Sunshine Bridge Emergency Repair

AASHTO COBS
6/27/2019

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LADOTD Bridge Design Administrator
OUTLINE

- Damages
- Repair
- Project Team
- Timeline
Damages
10/12/18 ~2:00am Sunshine Bridge was hit
Marquette Transportation’s mv. Kristin Alexis
Cooper Consolidated crane barge Mr. Erwin
West Channel 725’/125’
Main Channel 750’/133’

Built in 1964
Damaged Bottom Chord L15 – L16
Compression Member
DL = 1.7 Million Pounds
(≈142 Elephants)

Where did these elephants go after impact?
How many trapped in the damaged chord?
Damaged Bottom Chord

Damaged Laterals
49 locations
160+ misc. damages
Repair
Panel between L15 – L16 Shorten by ~ 3 3/8”
Repair Steps
1. Design, fabricate, and install jacking frame (load bypass system)
2. Apply jacking load to the estimated remaining comp. in the chord and then cut middle section of damaged chord
3. Heat straightening remaining ends
4. Jacking the structure to original geometry
5. Install replacement chord and splice ends
6. Transfer load from jacking frame to the replacement chord
Two Goals

➢ Restore Original Geometry

➢ Restore Load – 1700 k or 142
Step 1a – Design Jacking Frame

Jacking System Capacity = 1.5 \times 1,700,000 \text{ lbs} = 2,550,000 \text{ lbs}
Installation Procedure
50+ Steps

DAMAGED LATERAL L16-M15 REMOVAL STEPS

51) SECURE LATERAL L16-M15 TO STRINGERS USING TWO BEAM CLAMPS.
52) RIG SEGMENT OF LATERAL TO BE CUT AND HOOK TO CARRY DECK CRANE POSITIONED ON BRIDGE DECK.
53) CREATE DOGBONE STRAIN RELIEF PER DETAIL 2 IN LATERAL APPROXIMATELY 3 FT FROM L16 END
54) ADJUST JACK PRESSURES PER PROCEDURE
55) SEVER LATERAL
56) UNBOLT LATERAL AND REMOVE SEGMENT
Step 1b – Install Jacking Frame
Step 2 – Cut Damaged Chord
Step 3 – Heat Straightening
Step 4 – Jacking Structure to Original Geometry

Jacking Up to 2.1 Million Pounds at 50k increments. Critical, Slow, and Long Process 100+ Steps
Jacking Monitoring System
Step 5a – Install Replacement Chord
Step 5b – Splice Ends
Step 6 – Transfer Load from Jacking System to New Chord
Panel between L15 – L16 Shorten by ~ 3 3/8”
Prior to Repair
Green – Upstream
Pink – Downstream

After Repair
Gold – Upstream
Purple – Downstream

Geometry Restored

L16

Start Point: -440° 10 5/8”
End Point: -440° 8 13/16”
Delta: 0° 3 13/16”

Start Point: 104° 2 3/4”
End Point: 104° 2 1/16”
Delta: 0° 0 5/8”
Damaged Bottom Chord L15 – L16
Compression Member
DL = 1.7 Million Pounds
(~142 Elephants)

Stringers
Floor beams
Damaged Laterals

Where did these elephants go after impact?
How many trapped in the damaged chord?
Downstream Bottom Chord Load Changes in Kips

Upstream Bottom Chord Load Changes in Kips

- Load Restored
Barrier Deck Joint at L17 Before and After Repair
After 49 days (working 24/7) Sunshine Bridge Reopened to Traffic on 12/1/18
Lessens Learned

- Thermal loads must be considered in the design of jacking system (300k-400k).
- Heat straightening of impact damaged member is more challenging than heat damaged member.
- 3D scanning is a very useful tool in damage documentation, conflict/clash detection, and checking geometry during jacking.
- Attaching new members to existing damaged/distorted members and gusset plates requires tremendous preparation effort (templates, filler plates, accurate measurements, etc.).
Project Team
Design Team

- MODJESKI and MASTERS
- WJE
- BDI
- FORTE & TABLADA
- HUVAL

Contractor’s Team

- COASTAL BRIDGE
- DAN R. DALTON
- C.E.C., INC.
- AREJ SHEET METAL
- INDUSTRIAL SOLUTIONS INC.
- THOMAS INDUSTRIAL COATINGS
- SOUTHERN SYNERGY

Project Engineer
- CEI
Damage Assessment, Inspection, Structural Monitoring, Analysis and Load Rating, CEI, & QC/QA BDI - Instrumentation

Jacking/Load Bypass System, Jacking/Repair Procedures & Jacking Monitoring

Work Platforms, Replacement Chord, Bottom Laterals & Misc. Repair

Topo Survey, Laser Scanning/Damage Documentation, Conflict and Clash Detection, Movement and Displacement Monitoring during Jacking

Project Engineer, Communication and Coordination

Prime Contractor

Jacking Sub-Contractor

Jacking Framing Fabricator

Heat Straightening

Replacement Chord and Misc. Steel Fabricator

Industrial Solutions Inc. – Secondary Work Platforms

Thomas Industrial Coatings – Painting

Southern Synergy – Roadway Work
Timeline

- 10/12/2018 (Day 1) Sunshine Bridge was Hit and Closed
- 10/12/2018 (Day 1) Survey, Inspection, Repair Concept Started
- 10/20/2018 (Day 9) Crane Barge and Temp. Access in Place
- 10/22/2018 (Day 11) Repair Concept Verified on Site and Finalized
- 10/26/2018 (Day 16) Primary Work Platform Installed
- 11/04/2018 (Day 24) Jacking Frame Design and Shop Drawings Completed
- 11/08/2018 (Day 28) Jacking Frame Fabricated and Shipped
- 11/13/2018 (Day 32) Jacking Frame Installed
- 11/17/2018 (Day 36) Damaged Chord Removed
- 11/25/2018 (Day 45) Heat Straightening Completed
- 12/01/2018 (Day 49) Replacement Chord in Place; Geometry and Load Restored; Bridge Reopened to Traffic!
Thank you!