Stay Cable Replacement of the Luling Bridge

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Hale Boggs (Luling) Bridge
Statement of Problem

- Rusting and water leakage in anchorages
- Cracking/splitting of cable cover pipes
- Signs of compromise in cables safety
- In 2002, LADOTD initiated a project for Structural Evaluation of the Stay Cables
Old Stay Cables
Parallel Wire System
Deck and Cross Girder
Lower Anchorage
Project Team
Inspection through Construction (2002-2012)

- LADOTD, Paul Fossier, Project Manager, Alan Weber, Project Engineer - Construction
- CTLGroup, Inspection-Design
- BES, Armin Mehrabi, Project manager for Inspection-Design, Field Engineer for Construction Support
- TranSystems, Inspection-Repair Design
- ABMB, Traffic Control Design-Plans
- IBT, Design-Construction Support
- Kiewit-Louisiana, Construction
Inspection, Condition Rating, and Life-Cycle-Cost Analysis
Assessment of Overall Integrity

Differences between design and measured profile:

- NE I - TE
- NE I - TW
- NE I - BE
- NE I - BW
- NE II - T
- NE II - B
- NE III - T
- NE III - B
- NE IV - TE
- NE IV - TW
- NE IV - BE
- NE IV - BW
- NE V - TE
- NE V - TW
- NE V - BE
- NE V - BW
- NE VI - T
- NE VI - B

Cable Force Measurement

Difference between design and measured profile
Inspection
Cable Free Length Inspection
Cable Free Length Inspection

[Images of people inspecting cables with equipment]
# Inspection findings
## Damage Severity Levels

<table>
<thead>
<tr>
<th>Severity Level</th>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Satisfactory</td>
<td>Minor deterioration and anomalies noted</td>
</tr>
<tr>
<td>2</td>
<td>Poor</td>
<td>Deterioration of the protective elements and potential for degradation. Cables with this level of damages need to be routinely monitored and corrective action needs to be planned.</td>
</tr>
<tr>
<td>3</td>
<td>Critical</td>
<td>Deterioration or potential for deterioration of the main tension elements (steel wires) exists. Action (repair) is necessary. Cables with this level of damages shall be closely monitored until repairs are applied.</td>
</tr>
</tbody>
</table>
Severity Level 3 - Critical, Damage Examples
Summary

- 40 out of 72 cables were rated critical
- All cables had at least damage Level 2
- Increasing rate of deterioration was evident
- Timely corrective action was needed
- Based on a Life-Cycle-Cost Analysis, public safety concerns, and importance of the bridge, LADOTD decided to replace all cables
Cable Replacement Design, and Construction
Cable Replacement Design

Objectives:

- Develop a cost effective design.
- Minimize impact on traffic.
- Analyze for live load, wind force, and construction load effects.
Replacement Cable Design

Selected cable system

Parallel Strand System with Individually Greased Sheathed Seven-wire Strands Encased in HDPE Cover Pipe
Replacement cable design

Parallel strand, preferred system

- Larger anchorage and cable envelope
  - Require modifications to existing structure
  - Increase wind load
  - Change aerodynamic characteristics

Old Cables; 103 to 307, ¼” wires
New Cables; 23,45,57,67, 0.62” strands
Additional 24 reference strand for follow-up inspections
Temporary cable design

Need for Temporary cables

- Uncertainty in cable condition
- Large cable group spacing
- Need to maintain traffic w/o load limits
Temporary cable design
Temporary Cables
Construction Sequence
Install Temporary Cables
Construction Sequence
Detension and lower cable
Construction Sequence
Detension and lower cable
Construction Sequence
Modification of Anchorage Zones
## Construction Sequence
### Modification of Anchorage Zones

Cables Outer Diameter in Inches

<table>
<thead>
<tr>
<th>Cable Group</th>
<th>Old cables</th>
<th>New Cables</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>6.3</td>
<td>8.8</td>
</tr>
<tr>
<td>II</td>
<td>6.3</td>
<td>7.8</td>
</tr>
<tr>
<td>III</td>
<td>6.3</td>
<td>7.8</td>
</tr>
<tr>
<td>IV</td>
<td>4.3</td>
<td>6.4</td>
</tr>
<tr>
<td>V</td>
<td>6.3</td>
<td>7.8</td>
</tr>
<tr>
<td>VI</td>
<td>7.1</td>
<td>9.8</td>
</tr>
</tbody>
</table>
Construction Sequence
Modification of Anchorage Zones
Construction Sequence
Modification of Anchorage Zones
Construction Sequence
Modification of Anchorage Zones
Construction Sequence
Weld PE Pipe
Construction Sequence
Hoist PE Pipe
Construction Sequence
Install Strand and Stress
Lower Ends and Anchorages
Upper Ends and Anchorages
Modeling and Structural Analysis
Maintenance of Traffic
Design for Peripherals

Cable vibration suppression measures
Cable Vibration Suppression Measures
Cable Vibration Suppression Measures
Inspection performed 2002-2006
Cable replacement design 2007-8
Construction project bid February 2009
Construction began September 2009
Zone 1 completed February 2011
All Cables replaced September 2012
Questions?