Corrosion Mitigation Strategies for Concrete Structures

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Vector Corrosion Technologies

Presentation Agenda

- Corrosion Protection Strategies

- Why is this Important?

SHRP2 R19A


Bridges for Service Life Beyond 100 Years
Innovative Systems, Subsystems, and Components
SHRP2 RENEWAL RESEARCH
SHRP 2
TRANSPORTATION RESEARCH BOARD

Why is this Important?

- Construction is the single largest consumer of resources and raw materials
- Construction consumes almost 50% of all raw materials
- Construction and demolition generate about 40% of all solid waste

Why is this Important?

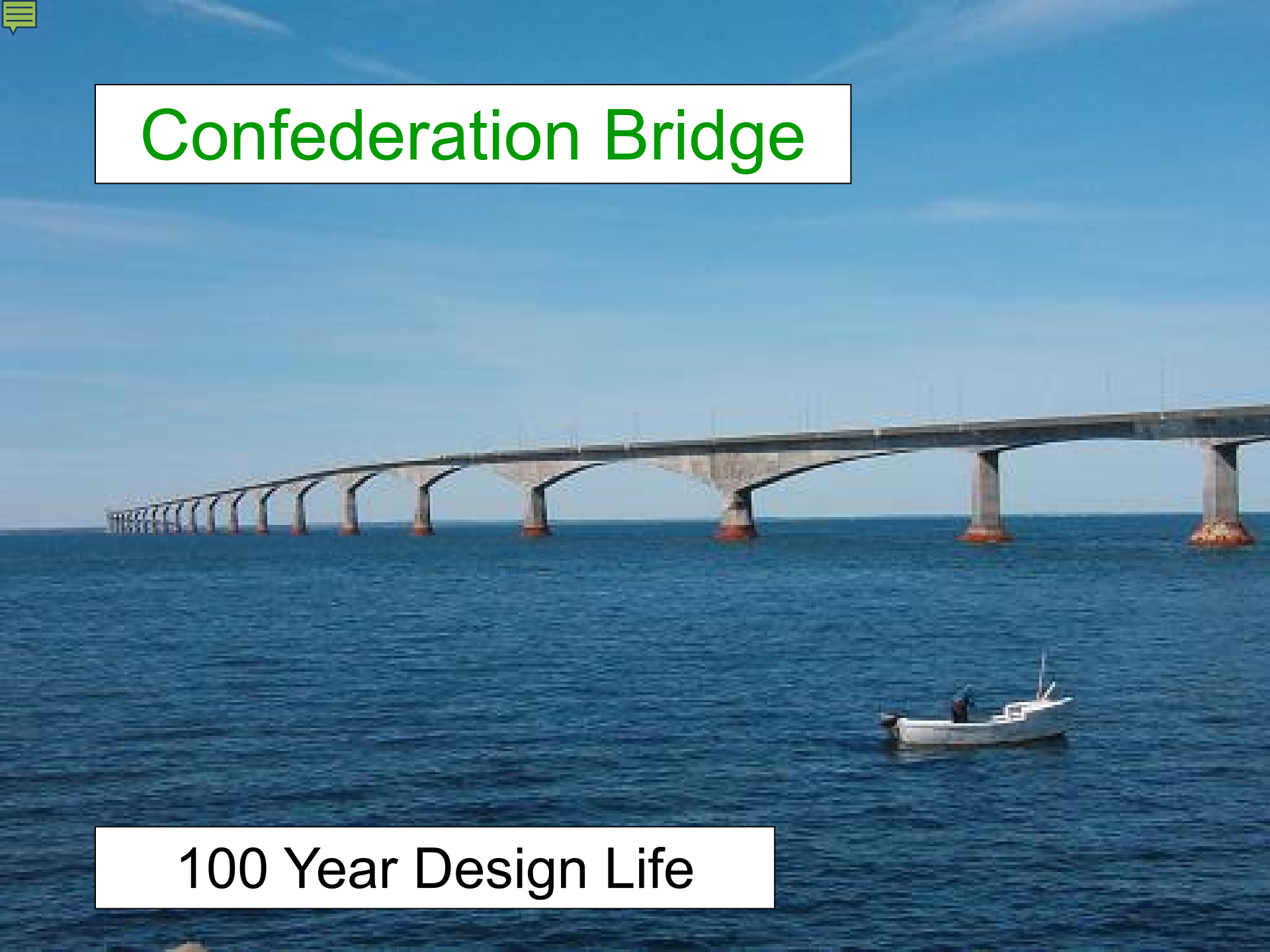
- Concrete is the most widely used man-made product in the world
- 6 Billion tons per year (3 Billion yd^3)
- Huge consumer of raw materials and energy
  - Cement, Aggregate and Concrete Production
  - Steel production is also energy intensive

Responsible Use of Concrete

- Despite the environmental impact, concrete is one of the most environmentally friendly materials available if we build structures to last or extend the life of existing structures.

Corrosion Prevention Strategies

- For New Structures:
- Design with Service Life in Mind
- Prevent Corrosion from Initiating
  - Design Structures which are Immune to Corrosion
  - Keep Water and Salt Away from Reinforcing Steel


Confederation Bridge
100 Year Design Life

Corrosion Prevention Strategies

- For Existing Structures:
  - Evaluation is Key
  - Have sufficient chlorides to cause corrosion penetrated or not?
- If Chlorides Have Not Penetrated
  - Do what you can to keep them out
- If Chlorides Have Penetrated
  - Can keep more chlorides out but probably need to do something more

Corrosion Prevention Strategies

- Chloride Contaminated Existing Structures
  - Some type of active protection is generally required to achieve long service life
- Impressed Current Cathodic Protection
- Electrochemical Treatment
- Galvanic Protection
- Fusion Systems

TECHNICAL

GUIDELINES

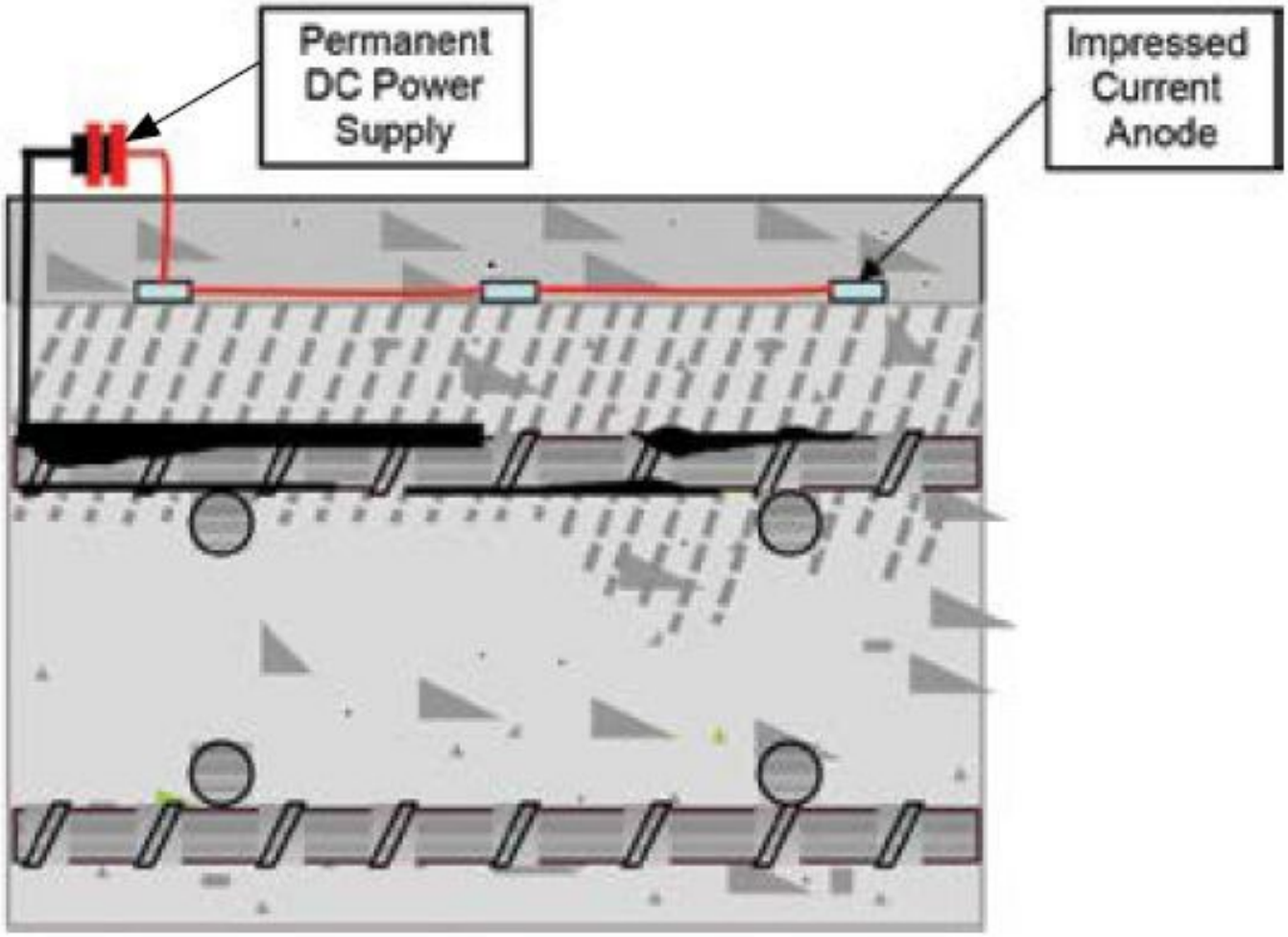
Prepared by the International Concrete Repair Institute June 2013



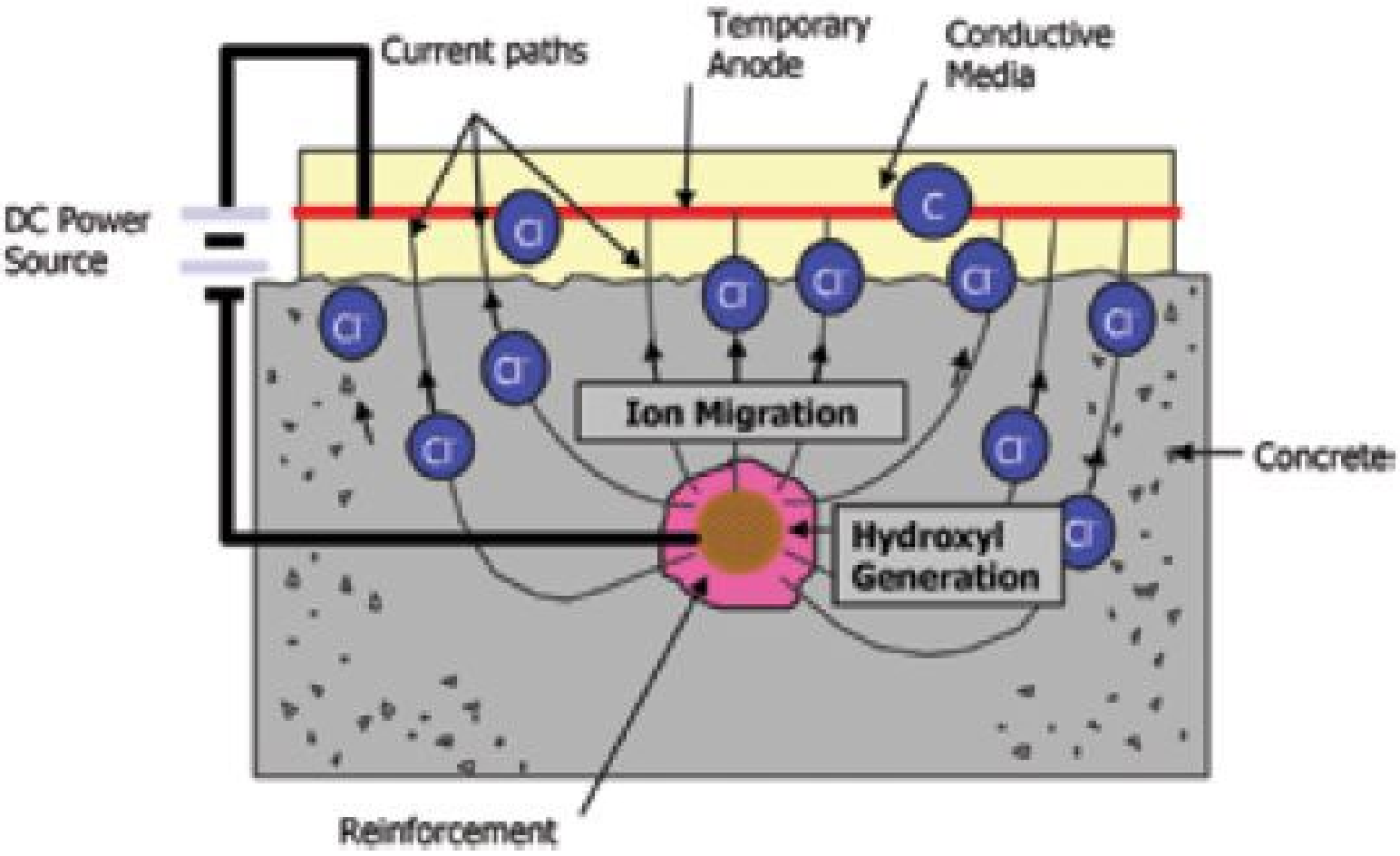

Guideline No. 510.1-2013

Guide for Electrochemical Techniques to Mitigate the Corrosion of Steel for Reinforced Concrete Structures

Impressed Current Cathodic Protection (ICCP)

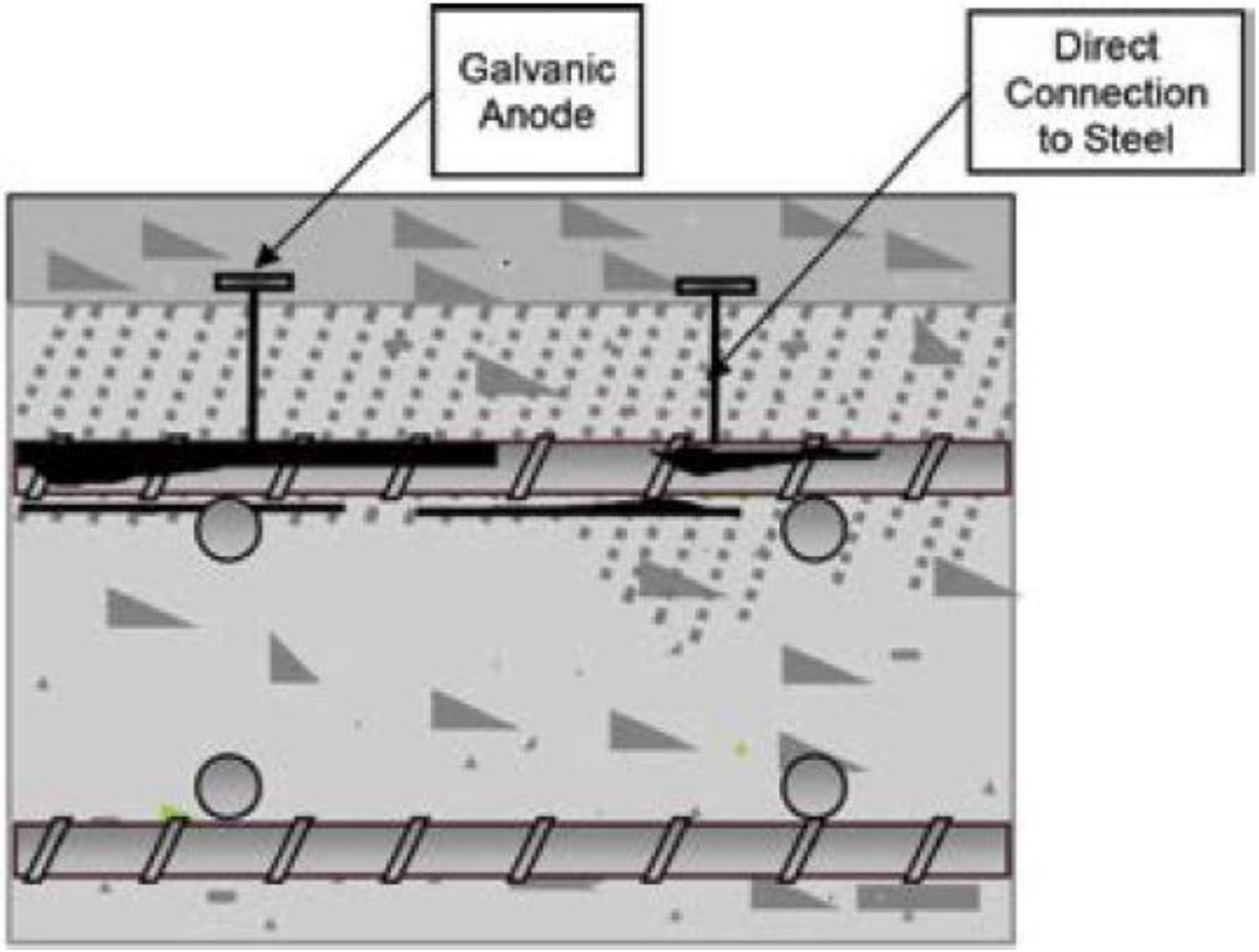


Electrochemical Chloride Extraction (ECE)



Electrochemical Chloride Extraction (ECE)

Galvanic Cathodic Protection (GCP)



INTERNATIONAL CONCRETE REPAIR INSTITUTE

Discrete Galvanic Anodes

ACI Vision 2020

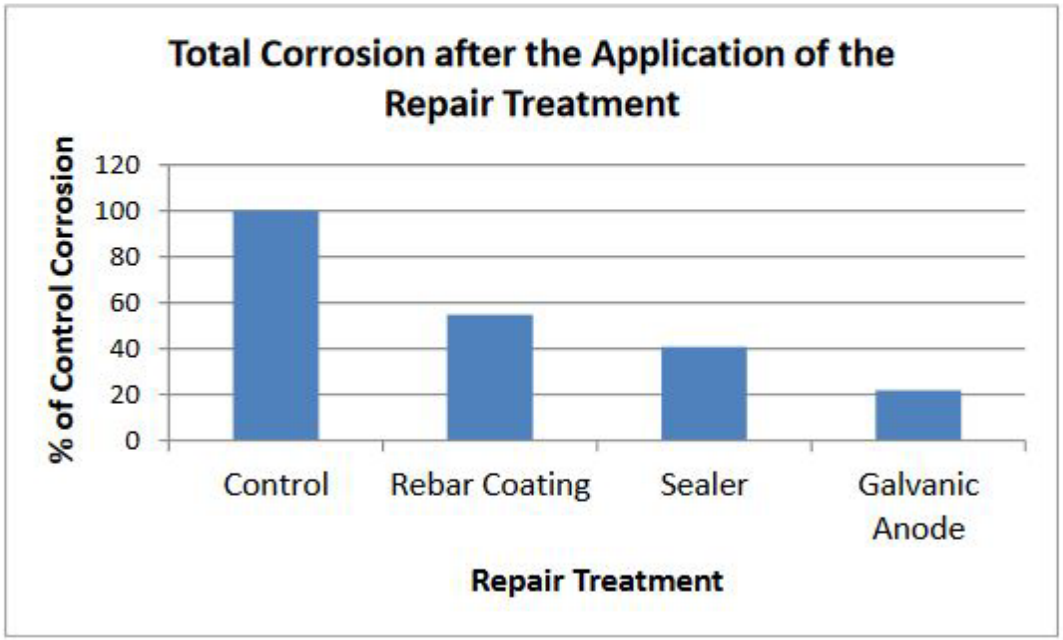
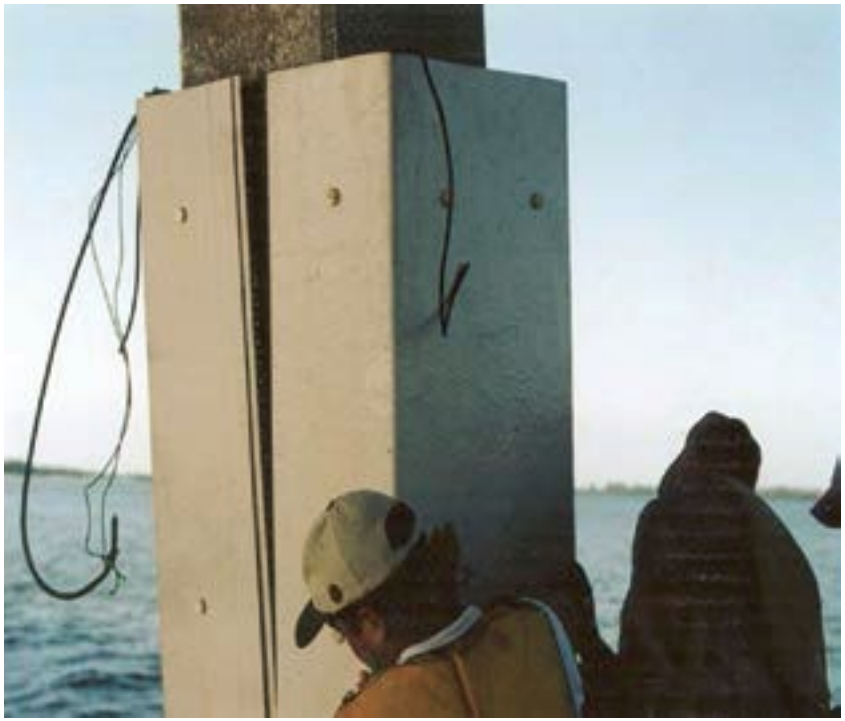


Figure 8 – Comparison of the performance of repair treatments for Batch #1.

Galvanic Jackets

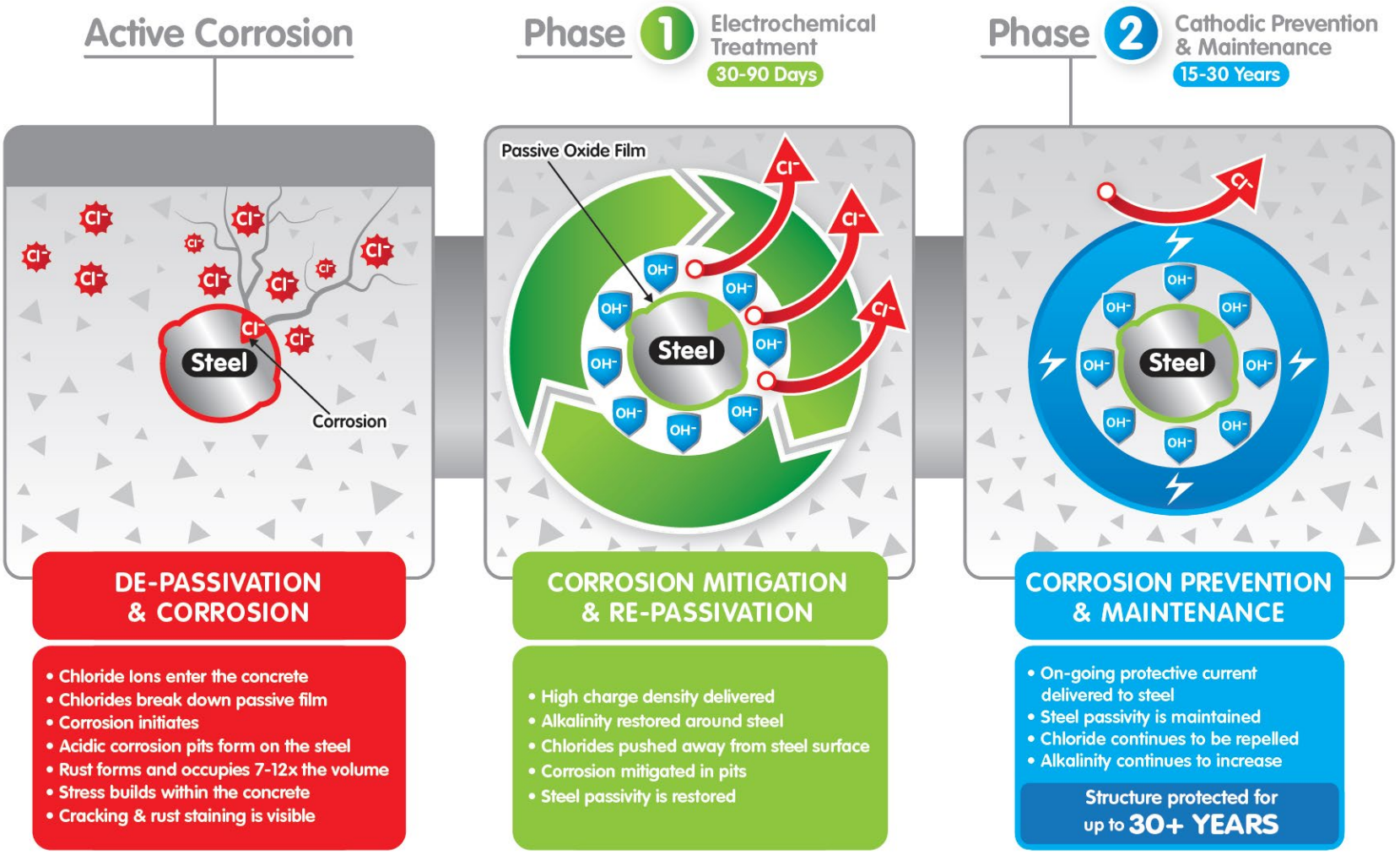


Fusion Systems

- Combine the Benefits of Impressed Current, Electrochemical Treatments and Galvanic Protection

1. Self-Powered Impressed Current to Passivate Actively Corroding Steel
2. Galvanic Protection to Maintain Passivity

Fusion Systems



Fusion Systems

Concluding Remarks

- There are many good reasons to design and build more durable bridges
- It is economically, socially and environmentally beneficial to invest our resources in maintaining our existing infrastructure instead of demolishing and rebuilding what we already have

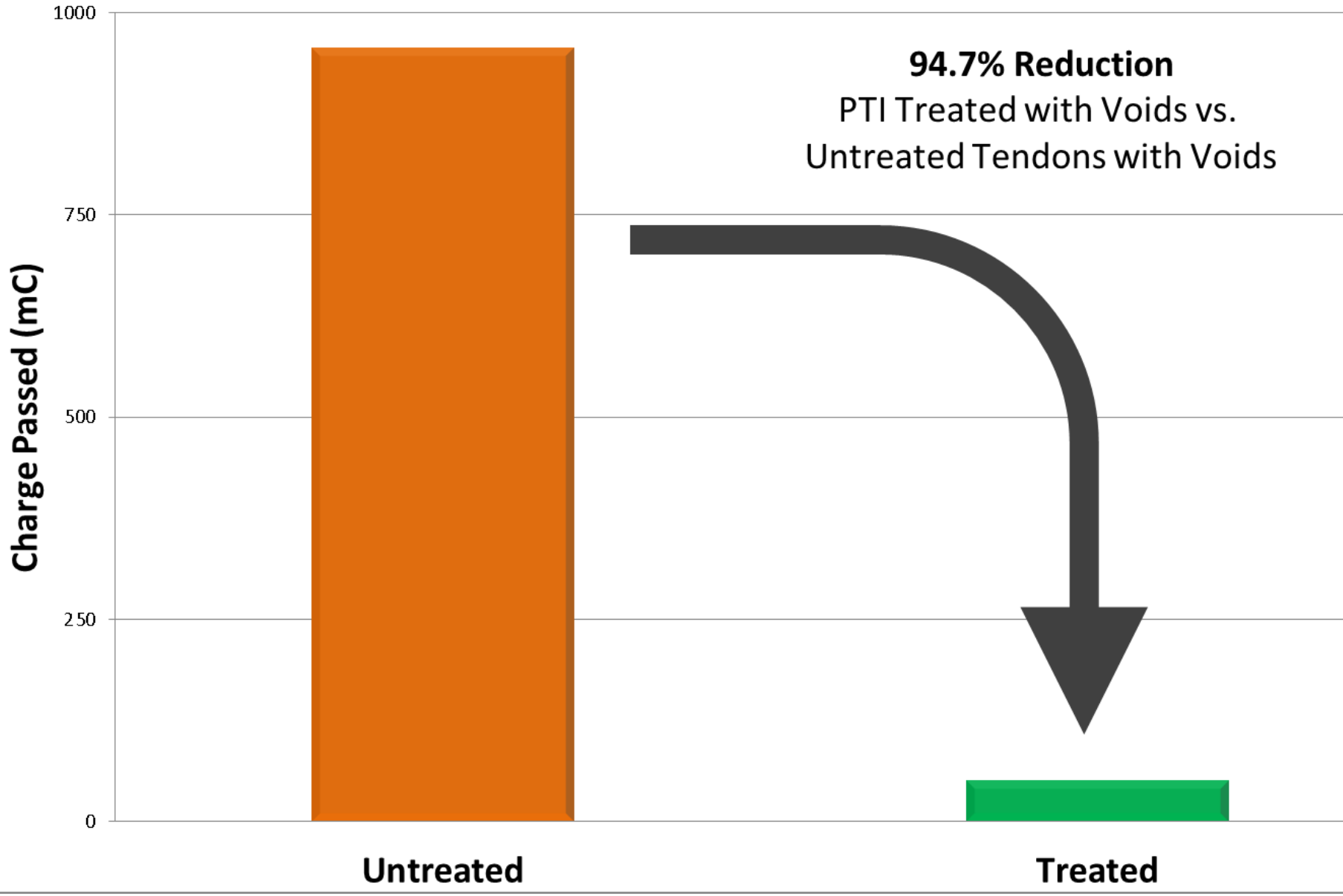

THINK

Thank You for Your Time and Attention

We Save Structures

Verification of Corrosion Protection of Tendons with Voids

Potentiostatic Testing Tendons in Uncontaminated Grout with 4.5% Void



Summary

- PT tendons are susceptible to corrosion
- Evaluation techniques can determine the cause and extent of the problem
- Corrosion mitigation techniques are available protect PT tendons in new and existing structures from corrosion