Preserving Suspension Span Cables using Dehumidification

The First Main Cable Dehumidification Project in North America
Very Unique Bridges

Severn River Bridge, UK
Forth Road Bridge, UK
Humbur Bridge, UK
Chesapeake Bay Bridge – Maryland, USA

*Cable Dehumidification*
Suspension Spans

Westbound Bay Bridge (completed in 1973)
- 3-Lane Suspension Bridge with 1,600 foot main span
- Shop-fabricated parallel wire strands (13" dia.)
- Compacted, banded & wrapped with spirally wound neoprene sheet

Eastbound Bay Bridge (completed in 1952)
- 2-Lane Suspension Bridge with 1,600 foot main span
- Helical galvanized strands with aluminum fillers (13" dia. cables)
- Wire wrap system, overwrapped in 1991-92 with neoprene
Cable Anchorage
Project Overview
Project Overview – Scope & Cost

**Scope**

- Rewrapping Cable & Dehumidification
- Perform Cable Band Bolt Tightening
- Wedge Select Panels for Internal Inspection
- Miscellaneous Structural Repairs

**Bid Cost**

- Bid Cost $41M
- 2-Year Maintenance/Warranty - $75K / Year
Project Overview – Project Delivery

2009/10 – Internal Investigation per NCHRP 534
   – 9 Panels WB & 8 Panels EB

2011 – Acoustic Monitoring System on WB Cables
   – Rewrapping/Dehumidification Advertised

2012 – NTP for Main Cable Rewrapping/Dehumidification

Feb 2014 – WB System Commissioned

Mar 2014 – WB System Operational

Nov 2015 – EB System Commissioned

Jan 2016 – EB System Operational
Project Overview – Project Delivery

Competitive Sealed Proposal (CSP)

• Contractor Submits Separate Technical and Price Proposals
  • Oral Presentations & BAFO
  • HVAC Drawings
    • Certain aspects “performance based” to allow Contractor flexibility in supplier selection and final detailing / integration
  • All components subject to review by A&W and AECOM
• 2-year Warranty Period; Plus optional 2-years
• Temporary Access Significant Challenge
Project Overview – Main Cable Access

Project specifications allowed flexibility in contractor work such as main cable access.

Contractor elected to use full-length platforms hung from main cables and made provisions for water access.
Recommendations from the Cable Investigation
Recommendations Based on Internal Investigations

• Rewrap main cables and re-caulk cable bands
• Install main cable and anchorage dehumidification system
• Utilize acoustic monitoring system data to monitor wire conditions
• Wedge and evaluate additional main cable panels as part of rewrapping project

Once the need to rewrap full-length was identified, dehumidification became a prudent **upgrade** in the overall cable preservation system.
Main Cable Dehumidification System
Cable Dehumidification System - General

- Cable Dehumidification first used in 1998 in Japan
- Based on research by W.H.J. Vernon in 1920’s & 30’s and other work by H.H. Uhlig, MIT
Cable Dehumidification System - General
Cable Dehumidification System

Westbound Bridge

Eastbound Bridge
Cable Dehumidification System – Wrapping
Cable Dehumidification System – Wrapping
Cable Dehumidification System – Cable Band Sealing
Cable Dehumidification System – Dried Air Supply
Cable Dehumidification System – Plant Rooms
Cable Dehumidification System – Plant Rooms
Shop Trials
Shop Trials – Wrap

Rigorous shop trials conducted on test rig

- Promote high quality wrapping & heat sealing
- Train crews prior to application to bridge
Shop Trials – Plant Rooms

- Preassembly & shop trials of plant rooms with control systems
- Facilitated start-up of the plant rooms on site
- Once deemed operational in the shop, plant rooms allowed to be installed on the bridges
Monitoring & Results
## Monitoring – Supervisory Control & Data Acquisition

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Monitoring – SCADA PC & Secure Website
Results – Relative Humidity WB Bridge

- Commissioned February 2014
- Fully operational March 2014
- RH < 60% by September 2014
- RH < 40% by November 2014
Results – Water Removed (WB Bridge – North Cable)

Approximately 300 gallons of water removed from the North cable by April 2016 and over 700 gallons total for North & South Cables.
Results – Relative Humidify EB Bridge

- System operation September 2015
- Commissioned November 2015
- Fully operational December 2015
- RH < 60% by October 2015
- RH < 40% by mid-October 2015

Plant room outage for work
Results – Water Removed (EB Bridge – N & S Cables)

Approximately 210 gallons of water removed from the North & South cables within 7 months
Project Overview - Team

**Maryland Transportation Authority, Owner**
- Engineering & Construction

**Ammann & Whitney, Owner’s Engineer**
- Overall Consultant Team Project Management

**AECOM, Owner’s Engineer**
- Cable Rewrapping & Dehumidification System Layout and General Design

**Kiewit, Prime Contractor**
- Supported by various specialty subcontractors and sub-consultants; HNTB & TYLin – Dehumidification System Detailing & Integration Engineers
Some Awards

• 2016 MDOT Award of Excellence –
  Long-Span Bridge Engineering Center
Honshu-Shikoku Bridge Expressway Company Limited

UrbanAce Samnomiya Bldg. 4-1-22 Onoedori, Chuo-ku, Kobe, 651-0088, Japan

Engineering Excellence Competition

• 2016 Honor Award – (ACEC) National Engineering Excellence Award Competition
Peregrine Falcon

- Classified as a raptor (bird of prey)
- Fastest animal on Earth flying at 200+ mph
- Become very aggressive when defending their nest