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Presentation Outline

• Research Objectives
• Research Team
• Research Approach
• Update of Current Status
• Discussion
Research Objectives


- Incorporate developments in movable bridge engineering
- Develop standardized **element-level** descriptions and nomenclature
- Edit the manual for improved clarity of presentation. This includes filling gaps, and eliminating redundancies
- ...also improve graphics
The Project Panel

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Research Approach

PHASE 1

Task 1: Review Relevant Literature

Task 2: Summarize Developments since 1998 Manual and Conduct Gap Analysis

Task 3: Prepare an Outline of Manual Sections Requiring Modification

Task 4: Prepare Interim Report No. 1

PHASE 2

WE ARE HERE

Task 5: Execute the Approved Work Plan to Revise the Manual

Task 7: Develop Standardized Descriptions for Inventory and Inspection on Element-Level

Task 6: Potential Impact of the Proposed Revisions

Task 8: Prepare Interim Report No. 2

Task 9: Incorporate Review Comments and Prepare Ballot Items

PHASE 3

Task 10: Prepare Final Report
Task 1 – Literature Review

- Annotated summaries were prepared for 44 key references


<table>
<thead>
<tr>
<th>DOT</th>
<th>Name</th>
<th>Scope</th>
<th>Interval</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>Special C—Suspension and movable bridges</td>
<td>Entire</td>
<td>12 months</td>
<td>Poor condition</td>
</tr>
<tr>
<td>Florida</td>
<td>Movable bridge</td>
<td>Operation</td>
<td>12 months</td>
<td>Team has electrical engineer and mechanical engineer</td>
</tr>
<tr>
<td></td>
<td>Movable portion</td>
<td>Equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maryland</td>
<td>Drawbridge</td>
<td></td>
<td>72 months</td>
<td>Movable bridge equipment</td>
</tr>
<tr>
<td>Michigan</td>
<td>Movable equipment, routine</td>
<td>Equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Jersey</td>
<td>Movable Bridge—Type I</td>
<td>Equipment</td>
<td></td>
<td>In-depth electrical, mechanical equipment inspection</td>
</tr>
<tr>
<td></td>
<td>Movable Bridge—Type II</td>
<td></td>
<td></td>
<td>Medium-depth electrical, mechanical equipment inspection</td>
</tr>
<tr>
<td></td>
<td>Movable Bridge—Type III</td>
<td></td>
<td></td>
<td>Visually monitor operation of electrical, mechanical equipment</td>
</tr>
<tr>
<td>North Carolina</td>
<td>Movable span inspections</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oregon</td>
<td>Movable bridge</td>
<td>Entire</td>
<td>12 months</td>
<td>Cursory inspection for operation</td>
</tr>
<tr>
<td>Virginia</td>
<td>Movable bridge</td>
<td></td>
<td></td>
<td>Special team having an electrical engineer, a bridge safety engineer, and a mechanical engineer</td>
</tr>
<tr>
<td>Washington</td>
<td>Movable bridge operation</td>
<td>Operation</td>
<td>1 month</td>
<td>Trial opening of span</td>
</tr>
<tr>
<td></td>
<td>Special feature—Movable</td>
<td></td>
<td>12 months</td>
<td>Inspector has special training or experience</td>
</tr>
<tr>
<td></td>
<td>Movable bridge equipment</td>
<td></td>
<td>72 months</td>
<td>In-depth for electrical and mechanical equipment</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>Movable bridge</td>
<td></td>
<td>12 months</td>
<td></td>
</tr>
</tbody>
</table>
Task 2 –
Summary of Developments since 1998 Manual & Gap Analysis

• Task 2a: Gaps (36)

• Task 2b: Developments (17)

• Task 2c: Redundancies (4)
### Example Table – Task 2a List of Gaps

<table>
<thead>
<tr>
<th>No.</th>
<th>Gap</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Incorporating items listed in Task 2b with regards to developments since the Manual’s last publication in 1998.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Adding condition ratings of mechanical and electrical items in Pontis.</td>
<td>Format as supplement to the AASHTO Manual for Bridge Element Inspection, 2013</td>
</tr>
<tr>
<td>3</td>
<td>Developing criteria for element level rating and what constitutes a particular condition rating.</td>
<td>Format as a supplement to the AASHTO Manual for Bridge Element Inspections, 2013</td>
</tr>
<tr>
<td>4</td>
<td>Consistency is needed for electrical and mechanical inspection methods and scopes.</td>
<td>Due to varying preferences among movable bridge owners, it may not be possible to create standardized scopes that will be accepted and used. Suggested scopes, methods, inspection frequencies, and personnel qualifications will be proposed.</td>
</tr>
<tr>
<td>5</td>
<td>Additional information to be included regarding hydraulic machinery inspection and standards.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Discuss emergency inspections after an extreme event.</td>
<td></td>
</tr>
</tbody>
</table>

...continues to 36 Gaps, 17 Developments, and 4 Redundancies
Task 3 –
Outline of Manual Sections Requiring Modification

MANUAL FOR EXISTING MOVABLE BRIDGES

PART 1 – INTRODUCTION

PART 2 – INSPECTION

PART 3 – MOVABLE BRIDGE ELEMENT DESCRIPTIONS

PART 4 – EVALUATION

PART 5 – MAINTENANCE

APPENDIX

Note: The proposed title and outline are based on the AASHTO Manual for Bridge Evaluation, 2011
### Task 3 – Outline of Manual Sections Requiring Modification

<table>
<thead>
<tr>
<th>Manual Section &amp; Heading</th>
<th>Reference Section from 1998 Manual</th>
<th>Reference Section from 2011 MBE</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2 Types and Scopes of Inspection</td>
<td>2.1</td>
<td>4.2</td>
<td>The recommended minimum types and scopes of movable inspections will be provided. A checklist for routine and in-depth movable bridge inspection will be provided for each discipline: structural, mechanical, and electrical.</td>
</tr>
</tbody>
</table>

**Reference Literature:**

**Gaps to be Addressed:**
- Consistency is needed for electrical and mechanical inspection methods and scopes.
- Discuss emergency inspections after an extreme event.
- Clarify requirements regarding when drive machinery should be load rated for motor sizing, brake settings, and machinery torque capacity.
- Define the various types of inspection and the recommended scope and frequency associated with each.
• Received approval to proceed to Phase II
  July, 2014
Task 5 – Execute the Approved Work Plan to Revise the Manual

New Cover, New Title

Manual for Existing Movable Bridges

2015

DRAFT

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All rights reserved. Duplication is a violation of applicable law.
Task 5 – Execute the Approved Work Plan to Revise the Manual

- Graphics / Photos
- Types and Scopes of Inspections
- Inspector Qualifications
- Resiliency, Security, Sustainability
- Wire Rope Retirement Criteria
- Span Balance
- Medium Voltage
- Megger Data Normalizing
Task 5 – Execute the Approved Work Plan to Revise the Manual

Figure 2.8.2.11.1.2-1 – Segmental girder and tread plate of track girder (the girder is embedded in the pier concrete).

Photo Update Examples
Task 5 – Execute the Approved Work Plan to Revise the Manual

Figure 2.8.2.3.3-1 – A bascule bridge split sleeve type trunnion bearing

Photo Update Examples
Task 5 – Execute the Approved Work Plan to Revise the Manual

Photo Update Examples

Figure 2.8.2.11.2.5.1-1 – Latch bar not properly engaged in pocket
Task 5 – Execute the Approved Work Plan to Revise the Manual

Figure 2.8.2.11.3.6.1-1 – Binding of links in balance chain.

Photo Update
New Photo not Identified

Ok, keep image
Task 7 – Develop Standardized Descriptions for Inventory and Inspection on Element Level

• Agency Developed Elements (ADEs) for mechanical and electrical known to exist in:
  • Louisiana DOTD
  • Florida DOT
  • Washington State DOT
  • Maryland SHA
WSDOT Unique in Use of Hierarchy for Agency Defined Elements for Movable Bridges

- Discipline (Mechanical or Electrical)
- System (Span Drive Machinery, Locks, etc)
- Component (Motor, Speed Reducers, Hydraulic Power Unit, etc)

- However, AASHTOWare Bridge (Pontis) does not support hierarchical element definitions
- Approximate Quantity of 250 element definitions
Louisiana DOT, Florida DOT, and Maryland DOT use hybrid approach for Agency Defined Elements for movable bridges

- Element = Component of Drive System (motor, coupling, brake, etc.)
  and/or
- Element = System (locks, traffic gates, navigation, etc.)

- The mixture of disciplines, systems, and components adds confusion.
- Element condition states do not clearly translate to system condition or repair costs.
Proposed Bridge Management Element Definitions for Movables

- Element = Movable Bridge System with Discipline

Total of 16 element definitions proposed

The proposed approach to element definitions maximizes information and minimizes confusion.
Proposed Bridge Management Element Definitions for Movables

- Movable Bridge Support System – Structural
- Movable Bridge Support System – Mechanical
- Movable Bridge Balance System – Structural
- Movable Bridge Balance System – Mechanical
- Movable Bridge Drive System – Mechanical
- Movable Bridge Drive System – Electrical
- Movable Bridge Control System – Electrical
- Movable Bridge Control System – Mechanical

...continued
Proposed Bridge Management Element Definitions for Movables continued...

- Movable Bridge Interlocking System – Mechanical
- Movable Bridge Interlocking System – Electrical
- Movable Bridge Navigation Guidance System – Structural
- Movable Bridge Navigation Guidance System – Electrical
- Movable Bridge Electrical Power System – Electrical
- Movable Bridge Traffic Control System – Mechanical
- Movable Bridge Traffic Control System – Electrical
- Movable Bridge House - Structural
Proposed Bridge Management Element Definitions for Movables

Element 555 – Movable Bridge Drive System – Mechanical

**Description:** All mechanical elements of the main drive system

**Classification:** BME

**Units of Measurement:** each

**Quantity Calculation:** Number of main drive systems for the entire bridge

<table>
<thead>
<tr>
<th>Defects</th>
<th>Condition States</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 – Good</td>
</tr>
<tr>
<td><strong>Operation</strong></td>
<td></td>
</tr>
<tr>
<td>Movable span operates smoothly.</td>
<td>Movable span operation has minor flaws, such as light vibration or noise. No remedial action required.</td>
</tr>
<tr>
<td><strong>Lubrication</strong></td>
<td></td>
</tr>
<tr>
<td>Lubricants are fresh, clean, and well distributed.</td>
<td>Lubricant exhibits minor contamination. Oil levels slightly low. Application of grease is excessive or barely adequate.</td>
</tr>
<tr>
<td><strong>Wear</strong></td>
<td></td>
</tr>
<tr>
<td>None.</td>
<td>Light wear present with less than 10% section loss. No remedial action.</td>
</tr>
</tbody>
</table>
## Proposed Bridge Management Element Definitions for Movables

**Element 555 – Movable Bridge Electrical Power System – Electrical**

**Description:** All electrical elements of the electrical power system  
**Classification:** BME  
**Units of Measurement:** lump sum  
**Quantity Calculation:** Electrical power system for the entire bridge

<table>
<thead>
<tr>
<th>Defects</th>
<th>1 – Good</th>
<th>2 – Fair</th>
<th>3 – Poor</th>
<th>4 – Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrosion</td>
<td>None.</td>
<td>Light corrosion present within the conduit couplings and pull boxes. No remedial action required.</td>
<td>Moderate corrosion present within the conduit couplings and pull boxes. Short-term replacement of components may be required.</td>
<td>Heavy corrosion present within the conduit couplings and pull boxes. Immediate replacement of components may be required.</td>
</tr>
<tr>
<td>House-keeping</td>
<td>Access to pull boxes, junction boxes, motor control center are blocked. Electrical rooms are clean, sanitary, free of debris and trip or fall hazards.</td>
<td>The electrical access areas are generally safe, but may have minor debris or inconvenient access.</td>
<td>The electrical access areas have safety issues. Short term repairs may be required.</td>
<td>The electrical access areas have significant safety issues such as: unsanitary waste, guano, or debris. Alternatively, there are unsafe trip or fall hazards. Immediate repair may be required.</td>
</tr>
<tr>
<td>Damage</td>
<td>None.</td>
<td>Minor damage noted.</td>
<td>Moderate damage noted.</td>
<td>Heavy damage present.</td>
</tr>
</tbody>
</table>
Task 6 – Potential Impacts of the Proposed Revisions

• Public Safety

• Inspection Procedures

• Resources Needed for Implementation
Task 6 – Potential Impacts of the Proposed Revisions

• Public Safety
  • Asset management approach
  • Clarified scopes and inspector qualifications
  • Appendix A – Suggested Inspection Forms
  • Improved clarity – photos, electronic native document

• Inspection Procedures

• Resources Needed for Implementation
Task 6 – Potential Impacts of the Proposed Revisions

• Public Safety

• Inspection Procedures
  • New sections: Sustainability, Security, Resiliency
  • Wire rope retirement criteria – CFR
  • Reference design manual for span balance criteria
  • Electrical inspection of medium voltage equipment
  • Normalizing electrical insulation (Megger) testing

• Resources Needed for Implementation
Task 6 – Potential Impacts of the Proposed Revisions

- Public Safety

- Inspection Procedures

- Resources Needed for Implementation
  - Pilot project recommended to field test new elements
  - National training class recommended to qualify movable bridge inspectors
  - Internal owner procedures for archiving and using the new element-level ratings
Research Approach

Schedule

Ballot Items (*Manual*)  
Response to Comments  
Due April 30, 2015

Final Report  
June 30\(^{th}\), 2015

- Task 1: Review Relevant Literature
- Task 2: Summarize Developments since 1998 Manual and Conduct Gap Analysis
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- Task 10: Prepare Final Report

NCHRP 14-32, Proposed Revisions to the AASHTO Movable Bridge Inspection, Evaluation, and Maintenance Manual
Discussion

• Does your agency use the AASHTO Movable Bridge Inspection, Evaluation, and Maintenance Manual?

• Has your agency fully adopted element level bridge inspections? Of movable bridges?
Comments

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