilitating information sharing and technology exchange among the states and other transportation agencies;
- identifying actionable items of common interest.
“The scan team will focus on practices for inspection, monitoring, countermeasure selection and placement, and risk management for scour-critical and scour-susceptible bridges individually and in networks of varying sizes.”
“By documenting and sharing successful practices the scan team will produce a valuable resource for use by bridge owners, state and local bridge inspectors, bridge designers and bridge management staff in reducing the risk to the travelling public due to flooding and scour.”
Scan Team

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Michigan DOT

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Bridge Scour Manager Louisiana Department of Transportation and Development (LADOTD)

AASHTO / NCHRP
U.S. Domestic Scan Program
Team’s Approach

Desk Scan, Literature Search, Identify Agencies and prepare questions.

Is the evaluation team multidisciplined?

- Yes
- No

Combine Responses

Host Workshop
Risk Analysis

Risk Analysis to prioritize US's

Neural Networks for Probability of Failure

Vulnerability Analysis / Tables

NV's culvert approach

When a storm is big enough, not only SC

Bridges are at risk
Topic 1: General Procedures and Risk Analysis

- States need to form scour committees with interdisciplinary capabilities (i.e., Engineers from Geotechnical, Structural, and Hydraulics areas)
Topic 1: General Procedures and Risk Analysis

- Due to limited resources, States should consider using Risk Analysis to prioritize how to best apply their limited resources rather than using vulnerability analysis to identify scour critical bridges.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Rehabilitation</th>
<th>Replacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Cost</td>
<td>Lower Initial Cost = $18,790,000</td>
<td>Higher Initial Cost = $43,392,000</td>
</tr>
<tr>
<td>Life Cycle Costs</td>
<td>Net Present Value = $27,266,671</td>
<td>Net Present Value = $47,616,837</td>
</tr>
<tr>
<td></td>
<td>Equiv. Uniform Annual Cost = $1,123,598</td>
<td>Equiv. Uniform Annual Cost = $1,962,183</td>
</tr>
<tr>
<td>Functionality</td>
<td>Remains the same</td>
<td>Wider roadway deck promotes safety &amp; accommodates center channelization lane for left turns</td>
</tr>
<tr>
<td>Long Term Reliability</td>
<td>Substructures would be 130 years old before bridge is replaced</td>
<td>New bridge built to current codes and requirements</td>
</tr>
<tr>
<td></td>
<td>Additional future scour countermeasures likely required</td>
<td>Scour resistant Substructure</td>
</tr>
<tr>
<td>Risk</td>
<td>Greater potential for unforeseen issues with major structural repairs</td>
<td>Fewer unknowns with all-new construction</td>
</tr>
<tr>
<td></td>
<td>Higher likelihood for possible issues with 80-year old substructures</td>
<td>Ability to fully considerer potential issues in new design</td>
</tr>
<tr>
<td>Constructability</td>
<td>Specialized &amp; complex repairs for track and tread replacements</td>
<td>Typical Movable Bridge Construction</td>
</tr>
<tr>
<td></td>
<td>Jacking and shoring leaves</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Major work during winter</td>
<td></td>
</tr>
<tr>
<td>Construction Disruption</td>
<td>9-Month Roadway Closure</td>
<td>21-Month Roadway Closure</td>
</tr>
</tbody>
</table>
Scour is a nation-wide threat. AASHTO should create a multidisciplinary task force that would develop guidelines and specifications for scour mitigation design and to serve as a clearing house for new innovations.
Materials testing for cohesive soils or rocks can be performed for more accurate results.
Topic 2: Scour Modeling and Analysis

- States are recommended to use 2D/3D models that are shown to be very useful in advanced cases. There is a need to identify the conditions or parameters when the 2D models can be applied.
Topic 2: Scour Modeling and Analysis

- Encourage States and other agencies, involved with 2D modeling, to participate in NHI courses and other training workshops.
Topic 3: Monitoring and Field Inspection of Scour Critical Bridges

- States should establish collaborative partnerships with USGS and other agencies to facilitate sustainable data collection for scour predictions.
AASHTO and FHWA should establish partnerships with USGS and other agencies for innovative applications to advance the State-of-Art of flooding on highway infrastructure.
States should work proactively with FHWA for use and acceptance of advanced technologies for underwater inspection (e.g., sonar) to improve data collection and divers’ safety.
Continued and future research is needed to enhance the capabilities of various systems to measure real-time scour. Moreover, communication and dissemination of various research projects is needed to raise awareness of accomplishments.
States should have procedures for inspecting countermeasures during construction and routine inspections.

<table>
<thead>
<tr>
<th>Defects</th>
<th>Condition State 1</th>
<th>Condition State 2</th>
<th>Condition State 3</th>
<th>Condition State 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scour or Erosion</td>
<td>None.</td>
<td>Countermeasure is substantially effective. Scour or Erosion exists without undermining.</td>
<td>Countermeasure device has limited effectiveness. Erosion may be evident with undermining of countermeasure.</td>
<td>The channel protection device or scour countermeasure are unstable, missing or no longer effective.</td>
</tr>
<tr>
<td>Material Defect (scaling, abrasion, spalling, corrosion, cracking, spitting and decay)</td>
<td>Insignificant or minor defects.</td>
<td>Countermeasure device is substantially effective. Extensive minor to isolated advanced defects.</td>
<td>Scour countermeasures have limited effectiveness. Extensive advanced to major damage.</td>
<td></td>
</tr>
<tr>
<td>Damage (unraveling, displacement, separation, and sagging)</td>
<td>Insignificant or minor damage.</td>
<td>Countermeasure device is substantially effective. Extensive minor to isolated advanced damage.</td>
<td>Scour countermeasures have limited effectiveness. Extensive advanced to major damage.</td>
<td></td>
</tr>
</tbody>
</table>
Topic 4: Design, Construction, and Sustainability of Countermeasures

- AASHTO should establish a body to help disseminate the information related to the performance of various types of countermeasures.
It is recommended that States consider additional information (e.g., cross section, whether the bridges on the detour route are scour critical, etc.) to enhance their POA which could be useful to the stakeholders.
Topic 5: Plan of Action (POA)

- States are recommended to develop emergency protocols for widespread flood events.
Topic 5: Plan of Action (POA)

- States should create risk-based prioritization for implementing POA during flood events, which could be based on specific triggers for specific bridges.
Final Report and other material will be made available on the web at

www.domesticscan.org

2017
National Team Wish List

- Multi-disciplinary – Structural, Hydraulic and Geotechnical Subject Matter Experts
- National Coordination with other agencies such as FHWA, USGS
- Clearinghouse for research and new testing procedures
- Place to share countermeasure successes and failures
- Body to advance state of the art when scour manuals and speed the implementation of innovations nationally
Thank you for your consideration and for the states that participated in the scan!