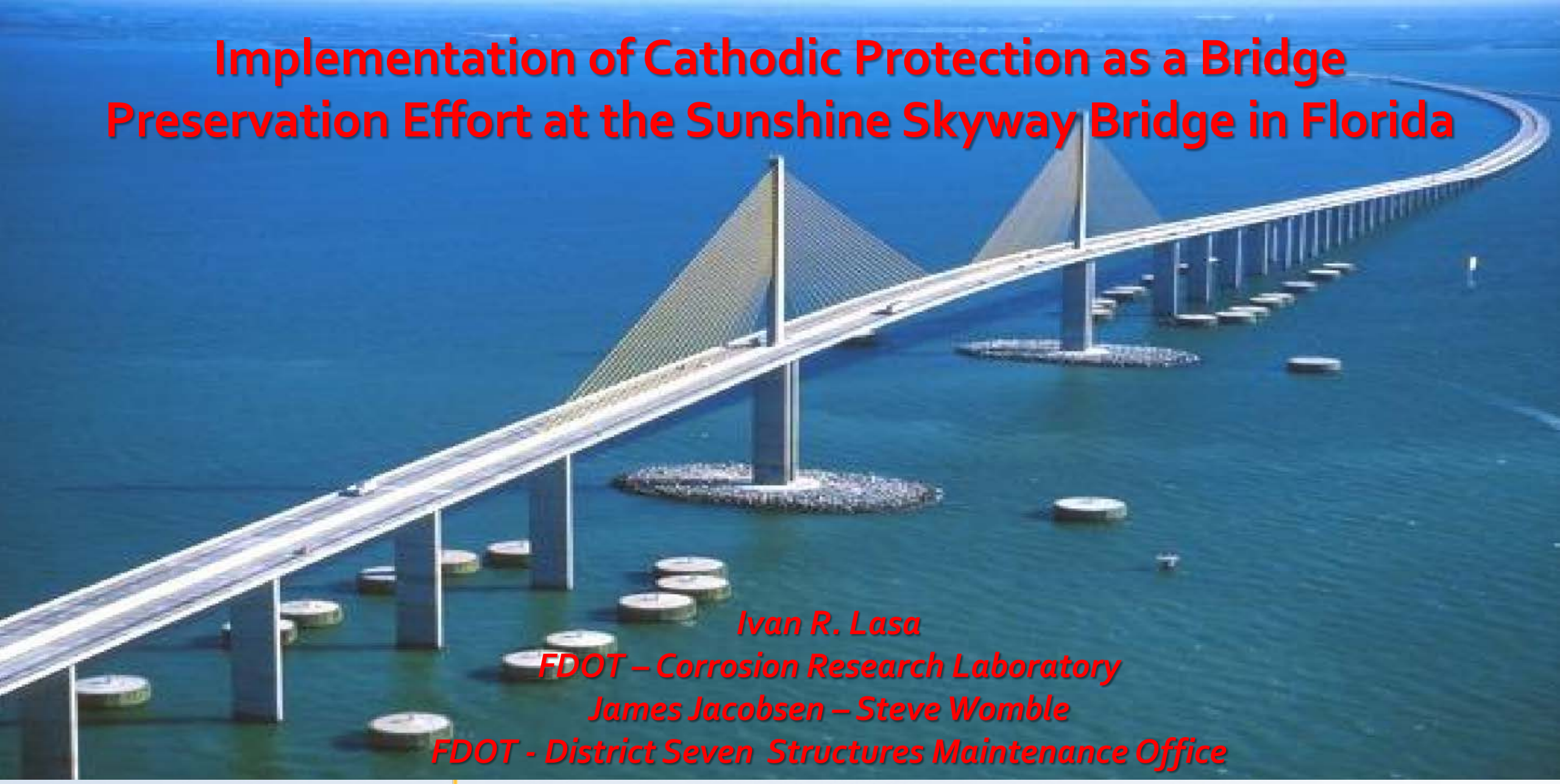
Implementation of Cathodic Protection as a Bridge Preservation Effort at the Sunshine Skyway Bridge in Florida

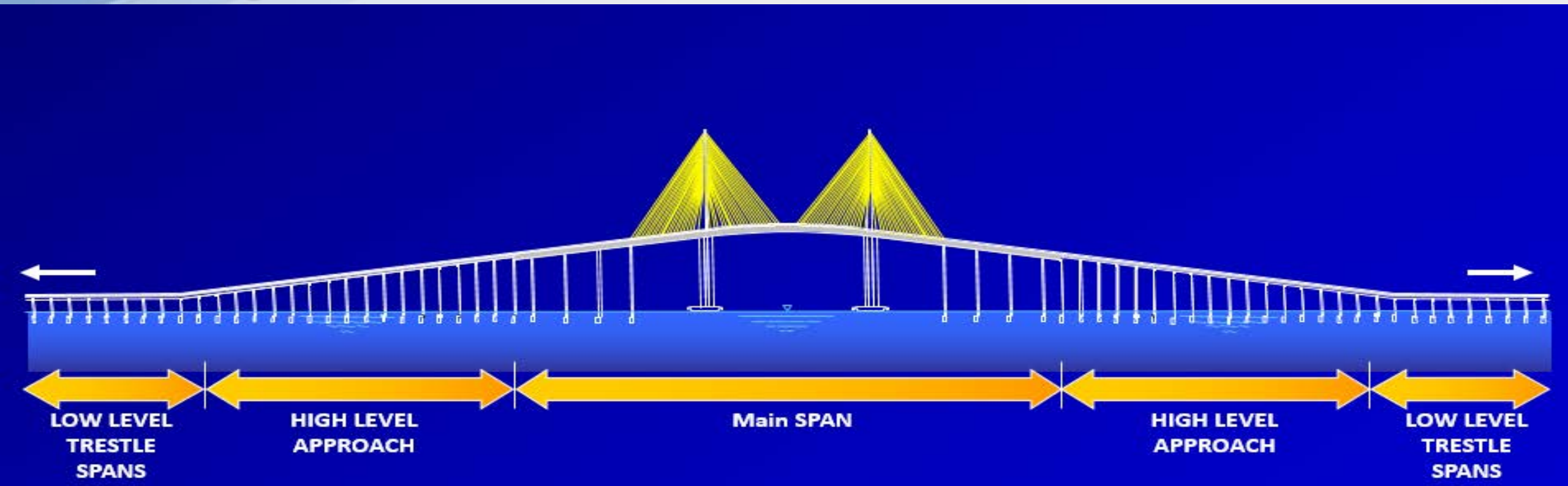


Ivan R. Lasa
FDOT – Corrosion Research Laboratory
James Jacobsen – Steve Womble
FDOT - District Seven Structures Maintenance Office

Bridge Background

- The Sunshine Skyway Bridge is located on the west central coast of Florida.
- Part of I-275 connecting the cities St. Petersburg and Bradenton across the Tampa Bay entrance.
- In May 1980, a ship impact caused the collapse of the southbound main span of the previous bridge at the location.
- In 1987, a new bridge with state-of-the-art technology at the time and improved safety features was opened to replace the old bridge.
- The new bridge is considered the "flag bridge" of the State and receives significant local and national media attention.

Bridge Profile



Total Bridge length: 4.14 miles

- A complex structure with numerous critical structural components
- Maintenance requires detailed attention to many components

Figure courtesy of FDOT Structures Office

Skyway Preservation Committee

- Established in 1999 to assist on the maintenance of the bridge.
- Goal is to look ahead on the service life of the structure to identify potential service life limitations and recommend efforts to prevent future conditions that could negatively affect the structure service life.
- Exceeding the 100 year service live is the group's mission.
- Composition includes members with expertise in
    - Structural & Post-Tensioning Engineering
    - Corrosion
    - Maintenance Engineering & Contractors
    - Academia consultants (on-demand)

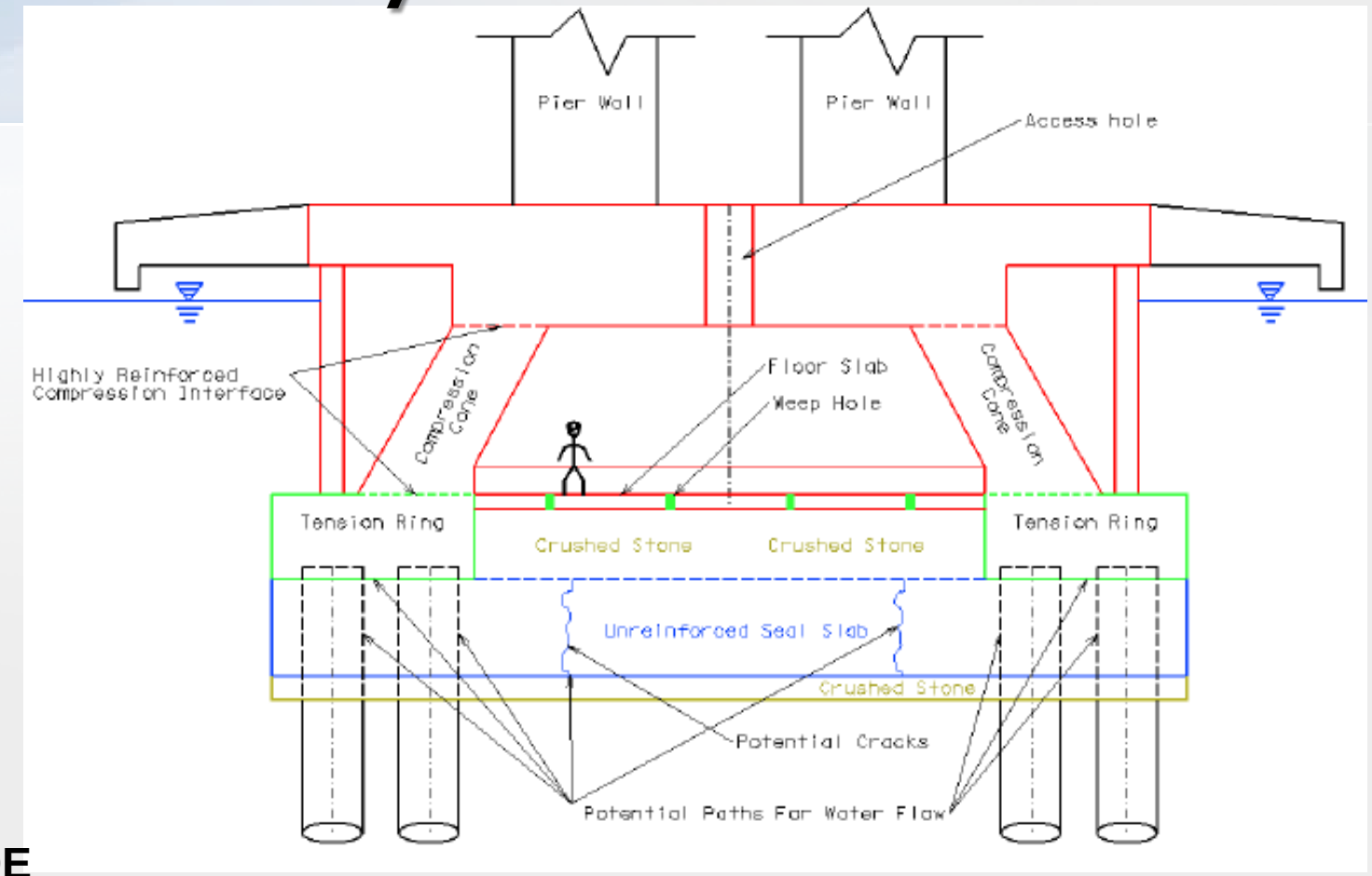
Due to the aggressiveness of the environment, corrosion is considered to be the major item of concern regarding the 100 year plus service life of the bridge

Cathodic Protection as a Preservation Effort

Main Piers Pylons Footers (Galvanic System)

Main Span Columns (Impressed Current System)

Cross-Section of Pylon Footer



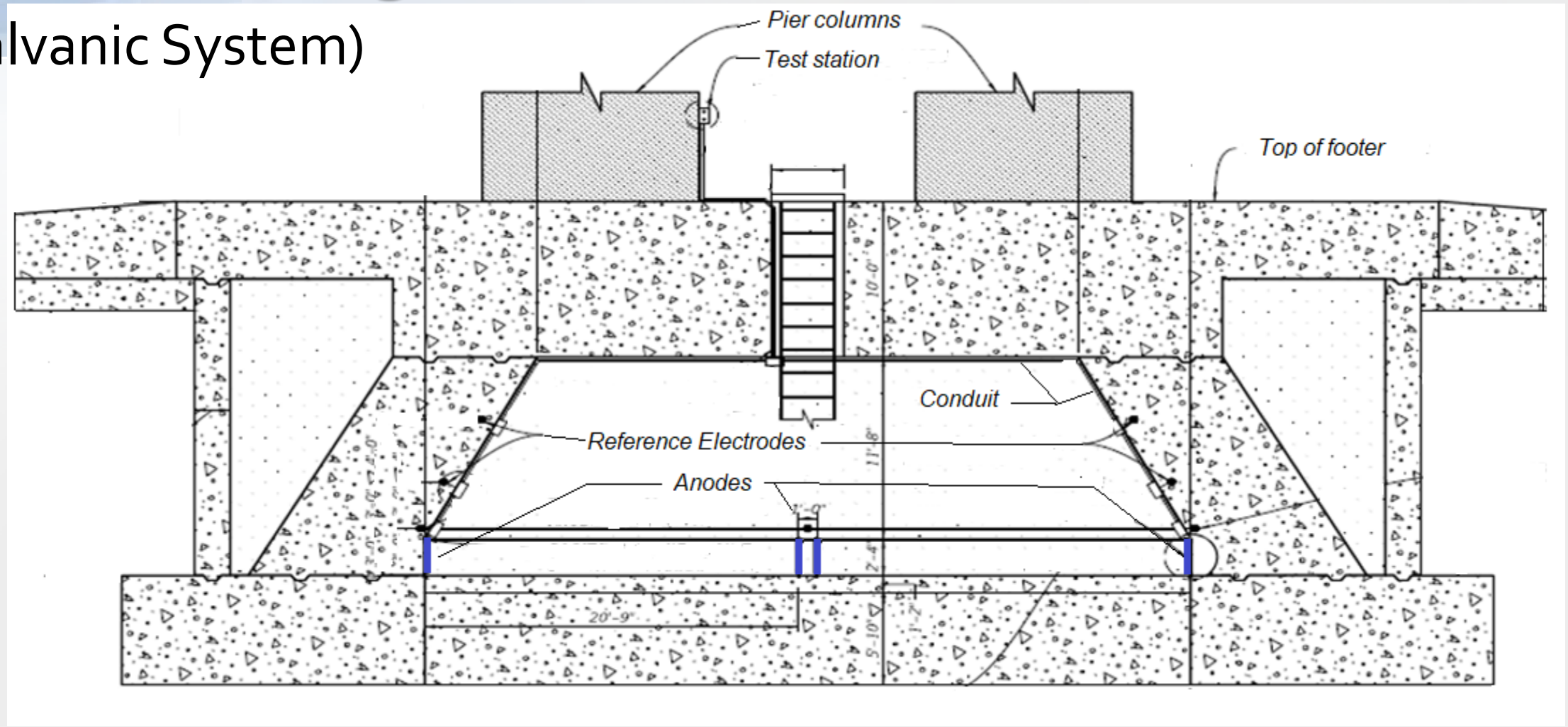
- HOLLOW INSIDE
- CRACKS FOUND ON THE FOOTERS WALL DURING CONSTRUCTION
- INSIDE CHAMBER IS FILLED WITH WATER ON BOTH PYLONS FOOTERS

Interior of Pylon

- THE REINFORCEMENT HAS ~ 4 INCHES OF COVER.
- CORROSION OF THE ECR WAS DETECTED BUT, ONLY ON REBARS INTERSECTED BY CRACKS.

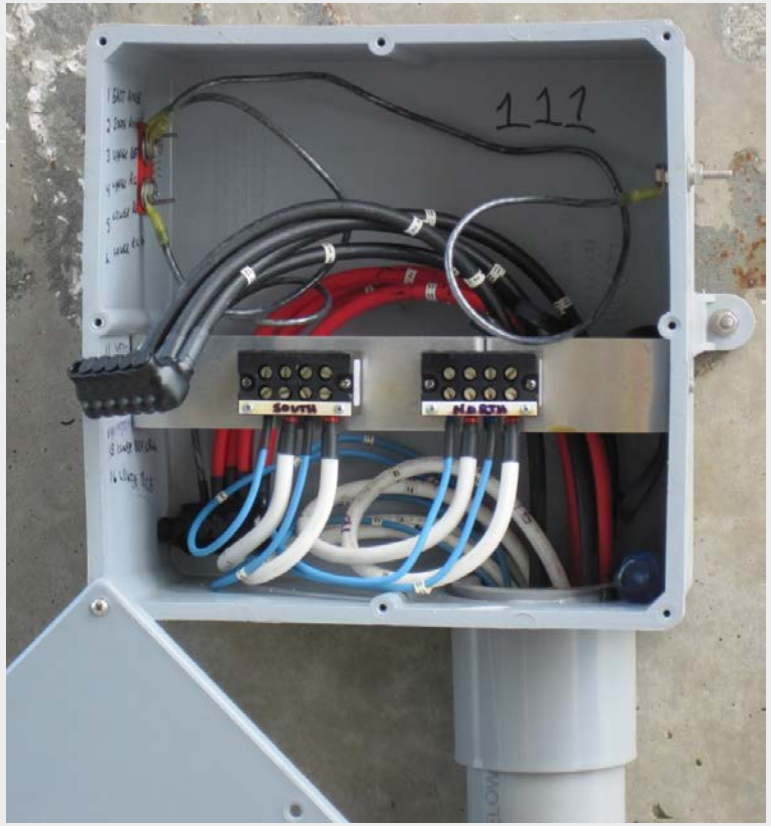
Pylon CP Design

(Galvanic System)



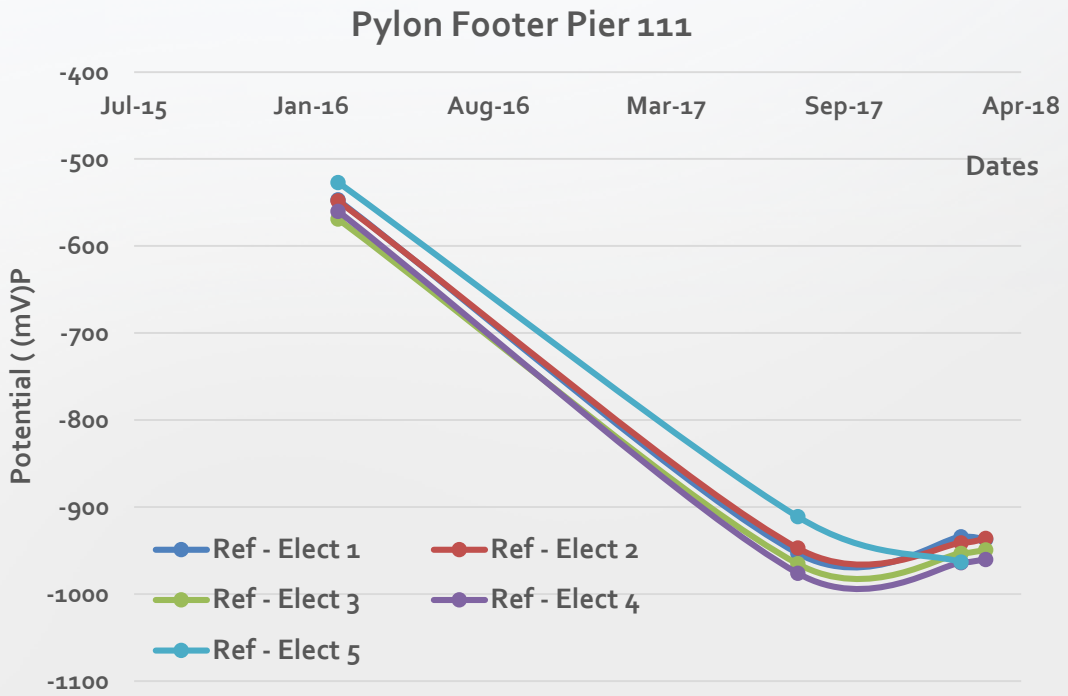
Pylon CP Design

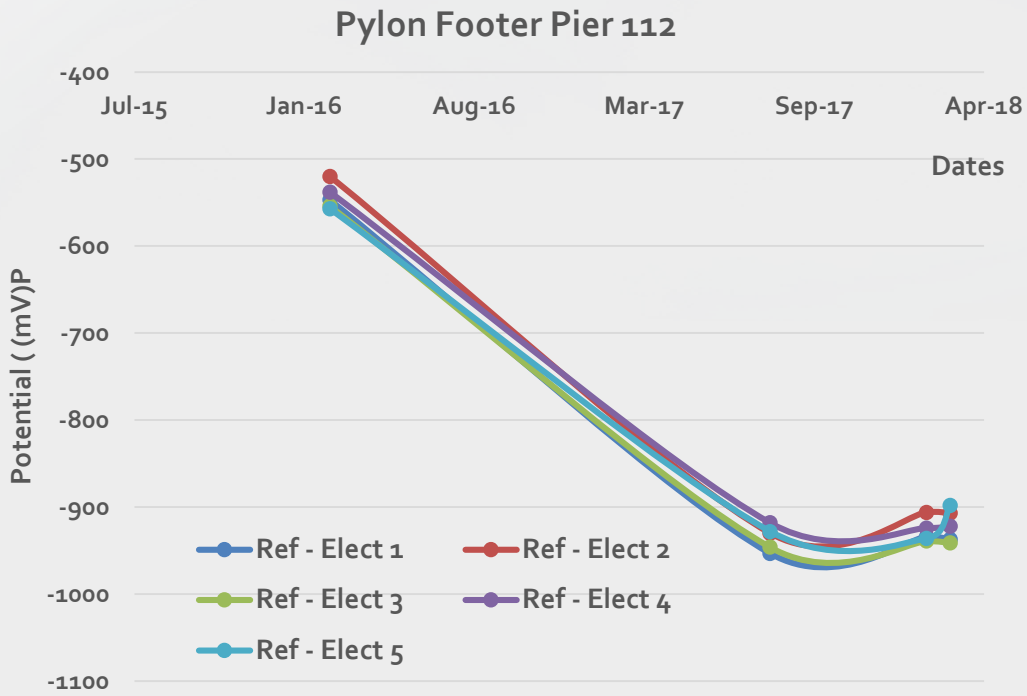
- Bulk anode assembly containing 100 Lb. zinc each
- Four assemblies installed per footer



- Connection wires routed to a central location to monitor performance

Pylon CP Data





System providing excellent performance

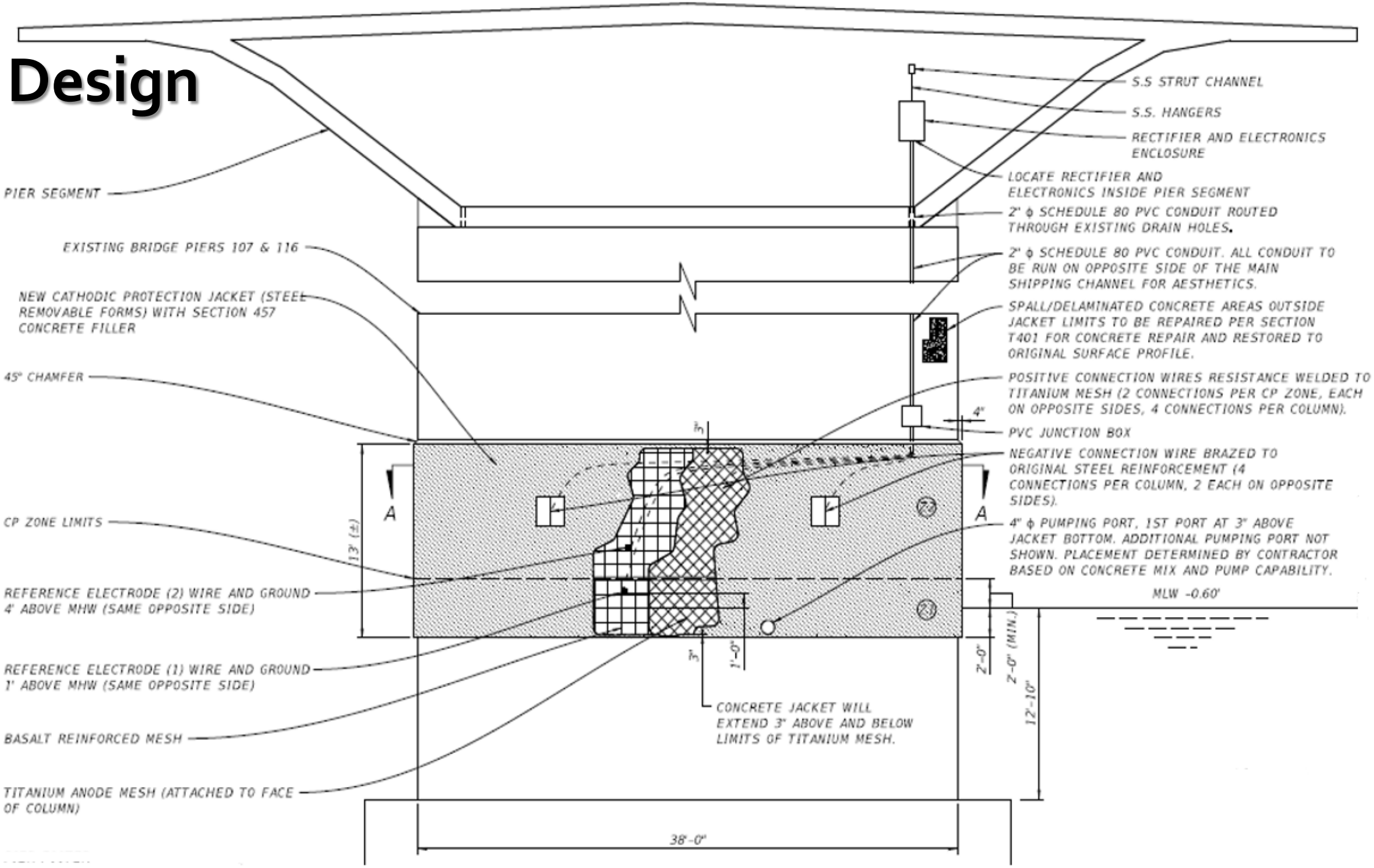
Main Span Columns CP

- **Concerns:**

- Many old and new cracks are showing severe amounts of moisture and efflorescence.

- After sealing, water continued to leak out of the crack, suggesting water inside column or on upper portion of the crack.

CP Design


S.S STRUT CHANNEL
S.S. HANGERS
RECTIFIER AND ELECTRONICS ENCLOSURE
LOCATE RECTIFIER AND ELECTRONICS INSIDE PIER SEGMENT
2" ϕ SCHEDULE 80 PVC CONDUIT ROUTED THROUGH EXISTING DRAIN HOLES.
2" ϕ SCHEDULE 80 PVC CONDUIT. ALL CONDUIT TO BE RUN ON OPPOSITE SIDE OF THE MAIN SHIPPING CHANNEL FOR AESTHETICS.
SPALL/DELAMINATED CONCRETE AREAS OUTSIDE JACKET LIMITS TO BE REPAIRED PER SECTION T401 FOR CONCRETE REPAIR AND RESTORED TO ORIGINAL SURFACE PROFILE.
POSITIVE CONNECTION WIRES RESISTANCE WELDED TO TITANIUM MESH (2 CONNECTIONS PER CP ZONE, EACH ON OPPOSITE SIDES, 4 CONNECTIONS PER COLUMN).
PVC JUNCTION BOX
NEGATIVE CONNECTION WIRE BRAZED TO ORIGINAL STEEL REINFORCEMENT (4 CONNECTIONS PER COLUMN, 2 EACH ON OPPOSITE SIDES).
4" ϕ PUMPING PORT, 1ST PORT AT 3" ABOVE JACKET BOTTOM. ADDITIONAL PUMPING PORT NOT SHOWN. PLACEMENT DETERMINED BY CONTRACTOR BASED ON CONCRETE MIX AND PUMP CAPABILITY.
MLW -0.60'
PIER SEGMENT
EXISTING BRIDGE PIERS 107 & 116
NEW CATHODIC PROTECTION JACKET (STEEL REMOVABLE FORMS) WITH SECTION 457 CONCRETE FILLER
45° CHAMFER
CP ZONE LIMITS
REFERENCE ELECTRODE (2) WIRE AND GROUND 4' ABOVE MHW (SAME OPPOSITE SIDE)
REFERENCE ELECTRODE (1) WIRE AND GROUND 1' ABOVE MHW (SAME OPPOSITE SIDE)
BASALT REINFORCED MESH
TITANIUM ANODE MESH (ATTACHED TO FACE OF COLUMN)
A
A
13' (±)
3"
1'-0"
3"
CONCRETE JACKET WILL EXTEND 3" ABOVE AND BELOW LIMITS OF TITANIUM MESH.
4"
2'-0"
2'-0" (MIN.)
12'-10"
38'-0"

CP Jacket Components

Ti Mesh anode w/basalt reinforcement.

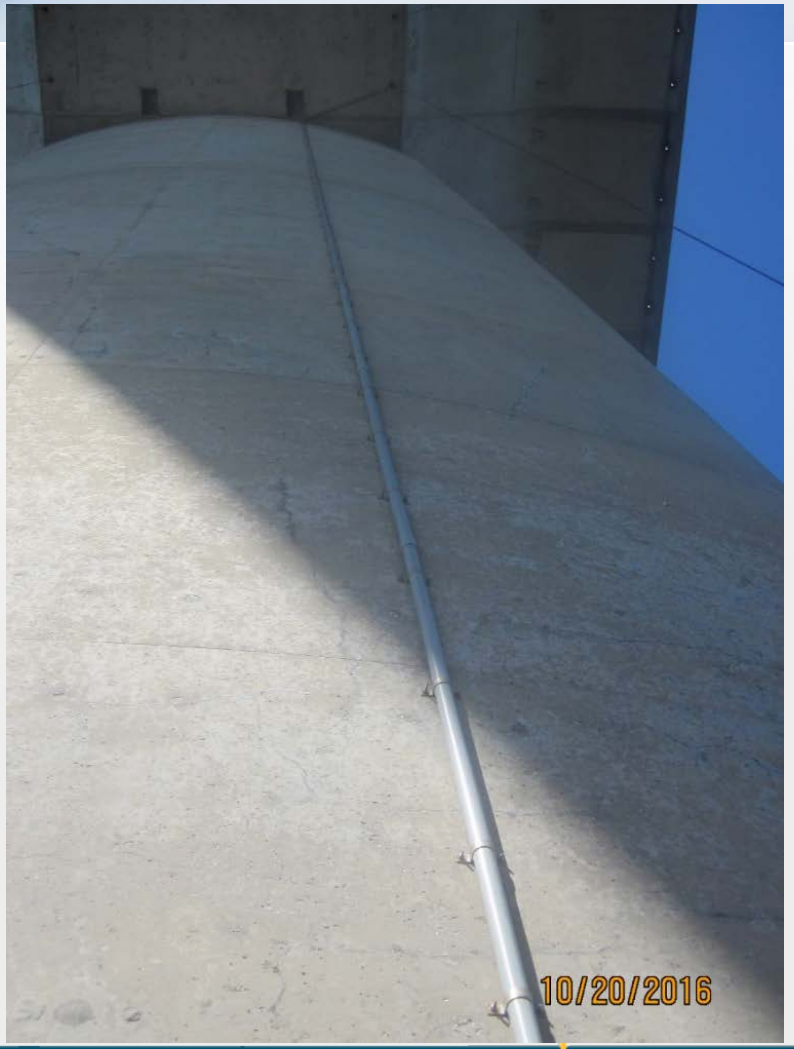
Light weight sectional aluminum forms .

Completed ICCP Jacket

Wiring to Rectifier

Energized by zones due to different current requirements as dictated by concrete conditions

CP Electronics



Wires routed to inside the segment and connected to a datalogger and telemetry system

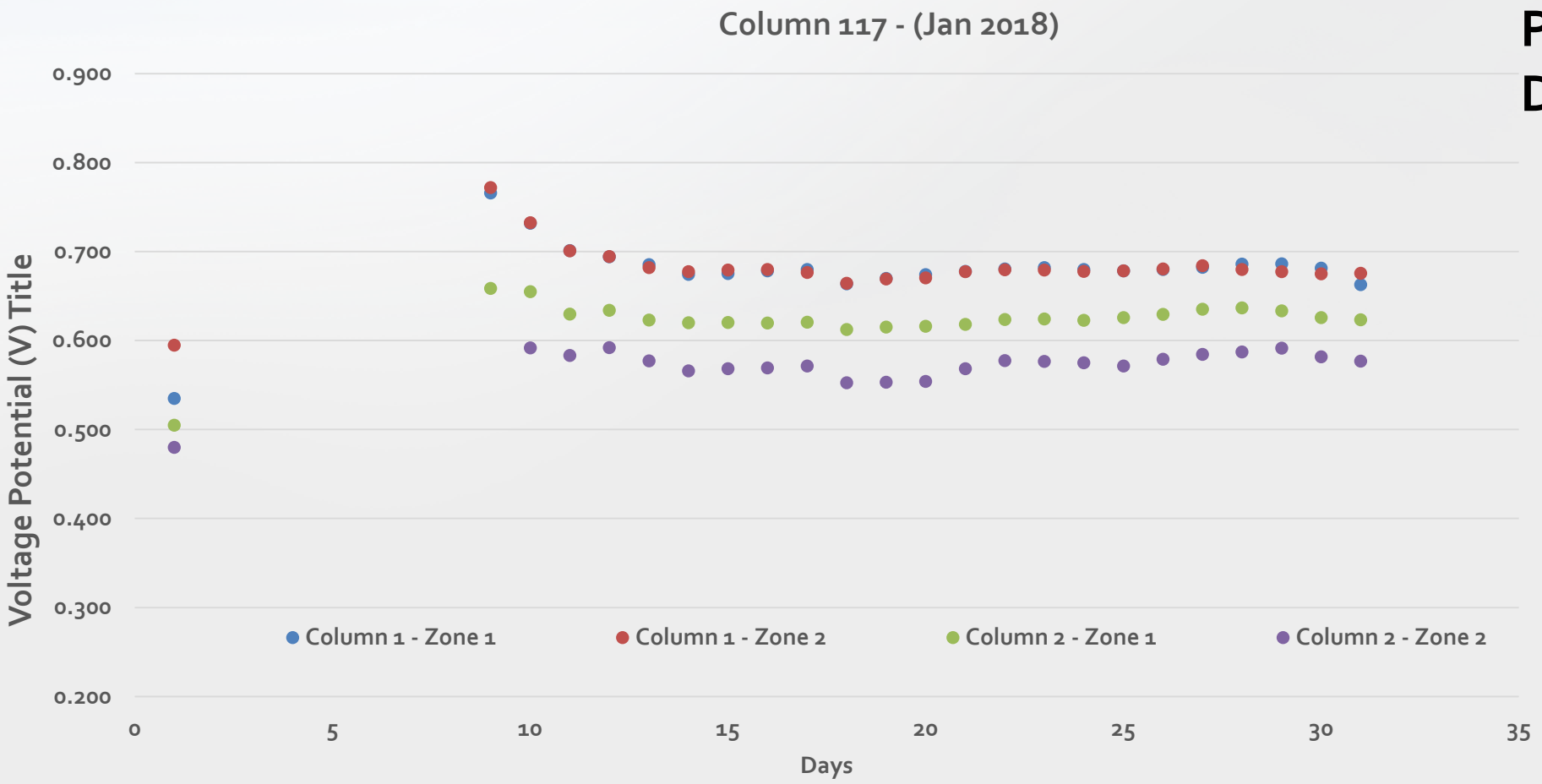
Criteria for Cathodic Protection

Cathodic protection requires monitoring it's performance

- NACE RP 290: Impressed Current Cathodic Protection of Reinforcing Steel in Concrete
- NACE RP 216: Sacrificial Cathodic Protection of Reinforcing Steel in concrete
- EN ISO 12696: Cathodic Protection of Steel in Concrete

Available criteria is based on the polarization of the steel by means of measuring voltage potentials and currents applied.

ICCP performance data



Processed Data

Conclusions

- Cathodic protection systems at the Skyway bridge are working satisfactory and should be big contributors for maintaining a 100 year plus service life.

- Other bridge preservation efforts have also been applied to the bridge or are scheduled for application such as: general cracks sealing, recoating of bearings and stays, and NDE inspection for the stays and post-tensioning systems.

- In general, bridge preservation efforts are expected to produce long term financial benefits to the State regarding the Skyway Bridge.

Thank You!