Session 36

H.R. Hamilton

University of Florida

St George Island Pile Testing

Topic Description

In 2004 the Bryant Patton Bridge over Apalachicola Bay in the Florida panhandle was replaced. During demolition, twelve prestressed concrete piles with varying levels of corrosion damage were recovered. Two of the selected piles were equipped with a cathodic protection that had been installed in 1994 as part of a repair project involving most of the piles supporting the bridge. REsults of flexural and material testing that were conducted on the recovered piles will be presented.

Speaker Biography

H. R. (Trey) Hamilton III, P.E., PhD is an Associate Professor of Civil Engineering at the University of Florida in the Department of Civil & Coastal Engineering. His research and teaching interests include reinforced and prestressed concrete.

FICE/FDOT Design Conference 2006

Designing For More Than Bridges and Roads

St George Island Bridge Pile Testing

Trey Hamilton, P.E., Ph.D.
University of Florida

Acknowledgements

- FDOT Research Center
- Mr. Marc Ansley, Project Manager
- Eric Cannon, Claire Lewinger and Laz Alfonso, Caesar Abi, UF Graduate Students
- Frank Cobb, Tony Johnston, David Allen, Paul Tighe, and Steve Eudy of the FDOT Structures Research Center
- Mr. Scott Gros of Boh Bros. Construction

Acknowledgements

- Mr. Richard Delorenzo, FDOT State Materials Office (strand testing)
- Mr. Don Buwalda and the inspection team from FDOT District Two
- Mr. Ivan Lasa from the Corrosion Group of the FDOT State Materials Office
- Mr. William Scannell of Concorr, Florida, Inc.

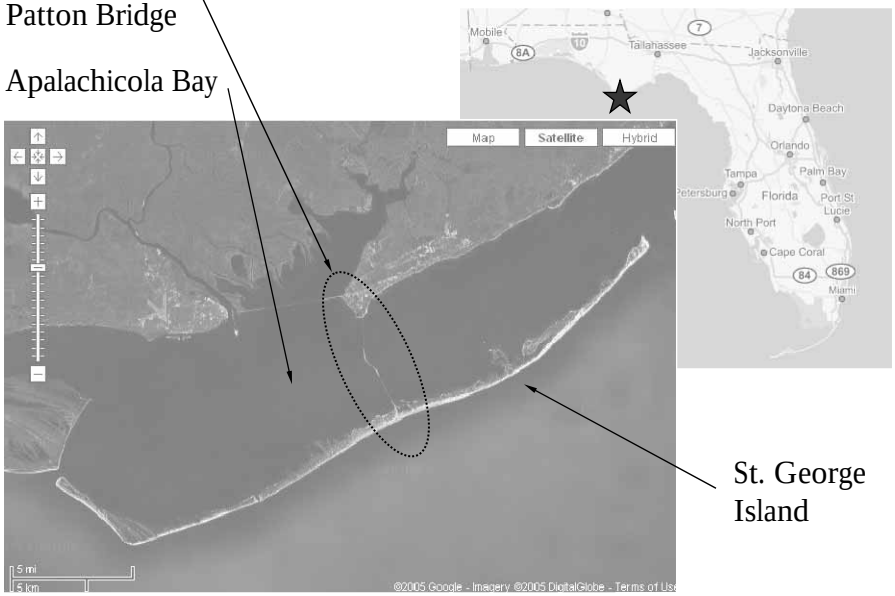
Outline

- Introduction
- Pile Recovery
- Testing
- Results
- Conclusions

Location

Bryant Grady Patton Bridge

Apalachicola Bay



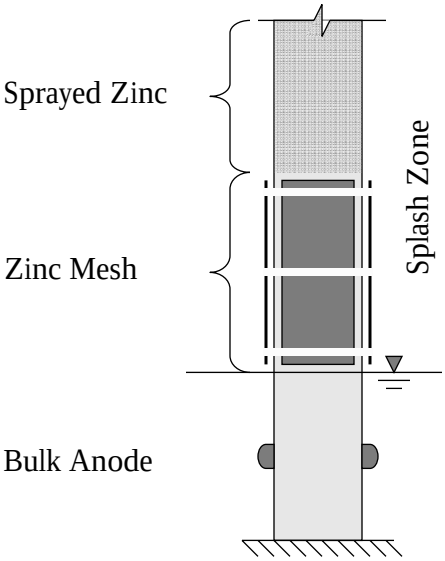
St. George Island

History – Bryant Grady Patton Bridge

- Constructed in 1965.
- Carries SR 300 over Apalachicola Bay
- Pile repair in 1994
  - Patch
  - Concrete jacketing
  - Cathodic protection
- Removed from service 2004

1994 Repair Program

Cathodic Protection System



Objectives

- Evaluate remaining flexural capacity of piles
  - Why? Resistance to lateral loads such as barge impact.
- Compare tested capacity to visual rating
  - Why? Most inspections are visual with ratings used to classify state of bridge.

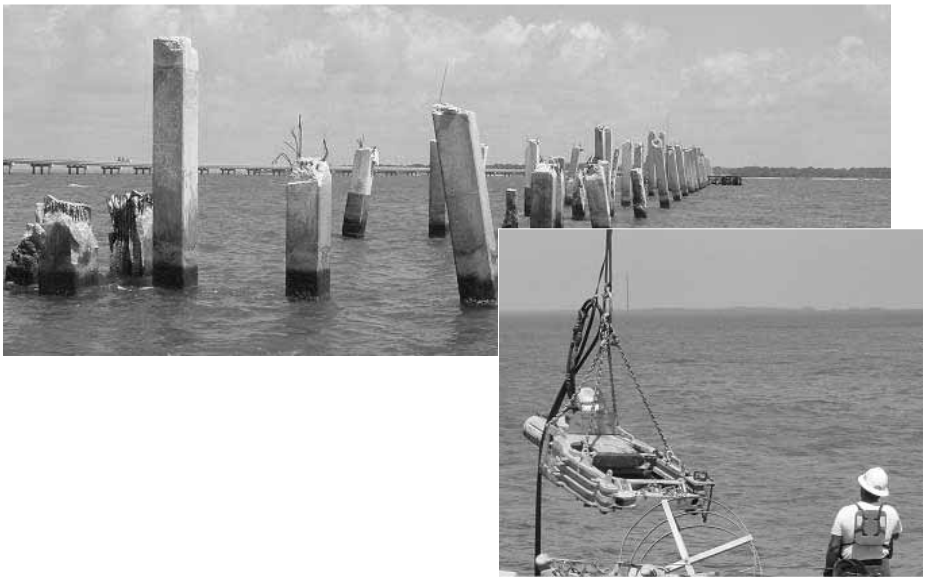
Tasks

- Select piles
- Visual inspection and corrosion potentials in place
- Sample dissolved hydrogen in CP pile
- Sample chloride content of concrete
- Structural testing
- Post-test evaluation
- Materials testing

Recovery – Selection

FDOT D2 Inspection

Recovery – Cap Beam Removal



Recovery – Pile Removal

12 piles recovered and tested

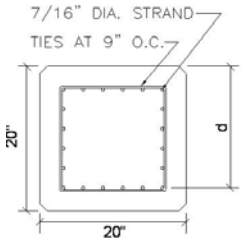
Recovery – Pile Removal

On site sampling of prestressing strands for dissolved hydrogen

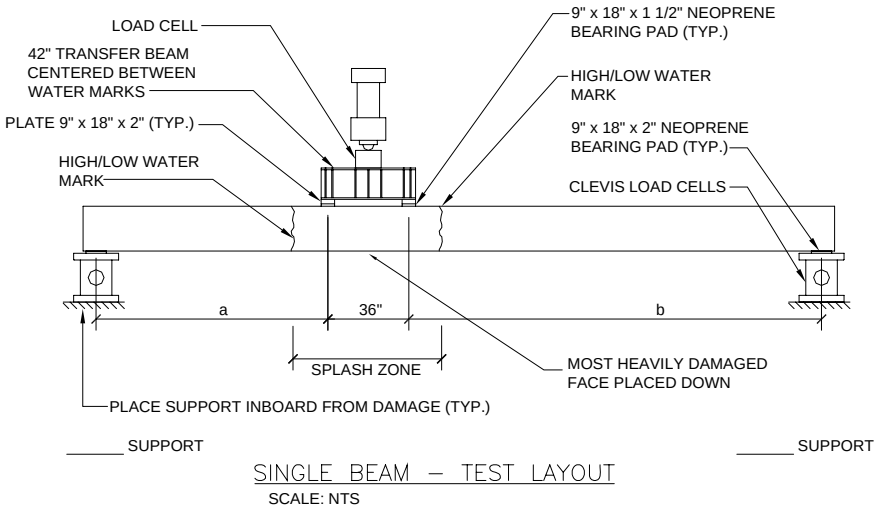
Recovery – Pile Preparation

Specimen Details

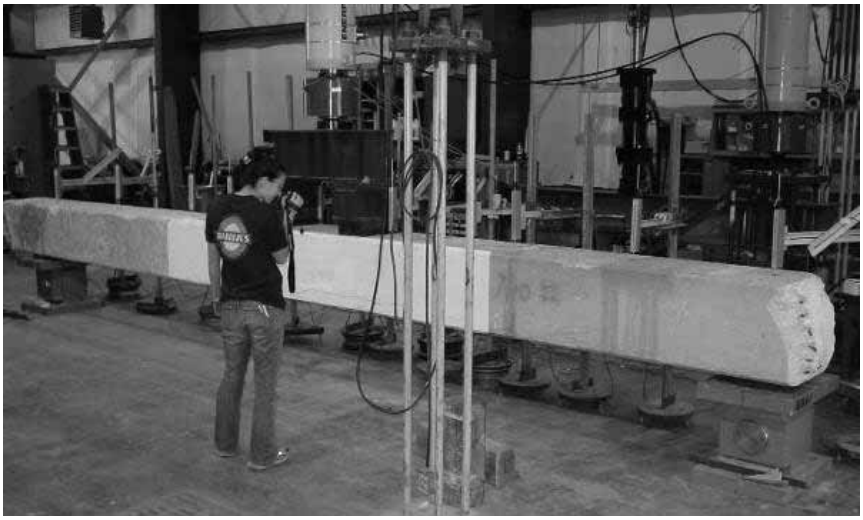
- (20) 7/16-in. diameter stress relieved 7-wire prestressing strands
- Average tested tensile strength of strands = 261 ksi
- Core concrete strength = 6200 psi



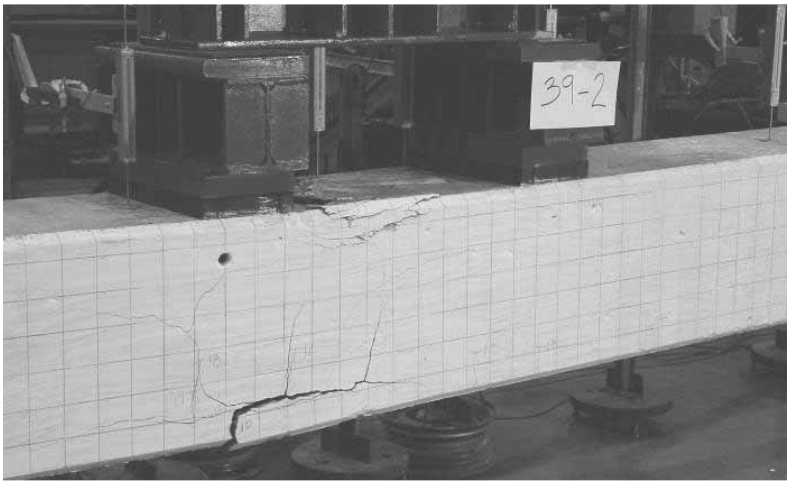
Flexural Test Set-up



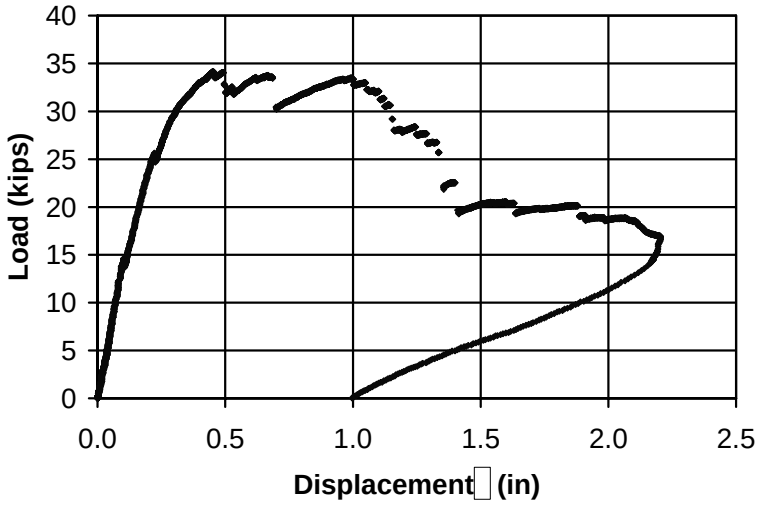
Flexural Test Set-up



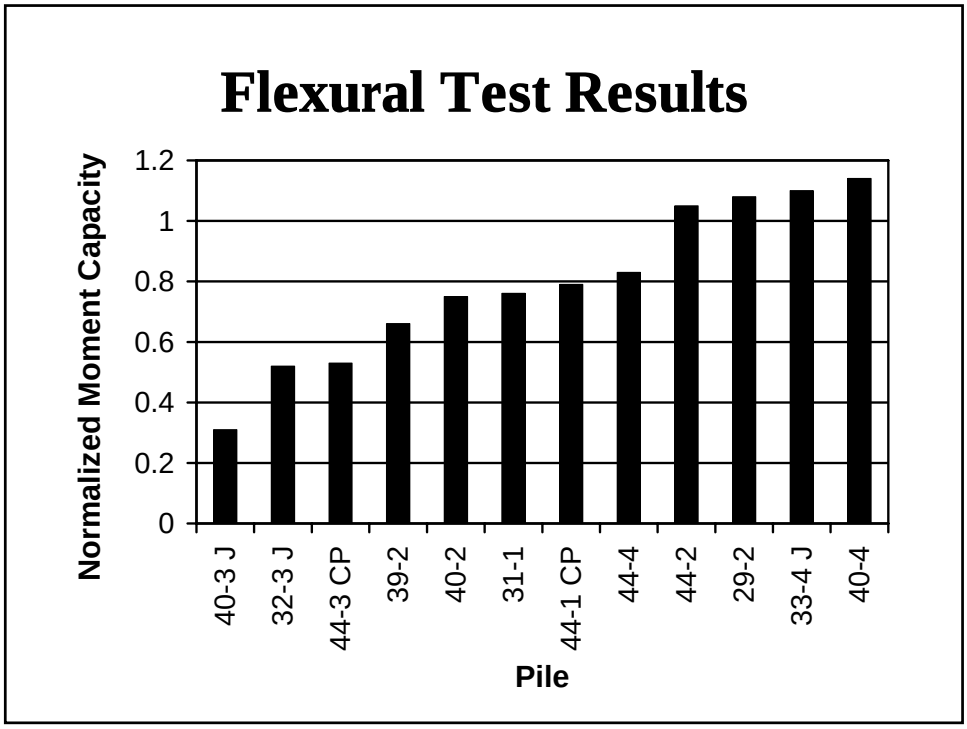
Typical Flexural Behavior

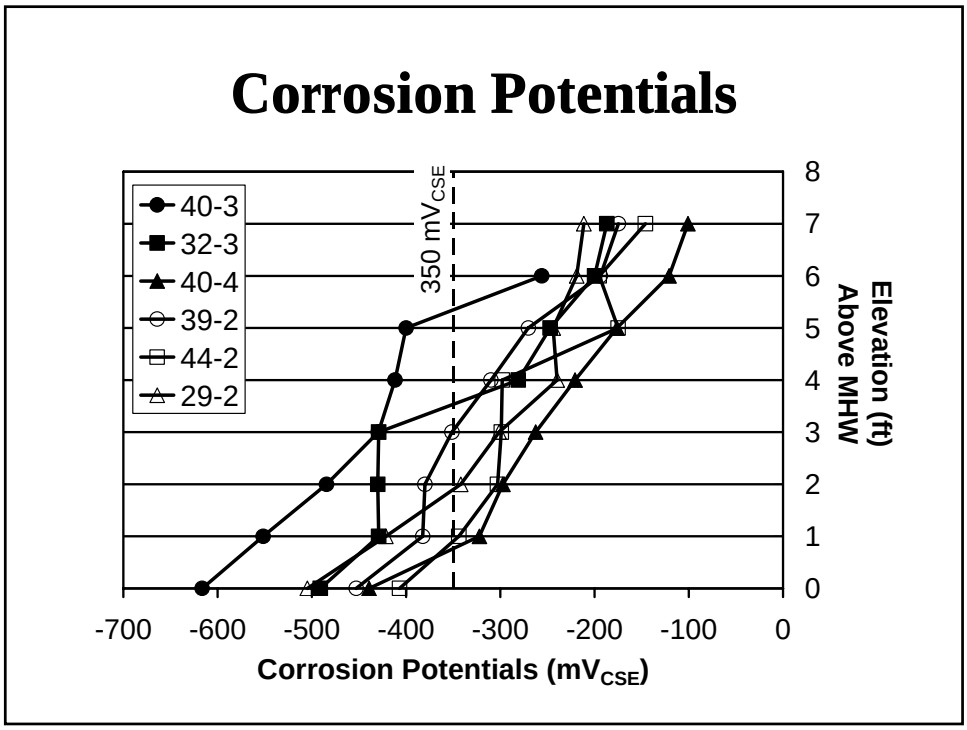


Typical Flexural Behavior

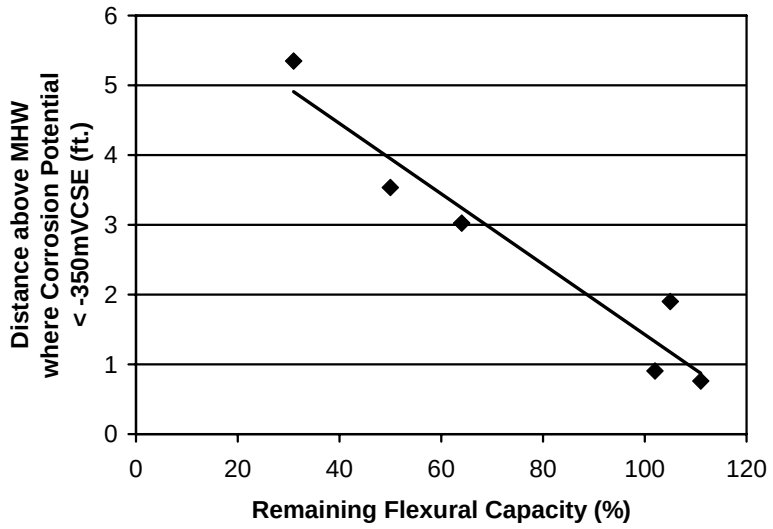


Corrosion Damage


Flexural Test Results
Normalized Moment Capacity
1.2
1
0.8
0.6
0.4
0.2
0
40-3 J
32-3 J
44-3 CP
39-2
40-2
31-1
44-1 CP
44-4
44-2
29-2
33-4 J
40-4
Pile

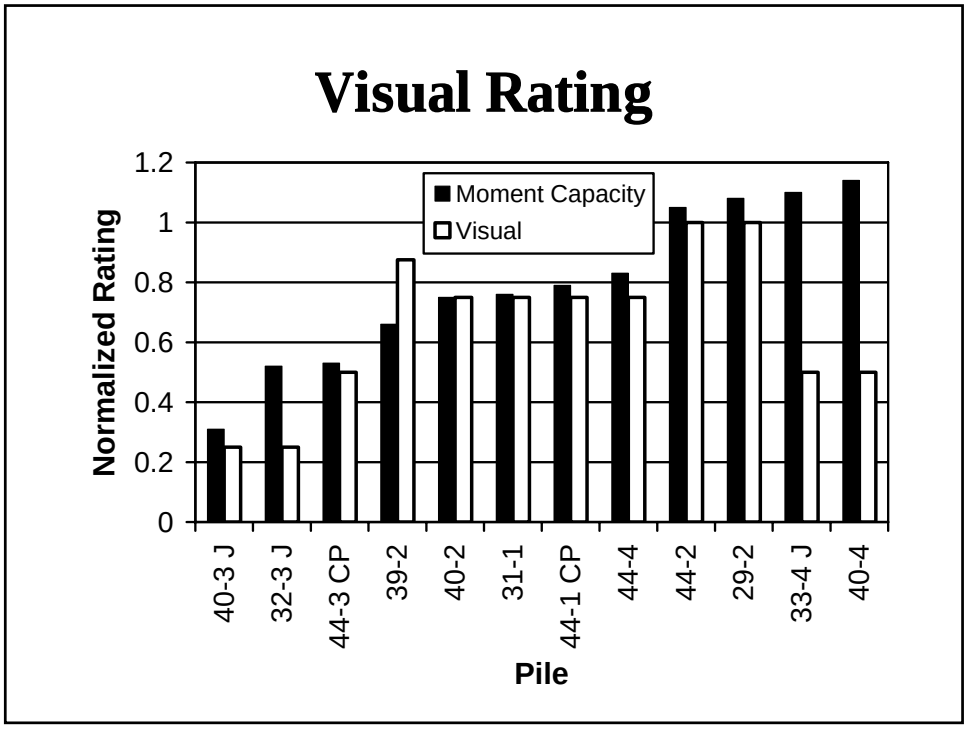

Corrosion Potentials
40-3
32-3
40-4
39-2
44-2
29-2
350 mV$_{CSE}$
8
7
6
5
4
3
2
1
0
Elevation (ft) Above MHW
-700
-600
-500
-400
-300
-200
-100
0
Corrosion Potentials (mV$_{CSE}$)

Corrosion Potentials

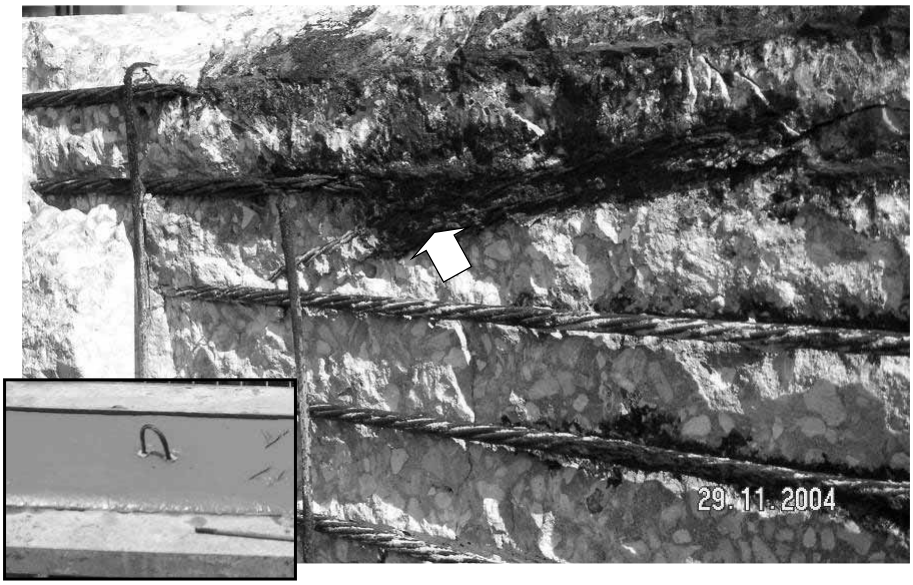


Visual Rating

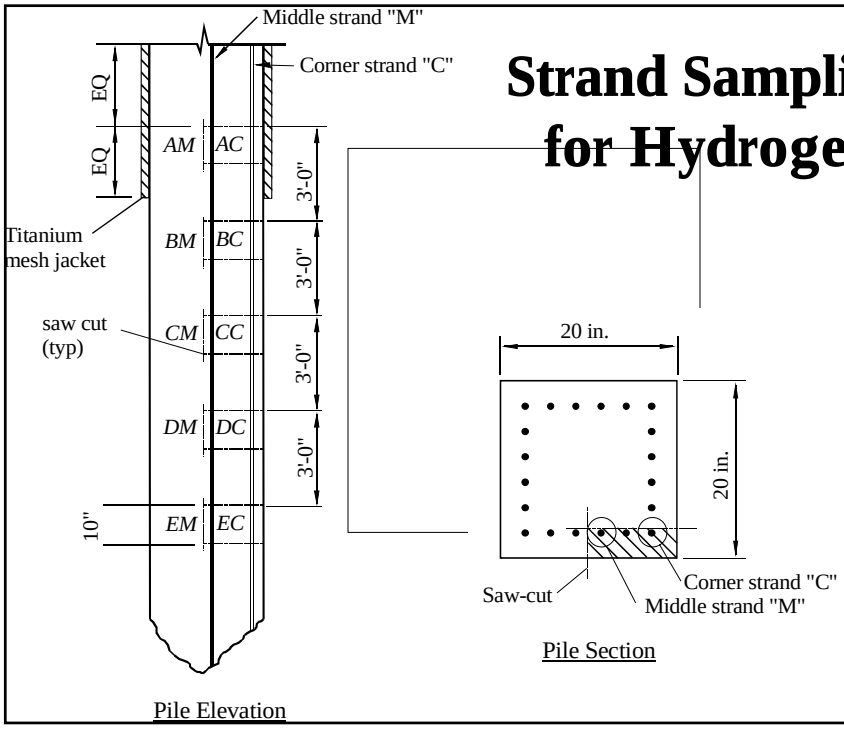
- Conducted by graduate student unfamiliar with flexural test results (no previous inspection training)
- Used photos and notes taken by D2 inspection team
- Ratings based on FDOT inspection guidelines for Commonly Recognized Structural Elements (CoRe)
- Normalized capacity based on rating


Visual Rating
Moment Capacity
Visual
Normalized Rating
1.2
1
0.8
0.6
0.4
0.2
0
40-3 J
32-3 J
44-3 CP
39-2
40-2
31-1
44-1 CP
44-4
44-2
29-2
33-4 J
40-4
Pile

Lifting Loops

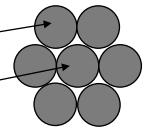


Strand Sampling for Hydrogen



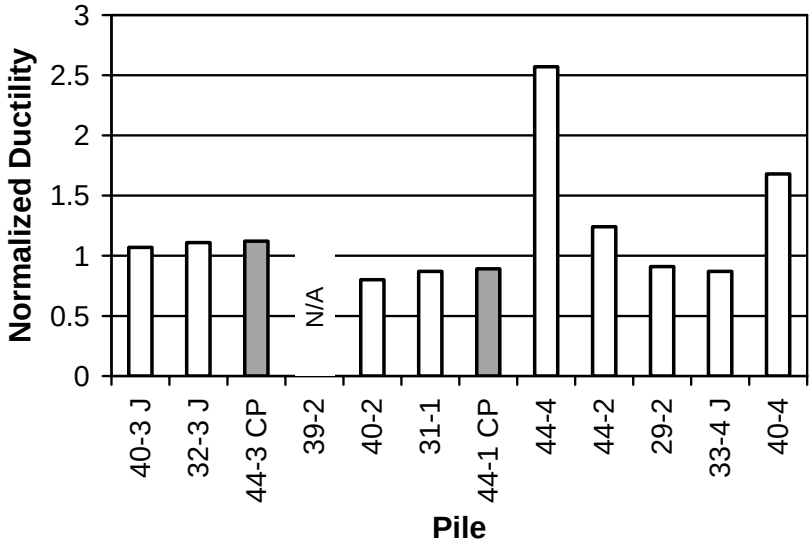
Results - Hydrogen Sampling

- Average of pile with CP:
  - Outer wire: 2.0 ppm
  - Inner wire: 1.4 ppm



- Average of pile without CP:
  - Outer wire: 0.92 ppm
- Expected background level: 0.6 to 0.7 ppm
- Appears that some charging had occurred

Effect of Hydrogen?



Conclusions – Hydrogen

- Elevated levels of hydrogen detected in CP piles
- Outer wires appeared to have higher levels of dissolved hydrogen
- No clear indication of a loss in ductility due to charging (based on flexural testing)

Conclusions – Pile Capacity

- 8 out of the 12 piles tested below the calculated flexural capacity.
- Reduced capacity ranged from ~30 to 80% of full capacity.
- Both CP piles tested below 80% of original capacity. Appeared to be loss of section before CP installation.

Conclusions – Visual Rating

- 7 of the 12 piles (58%) the normalized visual rating was within 10% of the normalized moment capacity
- One pile (8%) capacity was overestimated
- The remainder of the pile (34%) capacities were underestimated