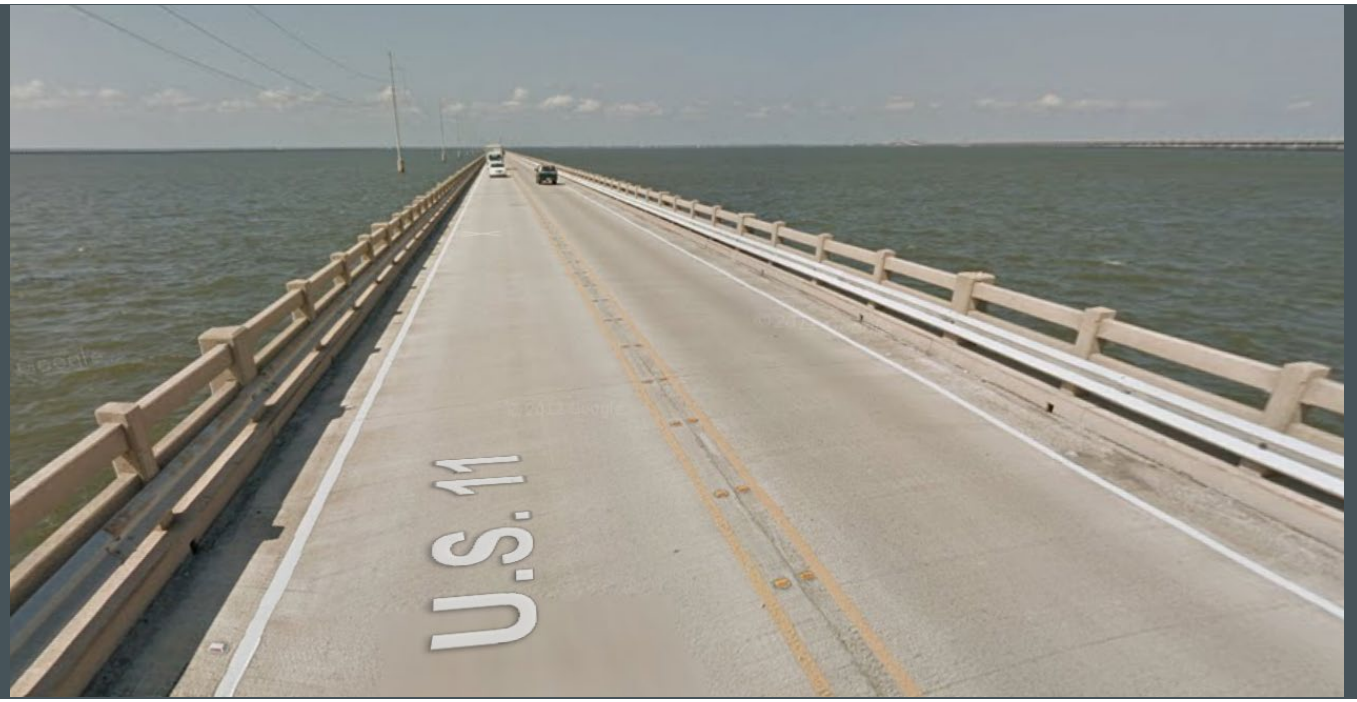
US 11 LAKE PONTCHARTRAIN BRIDGE REHABILITATION

ZHIYONG LIANG, PHD, PE



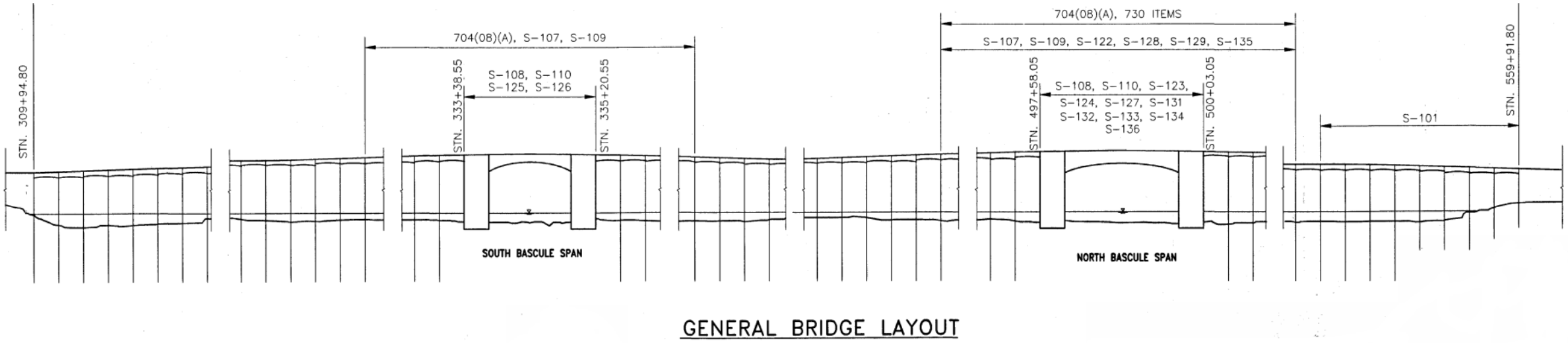
DOTD
LOUISIANA DEPARTMENT OF TRANSPORTATION & DEVELOPMENT

SDR

BRIDGE OVERVIEW

LOCATION MAP

BRIDGE OVERVIEW



GENERAL BRIDGE LAYOUT

Main Spans: Two steel movable spans
700 reinforced concrete spans
Total length 24,922 ft

Year Built: 1928

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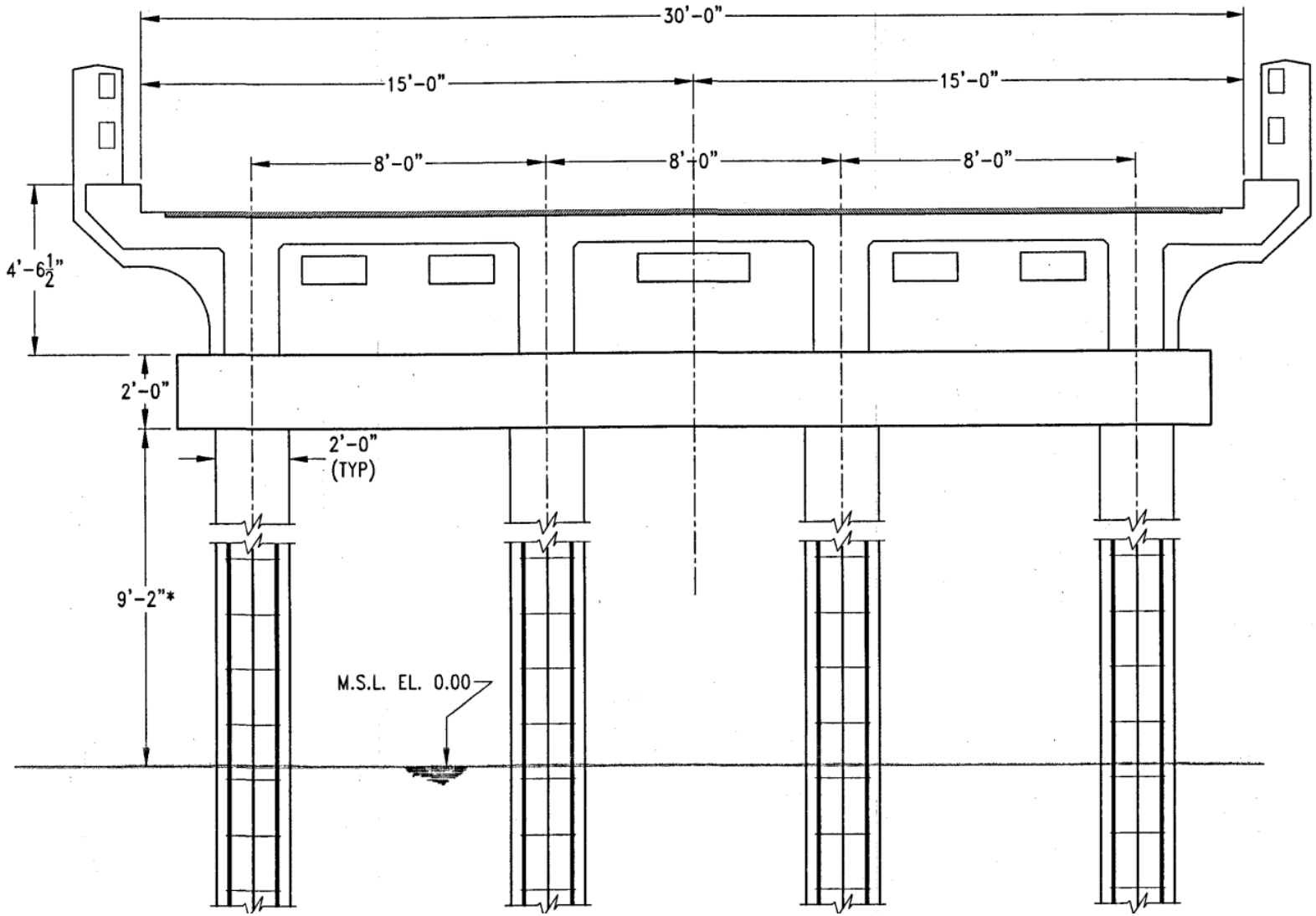
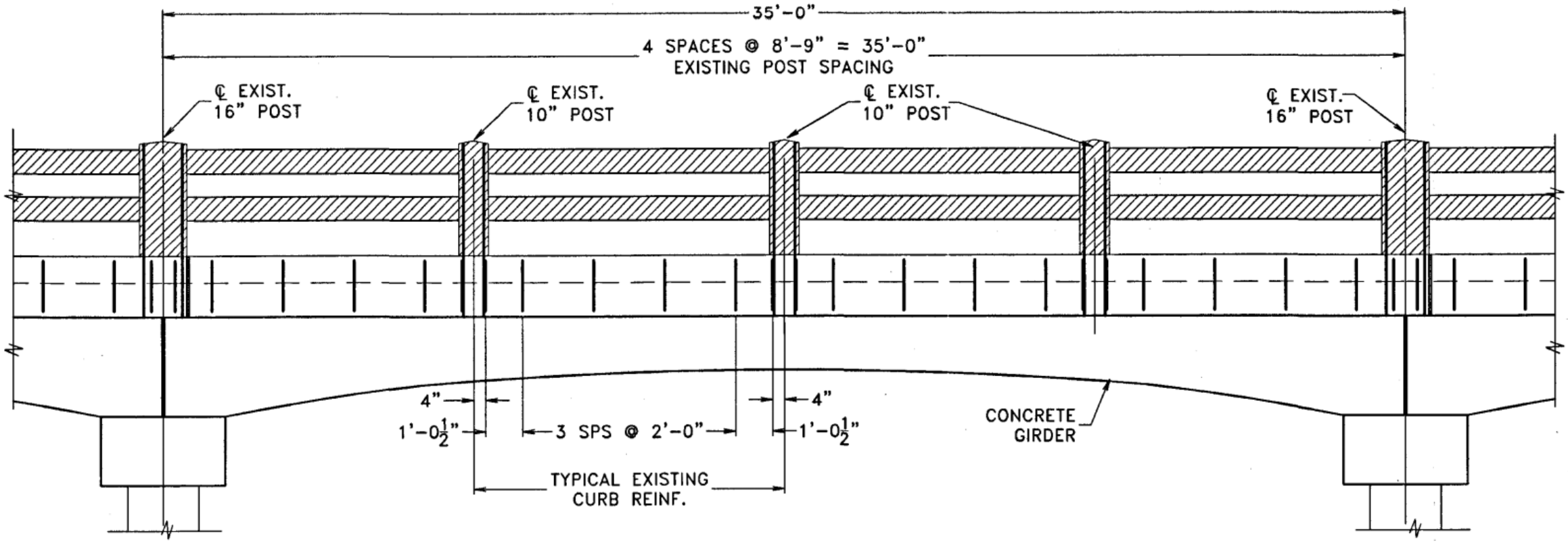
TYPICAL CROSS-SECTION



TYPICAL SPAN PROFILE



BRIDGE PHOTO

CONCRETE GIRDER

- Concrete spalling
- Steel corrosion
- Loss of section

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- Concrete spalling
- Steel corrosion
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CONCRETE PILE

- Large cracks near water surface
- Steel corrosion

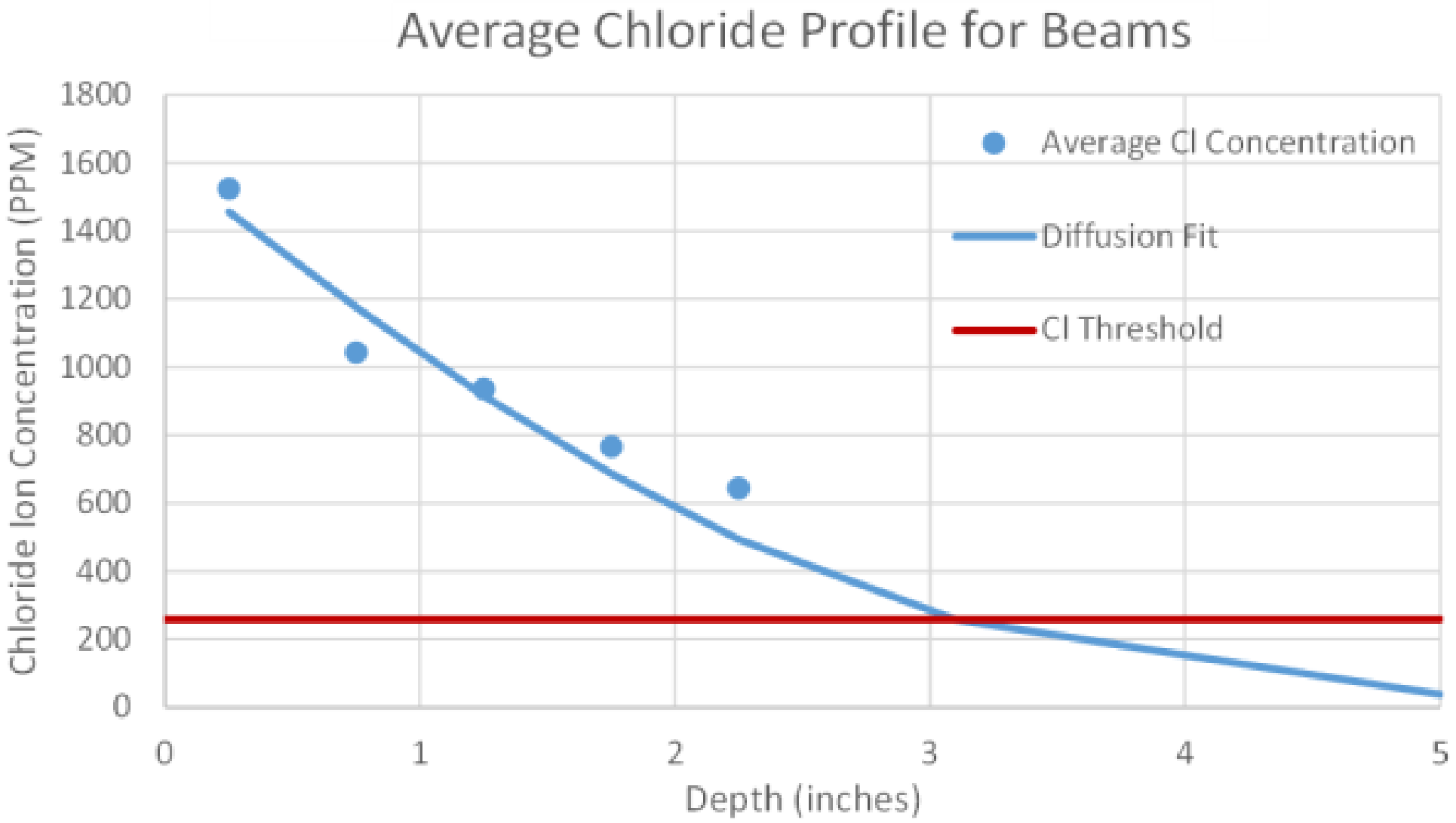
CONCRETE PILE

- Large cracks near water surface
- Steel corrosion

CHLORIDE ION PENETRATION

- Samples collected at 60 locations
- Increments of 0.5” up to 2.5” deep

CHLORIDE ION PENETRATION



BRIDGE INVESTIGATION

SUPERSTRUCTURE LOAD RATING BY BRR(VIRTIS)

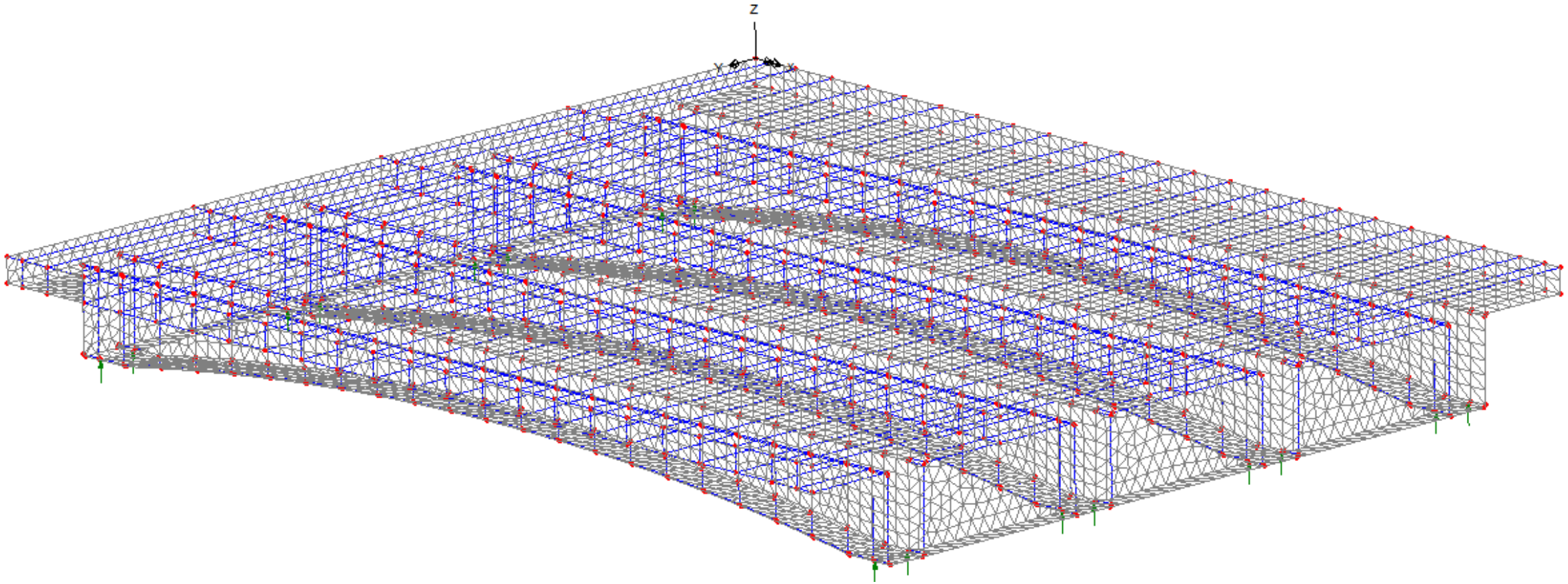
Vehicle Type		Rating Factors		
		Good	Fair	Poor
Design	HL-93 (Inventory)	0.80	0.74	0.63
	HL-93 (Operating)	1.04	0.96	0.82

All controlled by moment at the midspan of exterior beam.

LIMITATIONS OF TRADITIONAL ANALYSIS

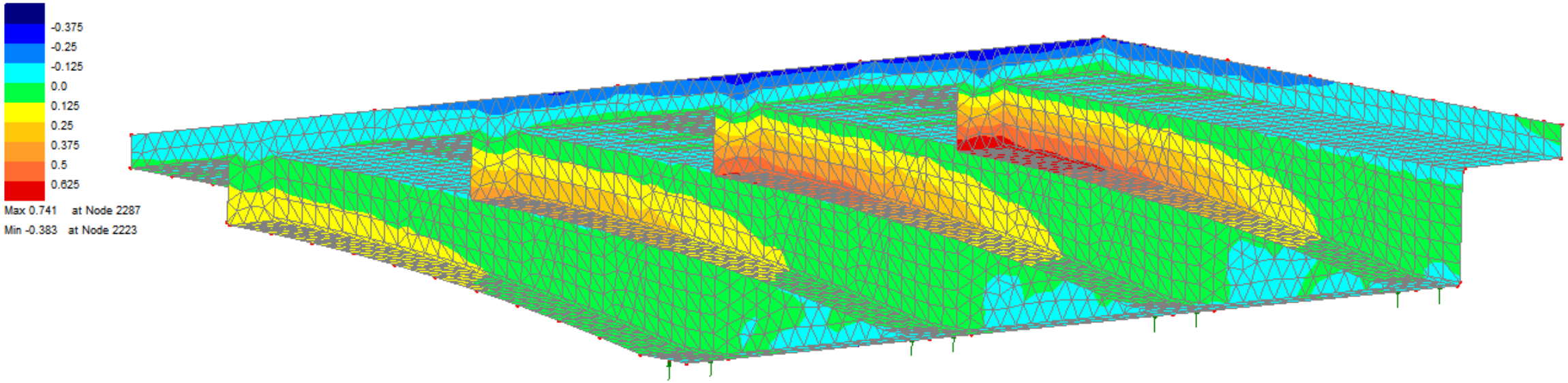
- The arch effect is ignored
- Live load distribution using lever rule is conservative
- Restrain of rotation by end diaphragm is ignored

FINITE ELEMENT MODEL



Deck, beam, and diaphragm are all modeled with solid element.

FINITE ELEMENT MODEL

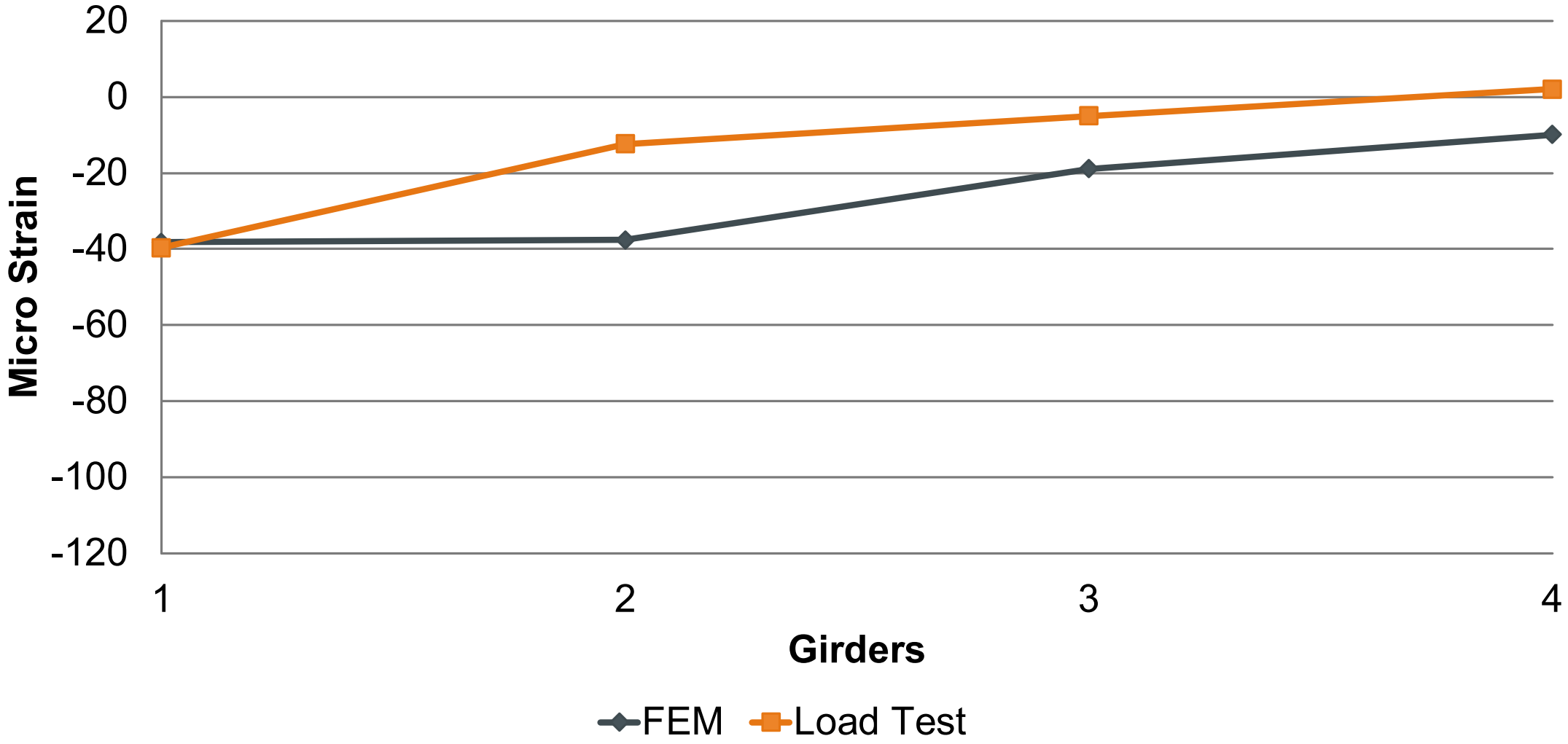


Live Moment at Midspan

FRAME	3D FEM	FEM/FRAME
437.7 k-ft	315.3 k-ft	72.0 %

LOAD TEST

LOAD TEST VS FEM



RATING FACTOR FRAME VS. FEM

	Vehicle	Rating Factor		
		Good	Fair	Poor
Virtis	HL93 Inv	0.80	0.74	0.63
	HL93 Opt	1.04	0.96	0.82
FEM	HL93 Inv	1.13	1.05	0.90
	HL93 Opt	1.47	1.37	1.16

SDR

REPAIR PLANS

REPAIR PLAN

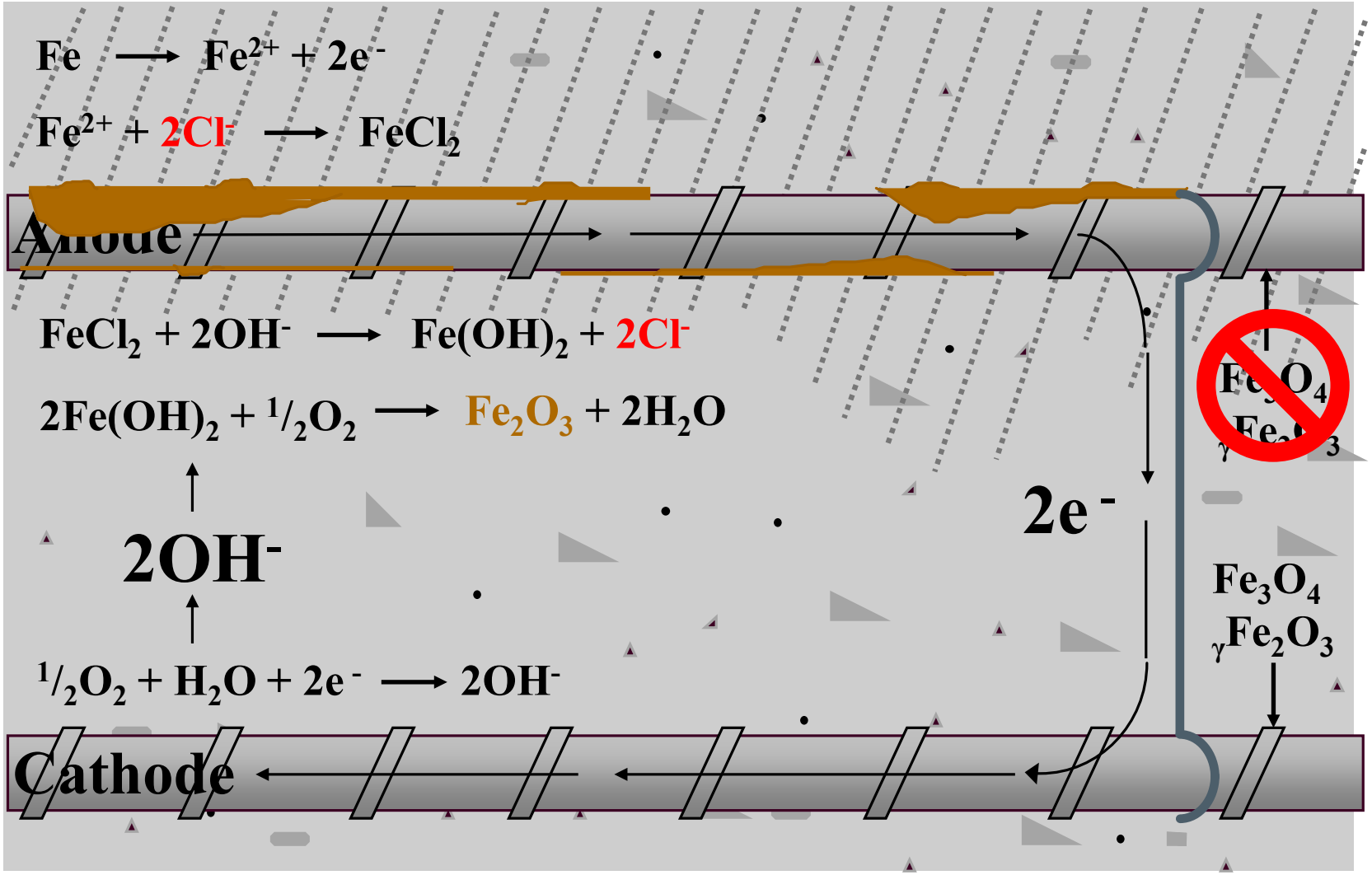
- **Superstructure:**

  Cathodic Protection + CFRP Wrap

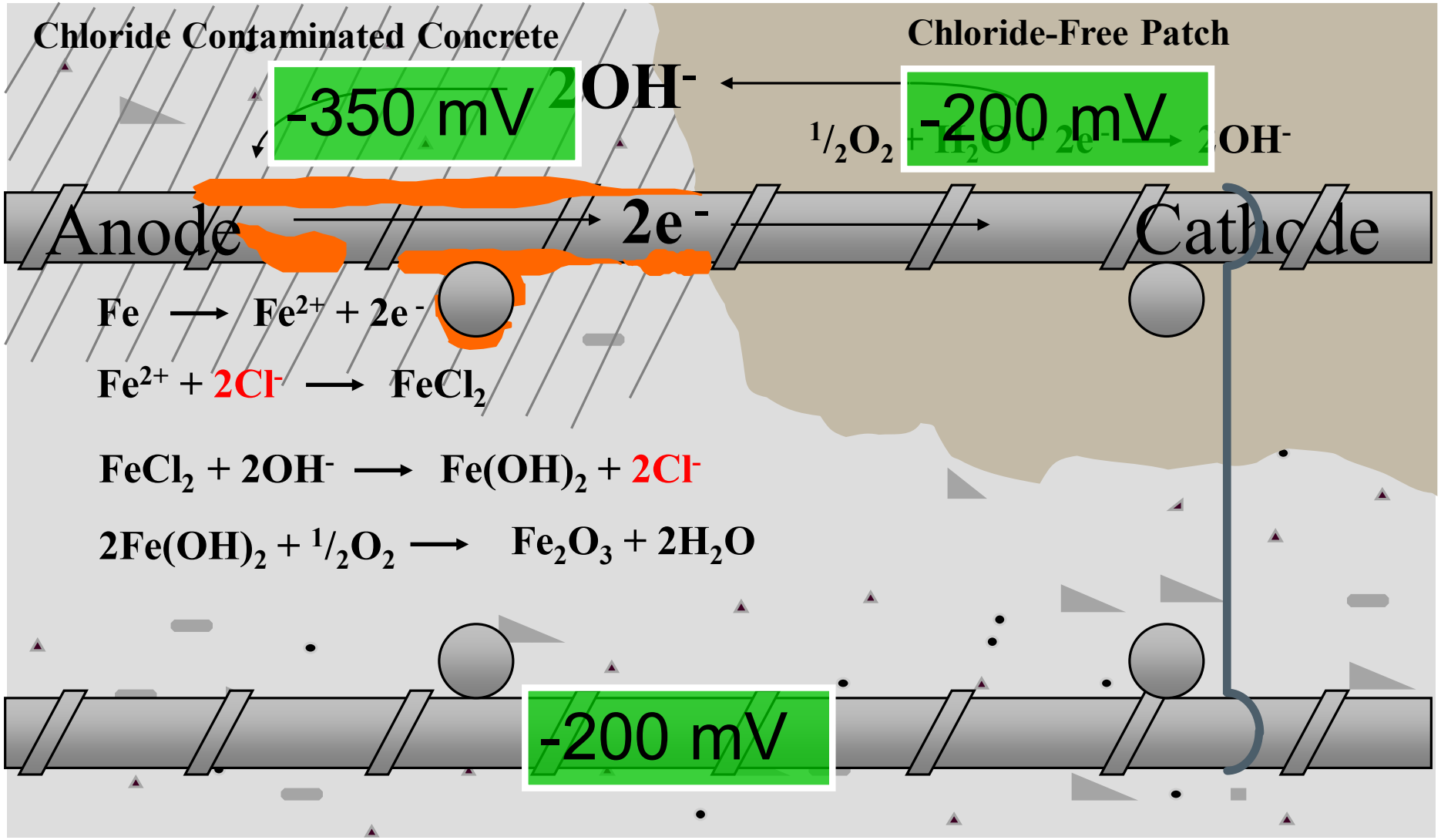
- **Substructure:**

  Cathodic Protection + Pile Jacket

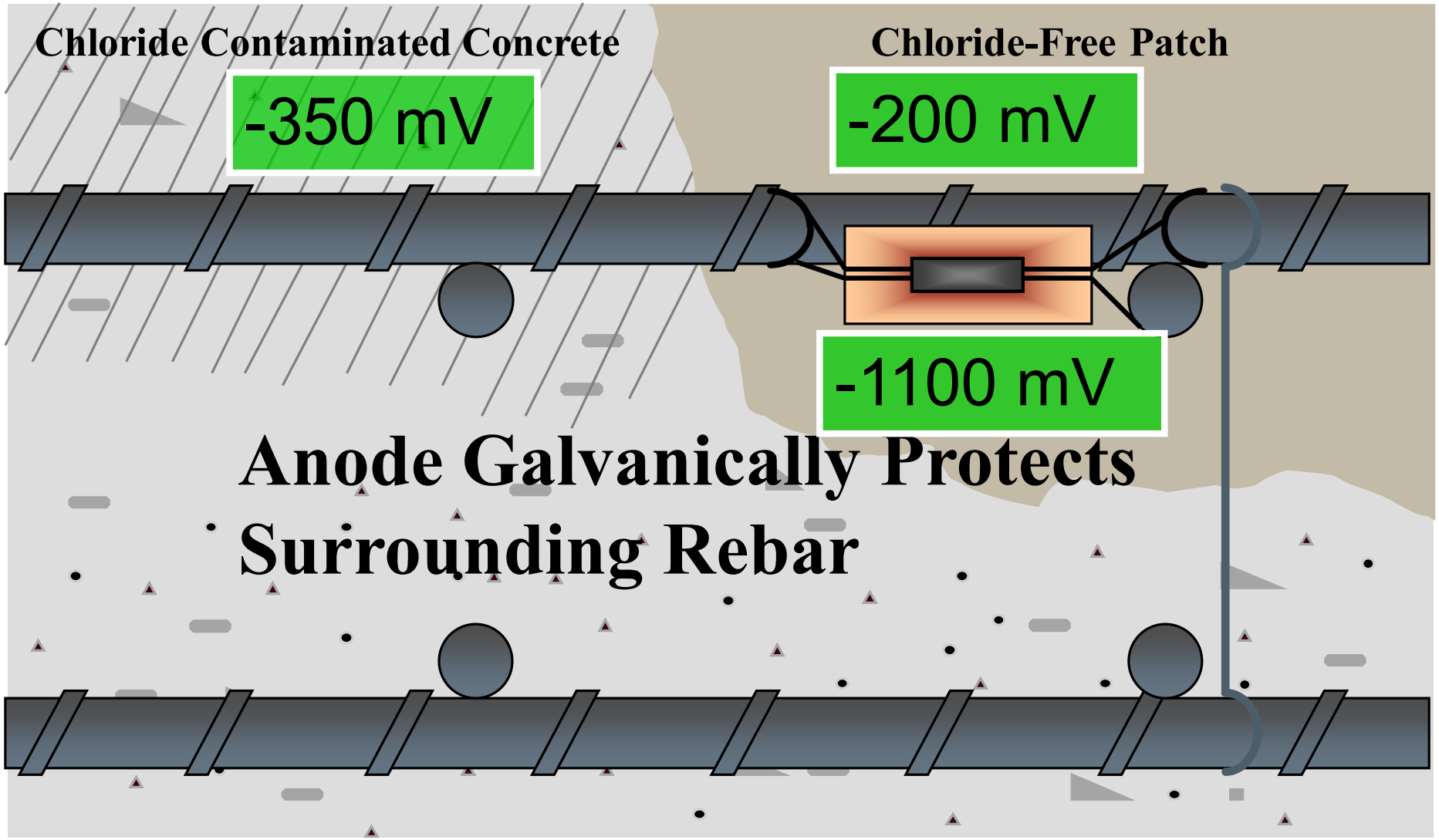
CORROSION CELL IN CONCRETE



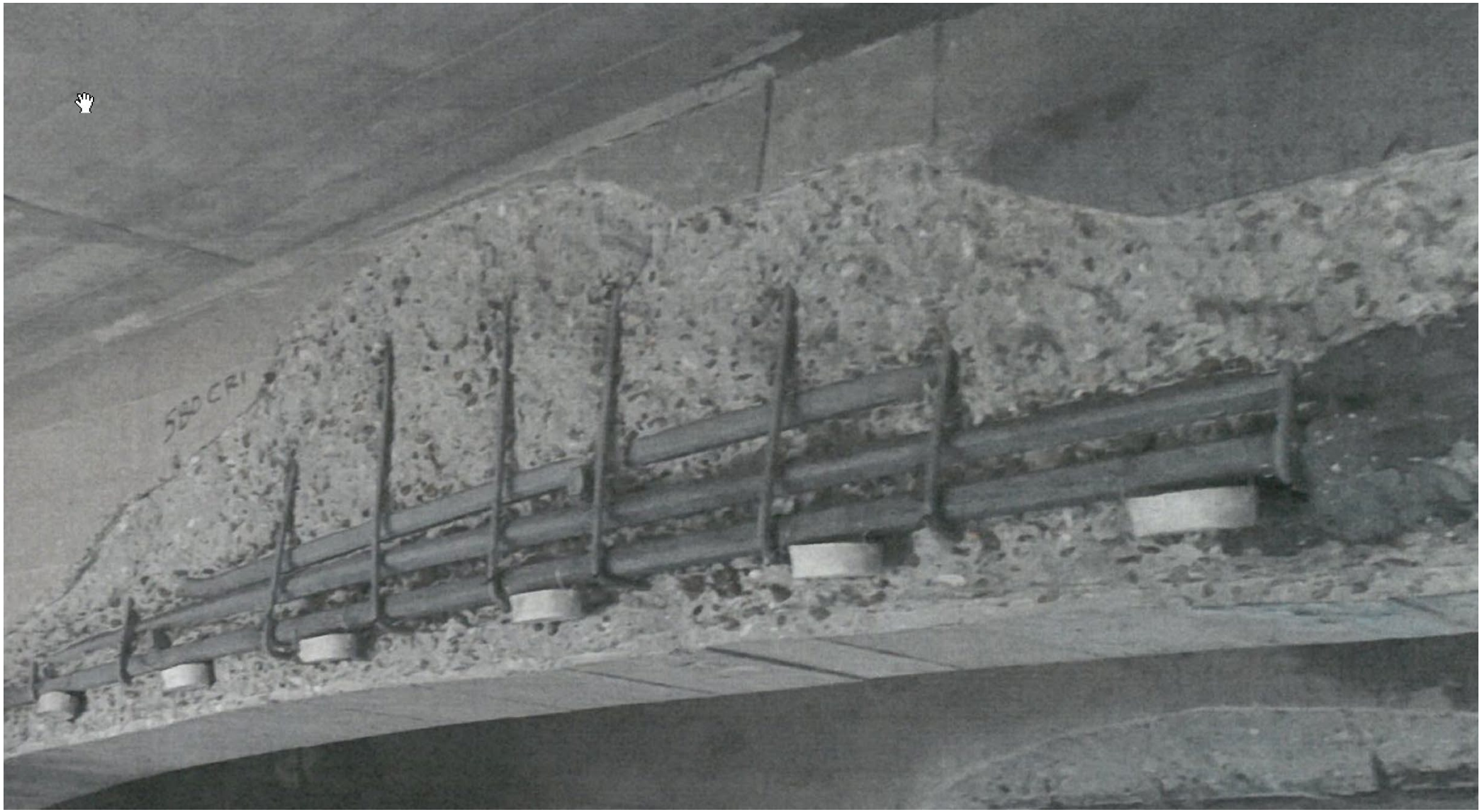
PATCH ACCELERATED CORROSION



PATCH ACCELERATED CORROSION



CATHODIC PROTECTION

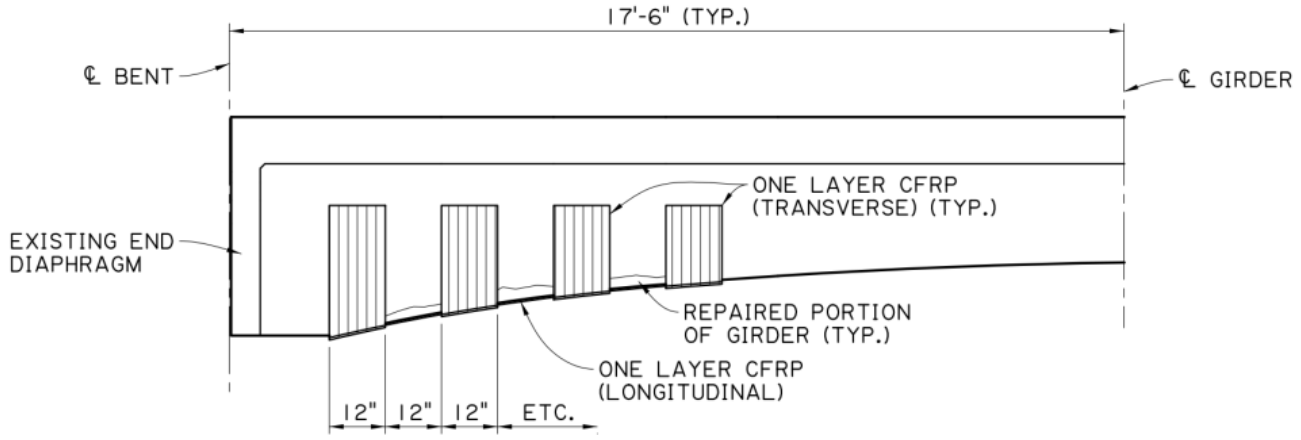


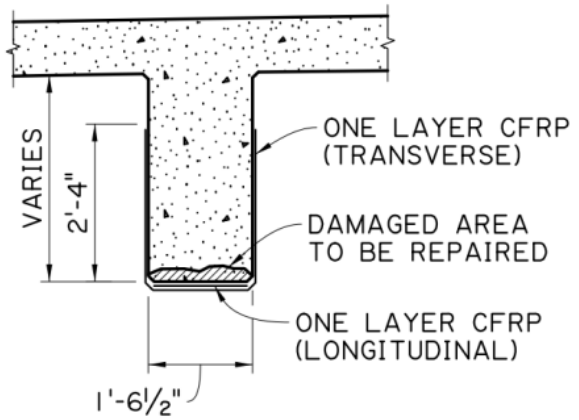
CATHODIC PROTECTION

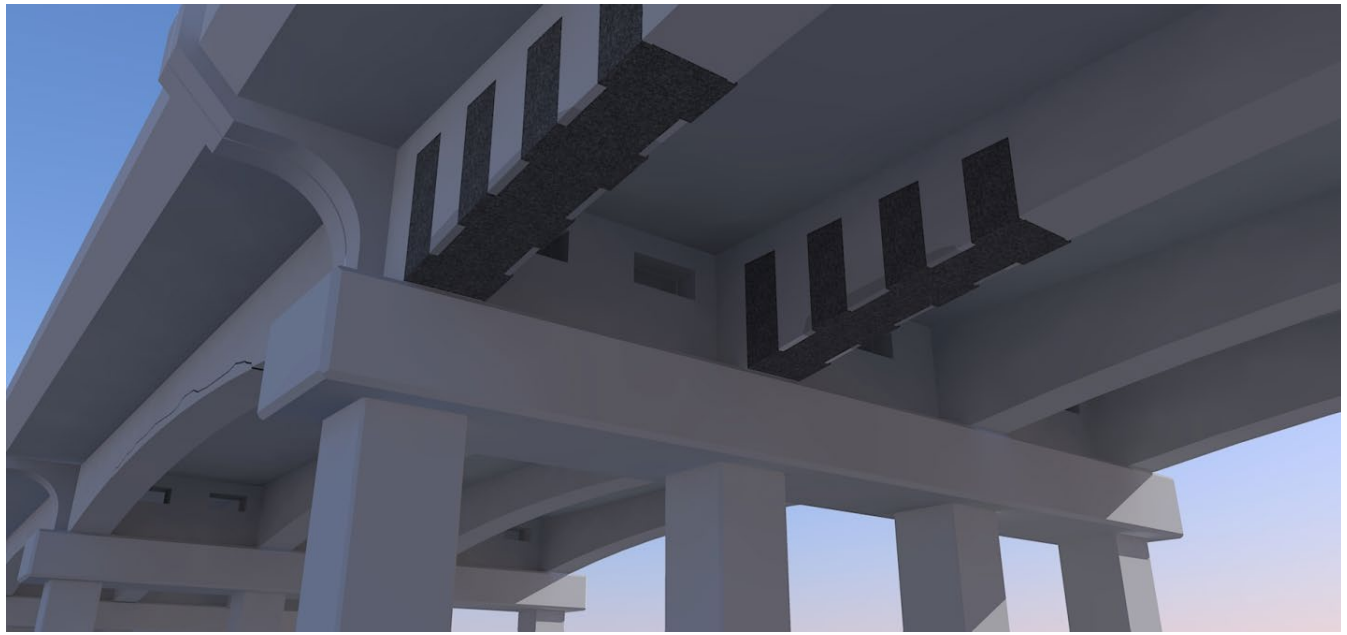
CATHODIC PROTECTION INSTALLATION

- Install anodes at the edge of spall (close to surround area)
- Confirm electrical continuity between anode and reinforcement
- Use concrete patching material with suitable conductivity
- Do not use non-conductive epoxy bonding agent

CARBON FIBER REINFORCED POLYMERS (CFRP)

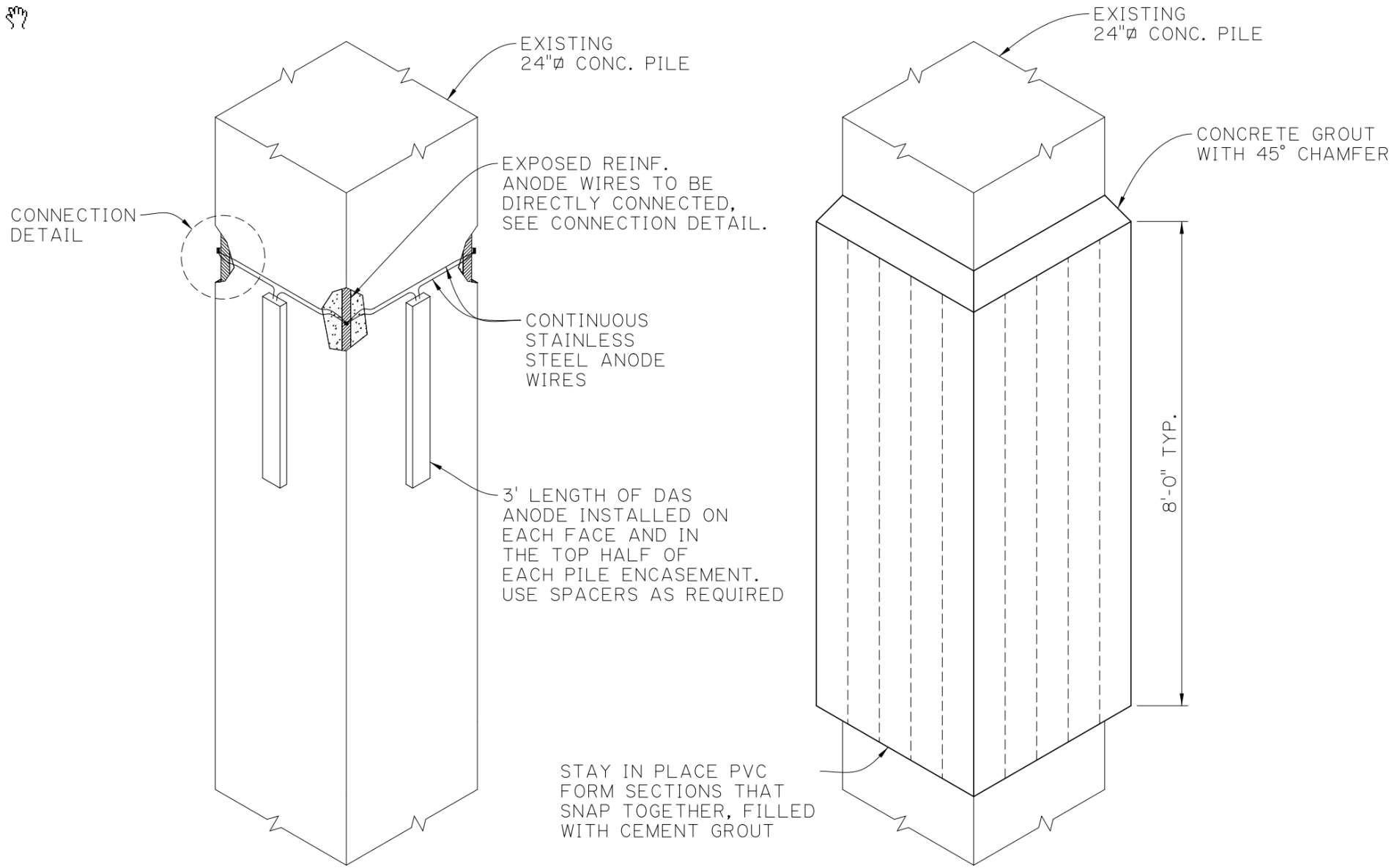




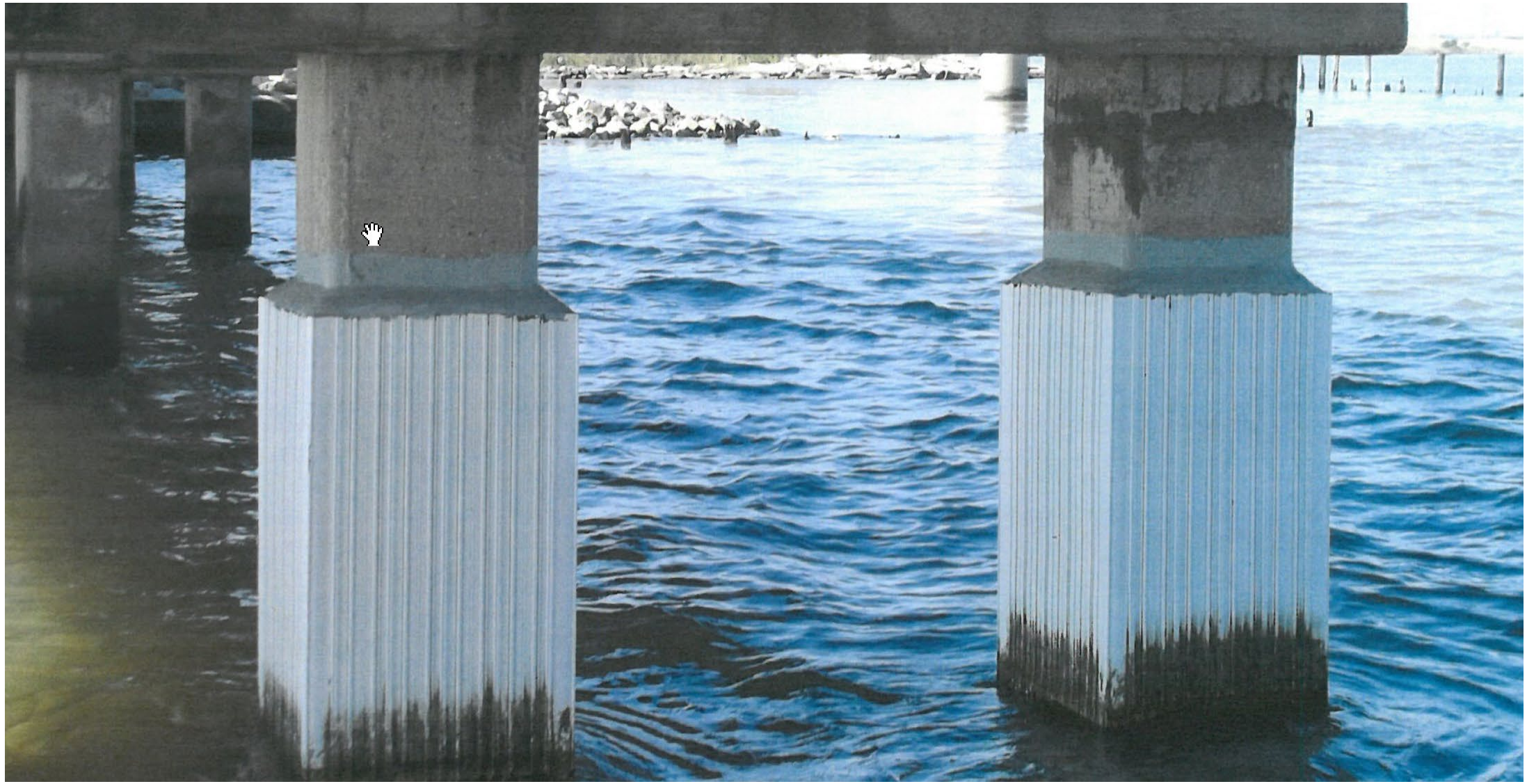


CFRP INSTALLATION

PILE JACKET


EXISTING
24"ø CONC. PILE
EXPOSED REINF.
ANODE WIRES TO BE
DIRECTLY CONNECTED,
SEE CONNECTION DETAIL.
CONNECTION
DETAIL
CONTINUOUS
STAINLESS
STEEL ANODE
WIRES
3' LENGTH OF DAS
ANODE INSTALLED ON
EACH FACE AND IN
THE TOP HALF OF
EACH PILE ENCASEMENT.
USE SPACERS AS REQUIRED
STAY IN PLACE PVC
FORM SECTIONS THAT
SNAP TOGETHER, FILLED
WITH CEMENT GROUT
EXISTING
24"ø CONC. PILE
CONCRETE GROUT
WITH 45° CHAMFER
8'-0" TYP.

PILE JACKET



QUESTION