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2025 SPRING CONVENTION

AUSTIN, TEXAS • APRIL 13 – 16, 2025

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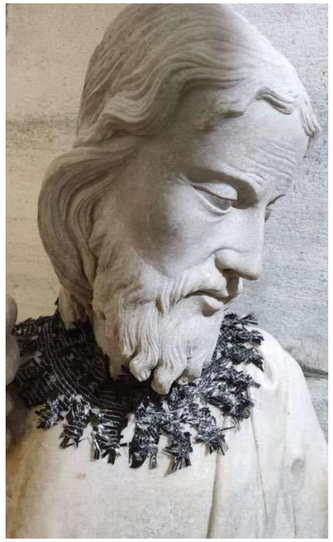
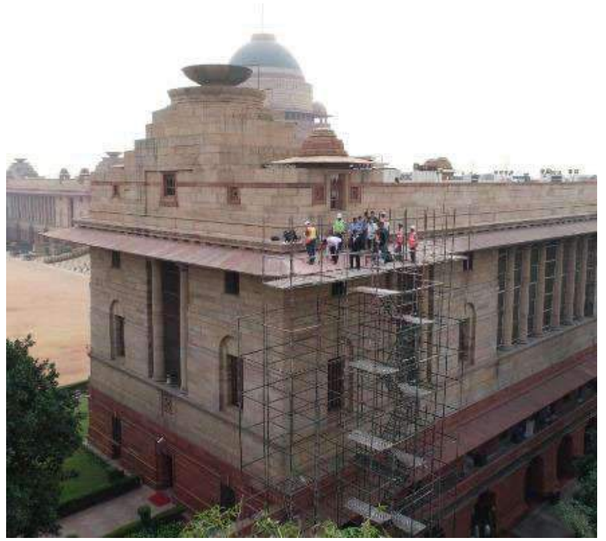
Concrete Confessions: Bizarre Stories that Led to Concrete Repair

Rick Ellingson
MAPEI

Jason Chodachek
Vector Corrosion Technologies

Josh Ahumada
Quakewrap, Inc





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From Grain to Gain

Upscale Living Inside a Historic Silo

Structural Challenges and Engineering Solutions

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Structural Reinforcement and Interior Transformation

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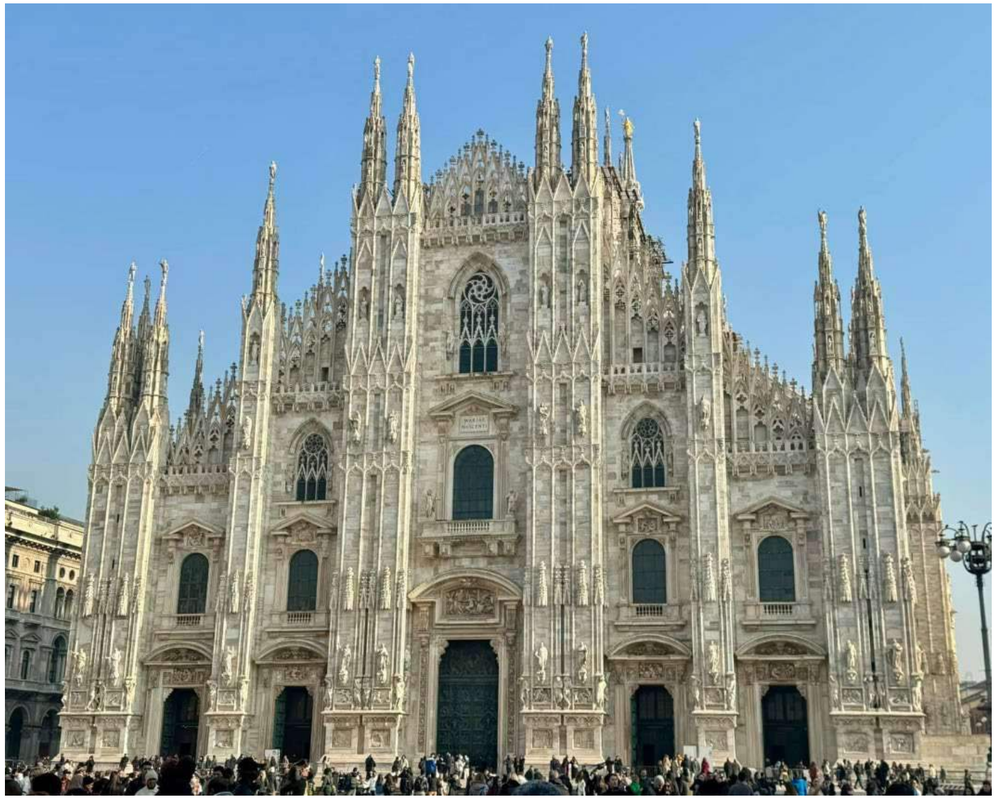
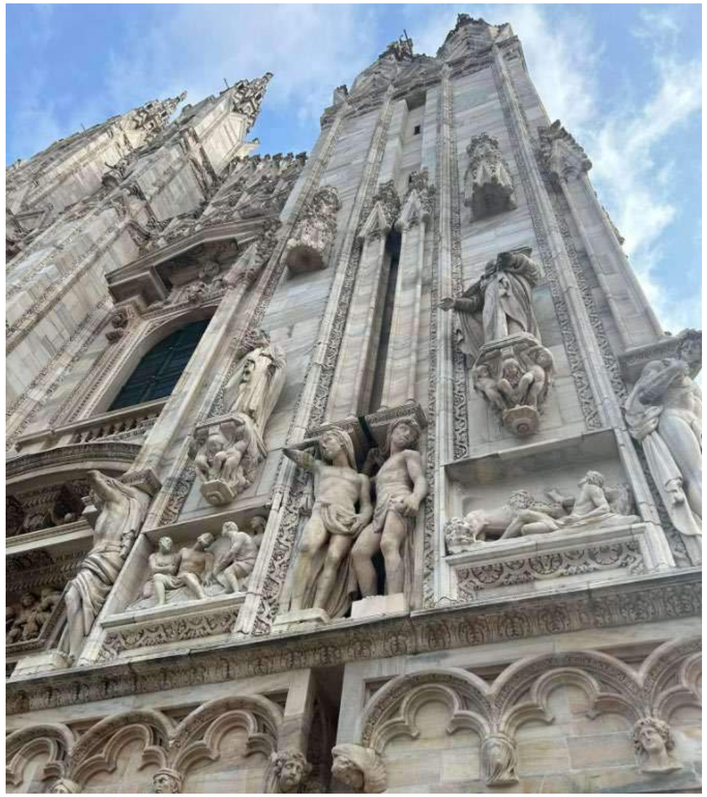
A Silo With A Skyline View

Key Figures

- Total built area: 53,000 sqft
- Residential area: 29,000 sqft
- Commercial space: 1,700sqft
- Hospitality facilities: 1,800sqft
- Wine Cellar: 1,600 sqft
- Building height: 130 ft
- Number of apartments: 31

Reinforcing History:
Carbon Fiber Meets Timeless Marble





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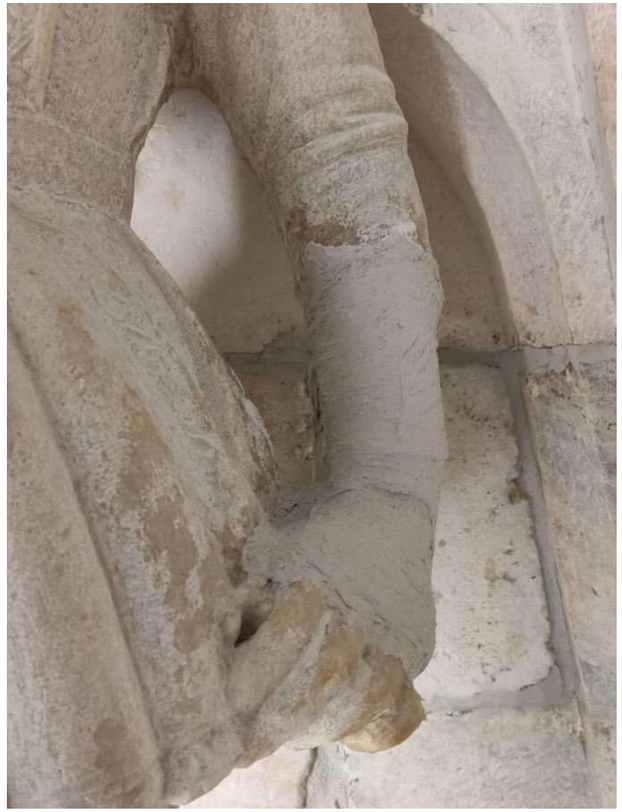
Live Content Slide

When playing as a slideshow, this slide will display live content

Poll: What is your primary concern when using FRP for structural repairs?

FRP Casts For Broken Arms



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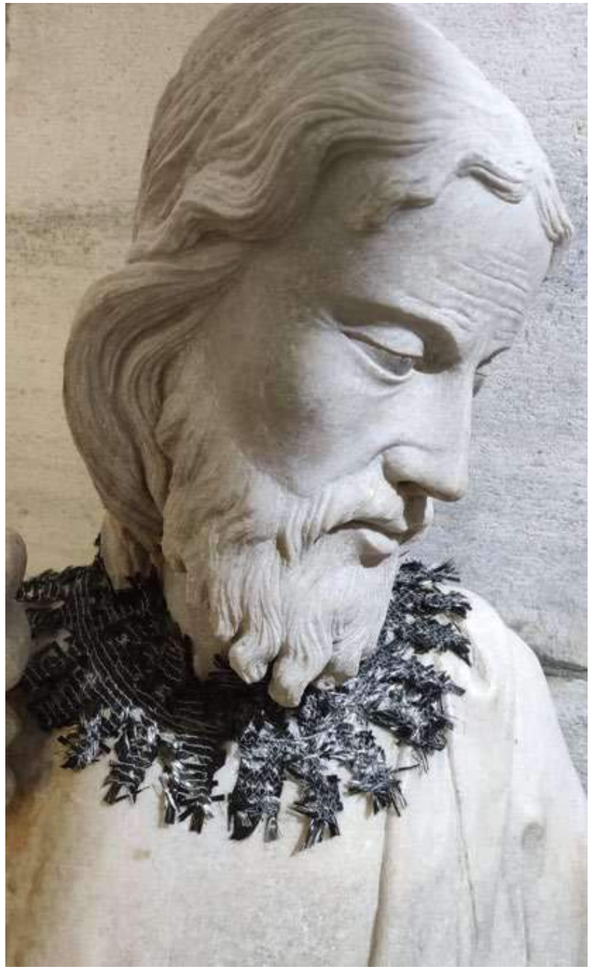

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Stitching Stone:
Science Behind Colosseum Care

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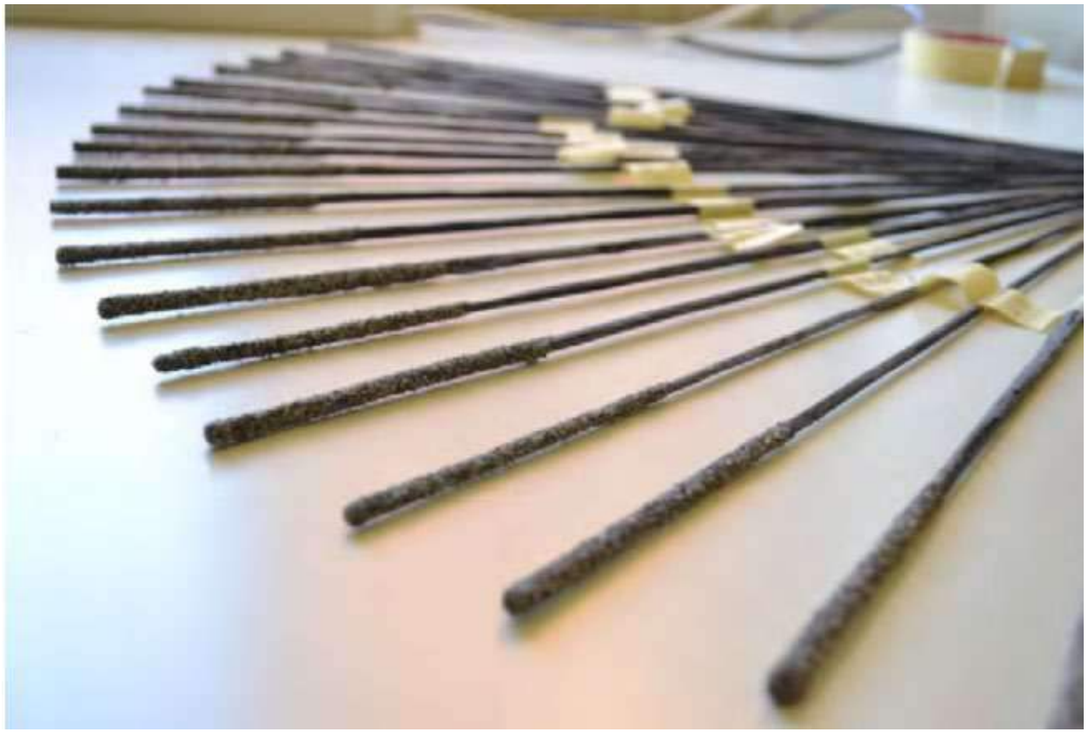
Experimental Research

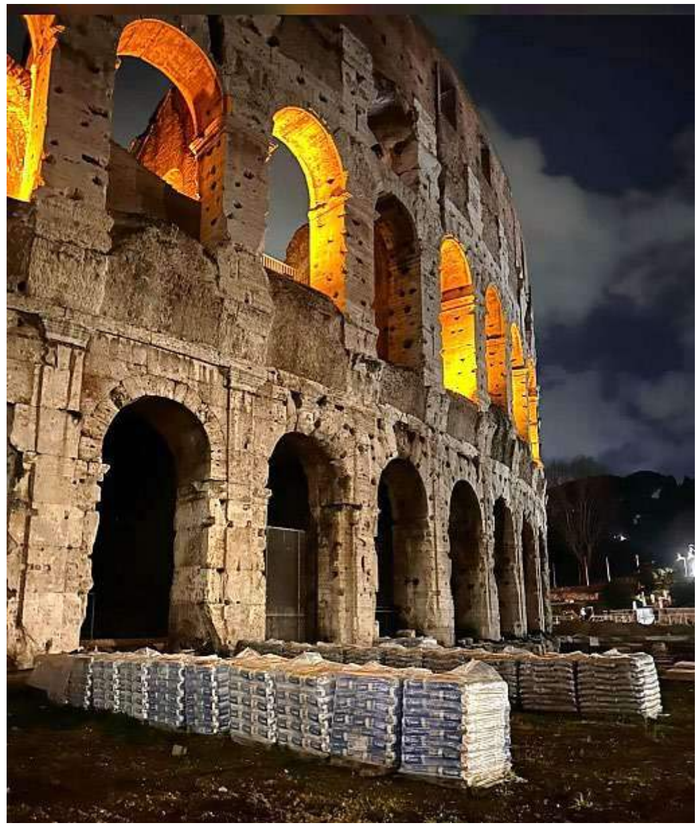
"From Podestà, S. (2016)*Valutazioni tecnico-scientifiche...*(p. 25, 29). University of Genoa."

Research Findings



"From Podestà, S. (2016)*Valutazioni tecnico-scientifiche...*(p. 37, 52). University of Genoa."

Innovation that Protects Heritage



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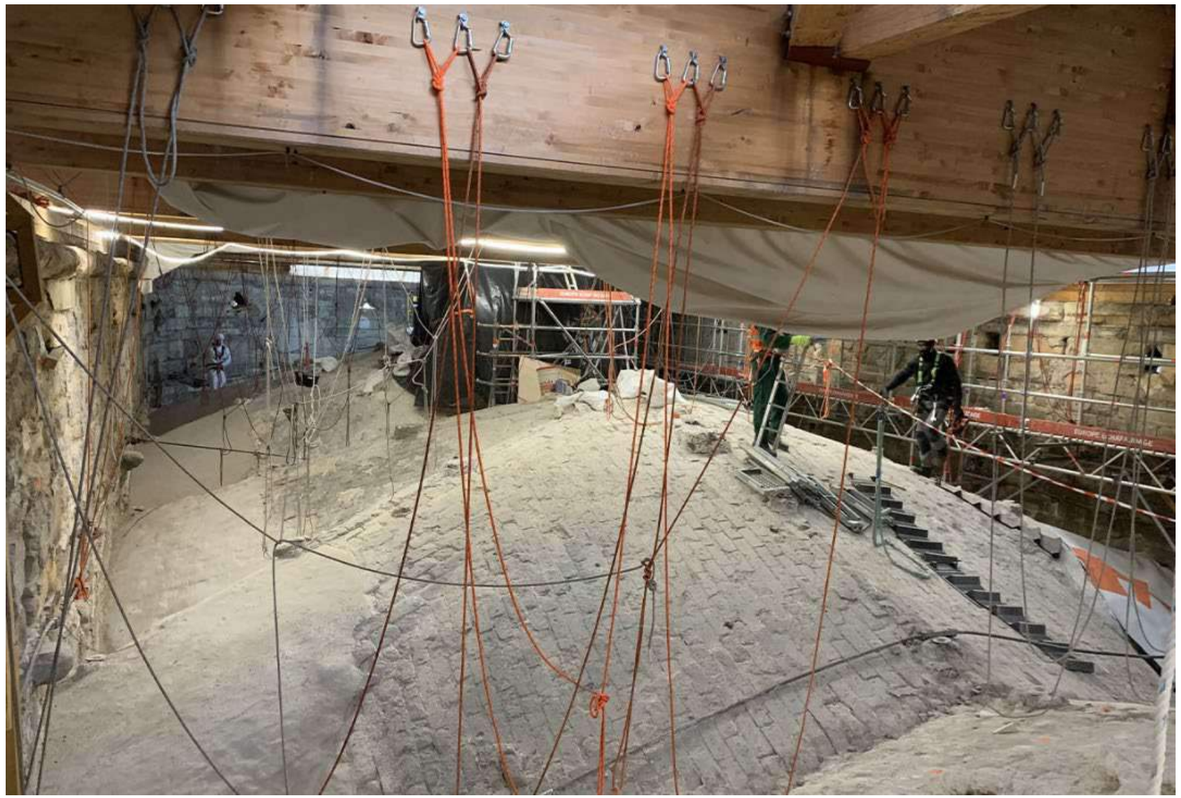
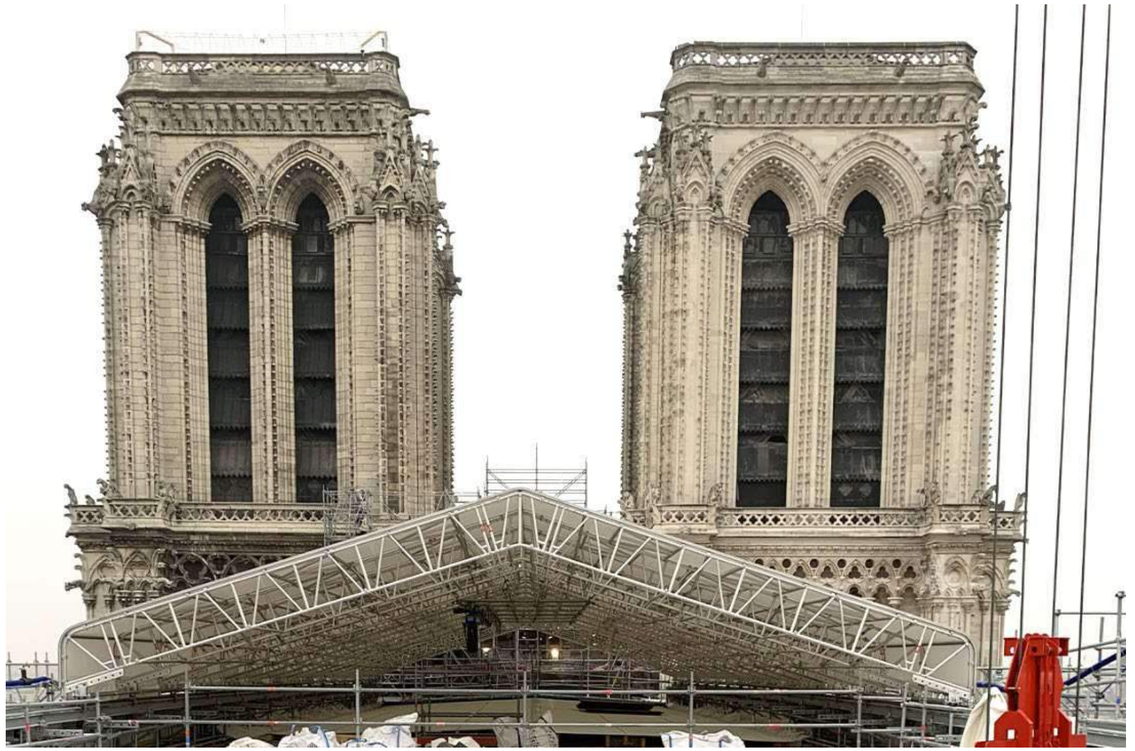
Beyond the Blaze: Notre-Dame's Trial by Fire

"From Arts & Collections (2019).*The Notre-Dame Fire: Saving the Treasures* Retrieved from http://bit.ly/4bU57eV"

Strength in Solutions



Strength in Solutions



The challenge:

Repair a pier with 50% loss of steel due to corrosion

Very close to & partially submerged in water

The Consultant's Solution:

Make timber formwork (heavy & difficult)

Attach reinforcing bars

Place concrete in annular space

Remove & discard the timber forms

Exposing the structure to salt spray and future corrosion

Owner did not receive any responsive bids at a reasonable cost

Our Value Engineering Solution:

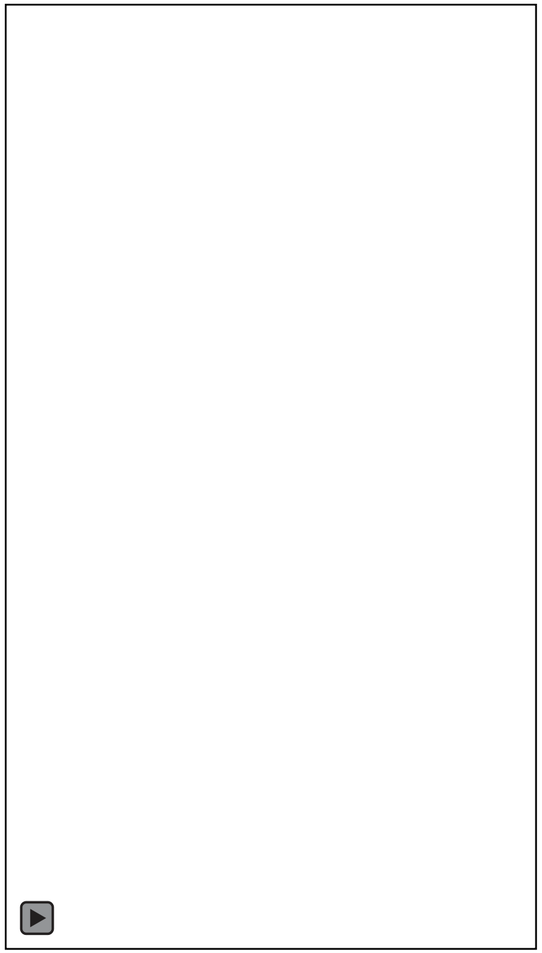
Make custom-made stay-in-place FRP form work

Use sandwich construction method

A core material

Covered with layers of glass FRP on both faces

Forms weigh only 2.2 lbs/SF



Forms were manufactured in Tucson & shipped to Galveston

Spacers & GFRP rebars were added in the field

Forms were lifted up from below and held in place with anchor bolts; Grout was pumped through ports

Benefits of the Value Engineering Solution:

Economical

Faster construction time

GFRP forms will permanently protect the structure from salt spray & corrosion -- Like a permanent layer of 3/8” thick paint!

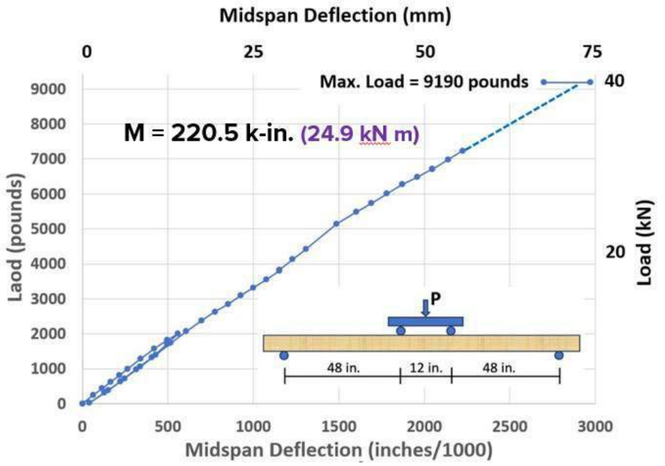
DEVELOPING A NEW PRODUCT

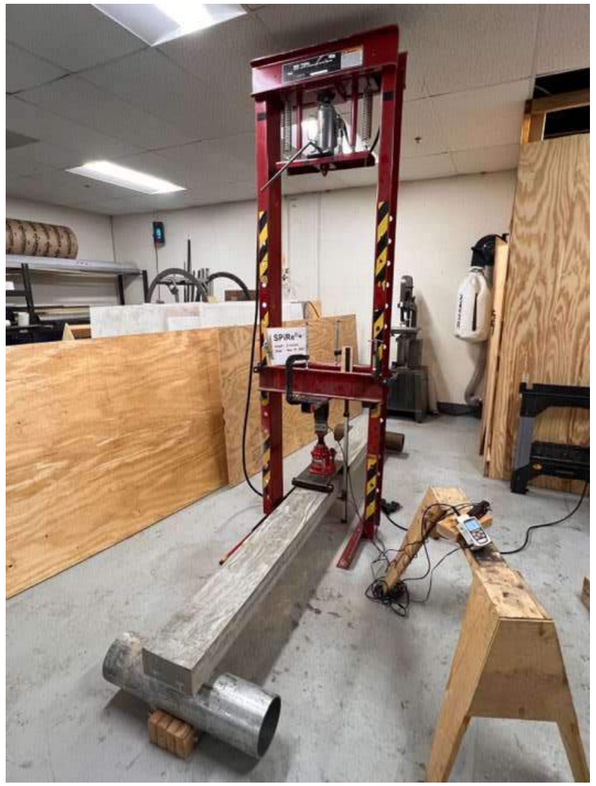
Recognizing the benefits of this solution

Having to add GFRP rebars in the field

The New Panels:

- 3-ft Wide
- Available in any length
- One Face is grit coated
- T-profiles serve as reinforcing bars
- Panel is equivalent to No. 6 Grade 60 steel rebar @3 ½” on center
- Use sealant at overlapping edges





Installation Procedure:

- Little to no surface preparation required
- Attach panels with anchor bolts about 3-ft on center
- Pump grout in annular space between panels and host structure
- Can assemble panels to make forms of any shape

The panels serve as:

- Stay-in-place form
- Reinforcing bars
- Waterproofing membrane

APPLICATION - SLAB

Corroded Slab

Install Panels

Cut penetrations as needed

Grout from above

APPLICATION– BRIDGE PIER WALL

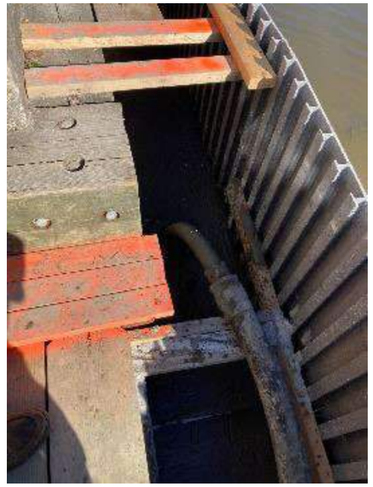
Damaged pier wall

Install Panels

Mix & pump grout

Repaired wall

APPLICATION - SEAWALL



Vibrating the panels in

Securing w/ anchor bolts & grouting

Trim the top edge

The Presidential Palace - Government of India
Rashtrapathi Bhavan

Live Content Slide

When playing as a slideshow, this slide will display live content

Poll: Which corrosion mitigation strategy do you use most often in concrete repairs?

The Problem

- Construction Started 1912, Completed 1929
- Cantilever reinforced concrete sun shade

The Problem

- Floral patters on the bottom and layers of plaster
- Corrosion of reinforcing bars and delamination of plaster and concrete
- A cathodic protection system was required

The Problem

Cantilevered Reinforced Lime Concrete Sunshades (Chajjas)

- Exhibiting active corrosion of reinforcing steel and delamination of concrete
- Previous repairs using polymer-modified mortar failed prematurely
- Lime concrete has a low pH, which promotes active steel corrosion
- Steel reinforcement requires re-passivation and long-term cathodic protection to prevent further corrosion

Client Requirement

- Develop a long-term repair strategy to extend service life
- Protect any new repairs from premature failure
- Preserve the original shape and dimensions of the sunshade, avoiding full replacement

The Approach

Pilot Study and Monitoring:

- Conducted to assess the feasibility of various anode systems

  - **Type 1A**: Flat anodes
  - **Type 2A**: Two-stage anodes

Type 1A

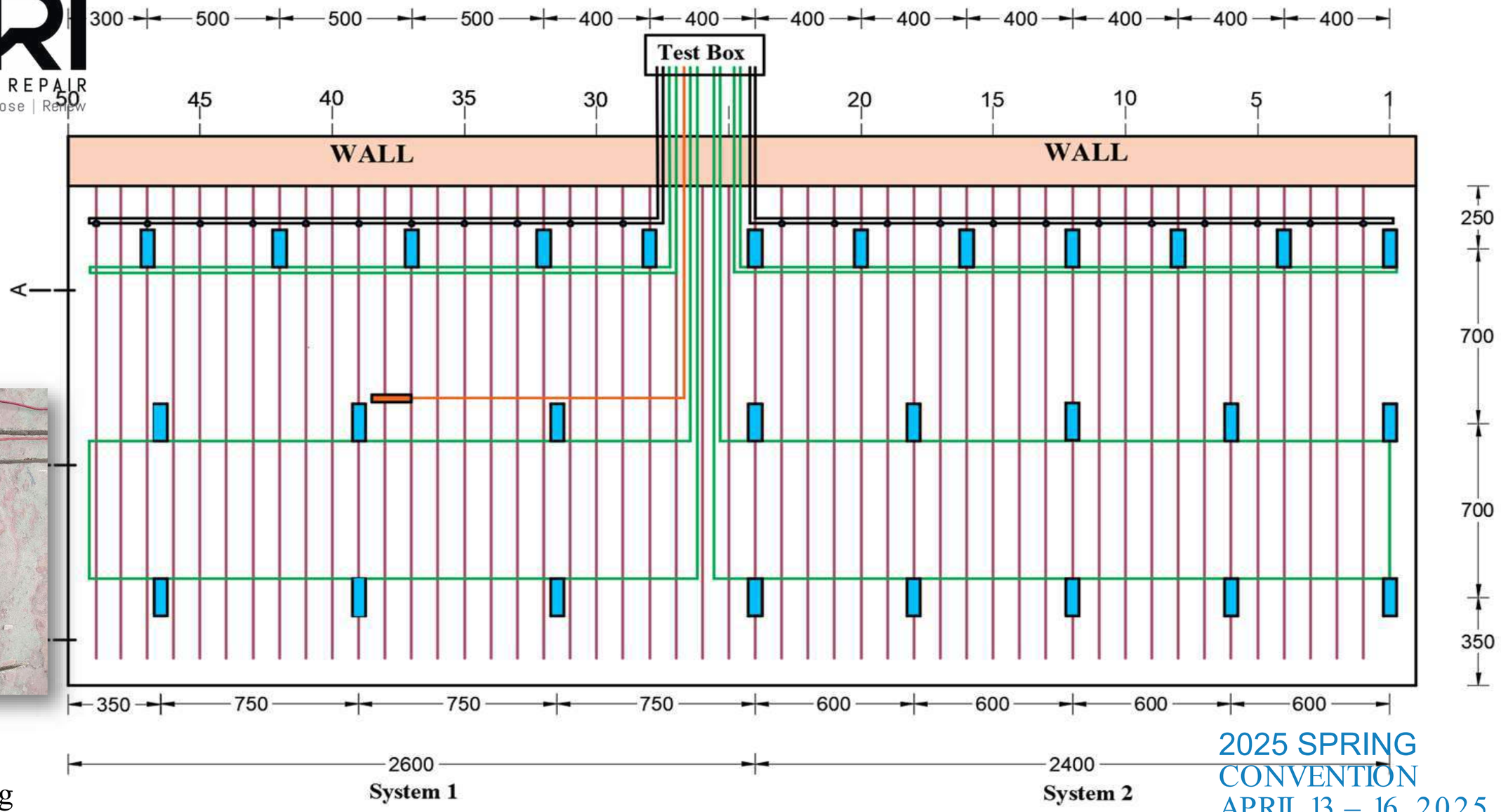
Type 2A

The System - Type 2A – Narrow

Key Benefits of the Repair Solution:

- Two-stage anode system operates without an external power source
- Rapid passivation of actively corroding steel reinforcement
- Long-term protection, significantly delaying the onset of future corrosion
- Alkali-activated mortar used in the system are non-corrosive and safe for embedded steel

ANODE LAYOUTS – TYPE 2A ANODES



Installation

Locating rebars

Check for High Corrosion Potentials

Check for rebar connectivity

Installation

Chases for anodes

Installation of anodes

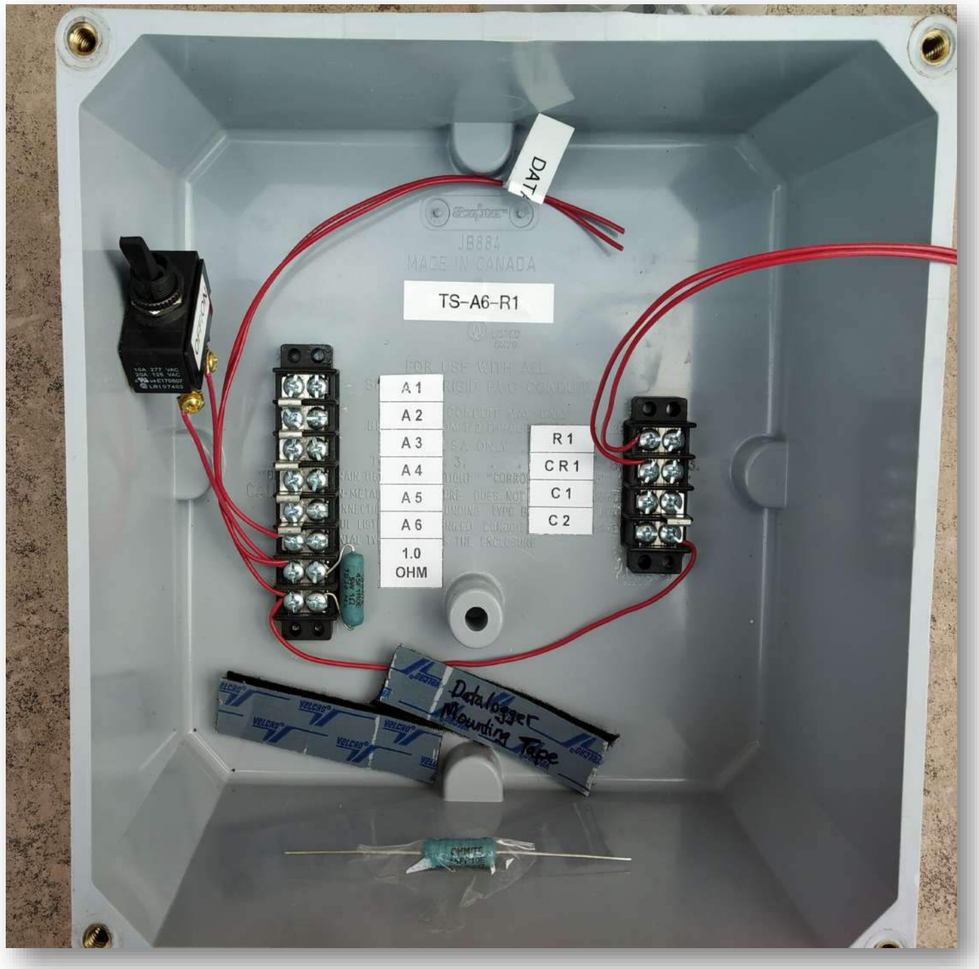
Installation

Checking connectivity of anodes

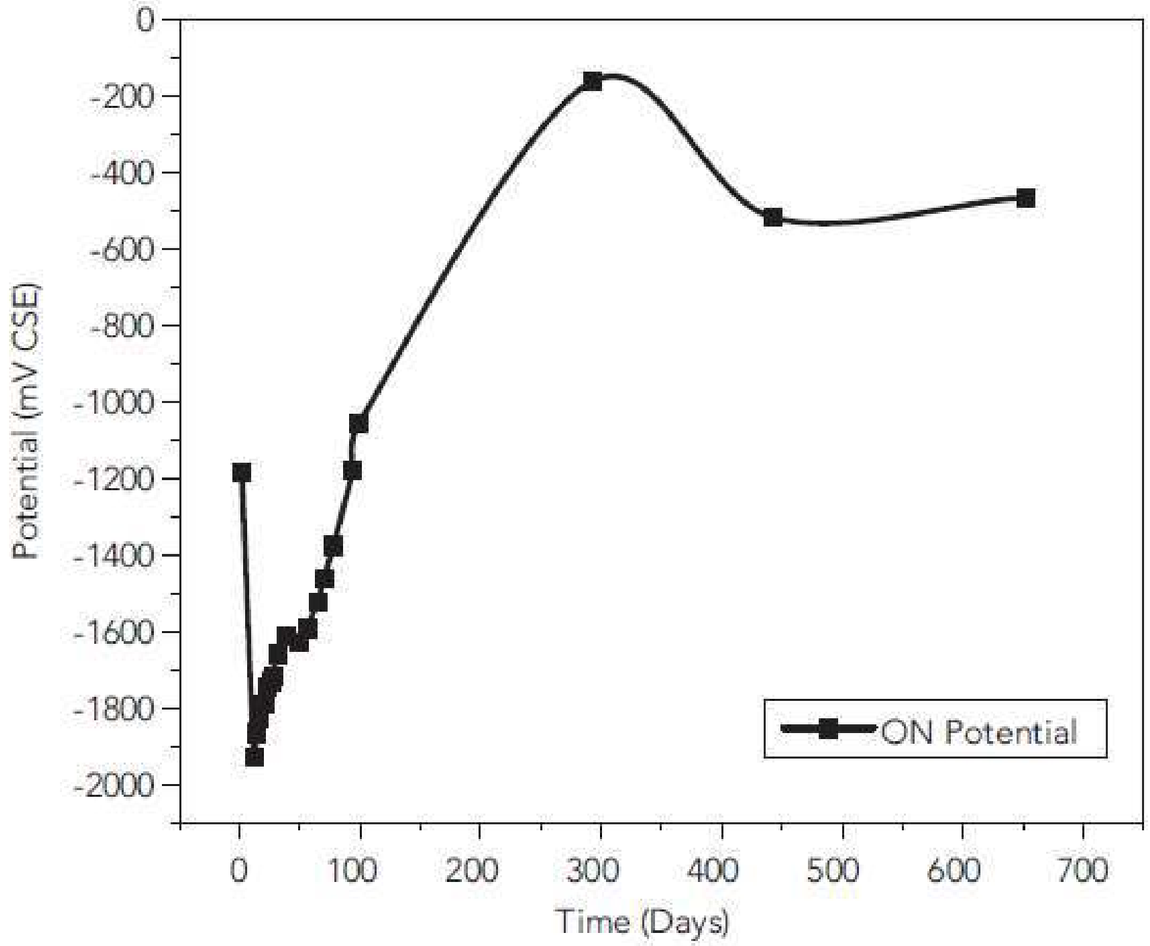
Embedded reference electrode

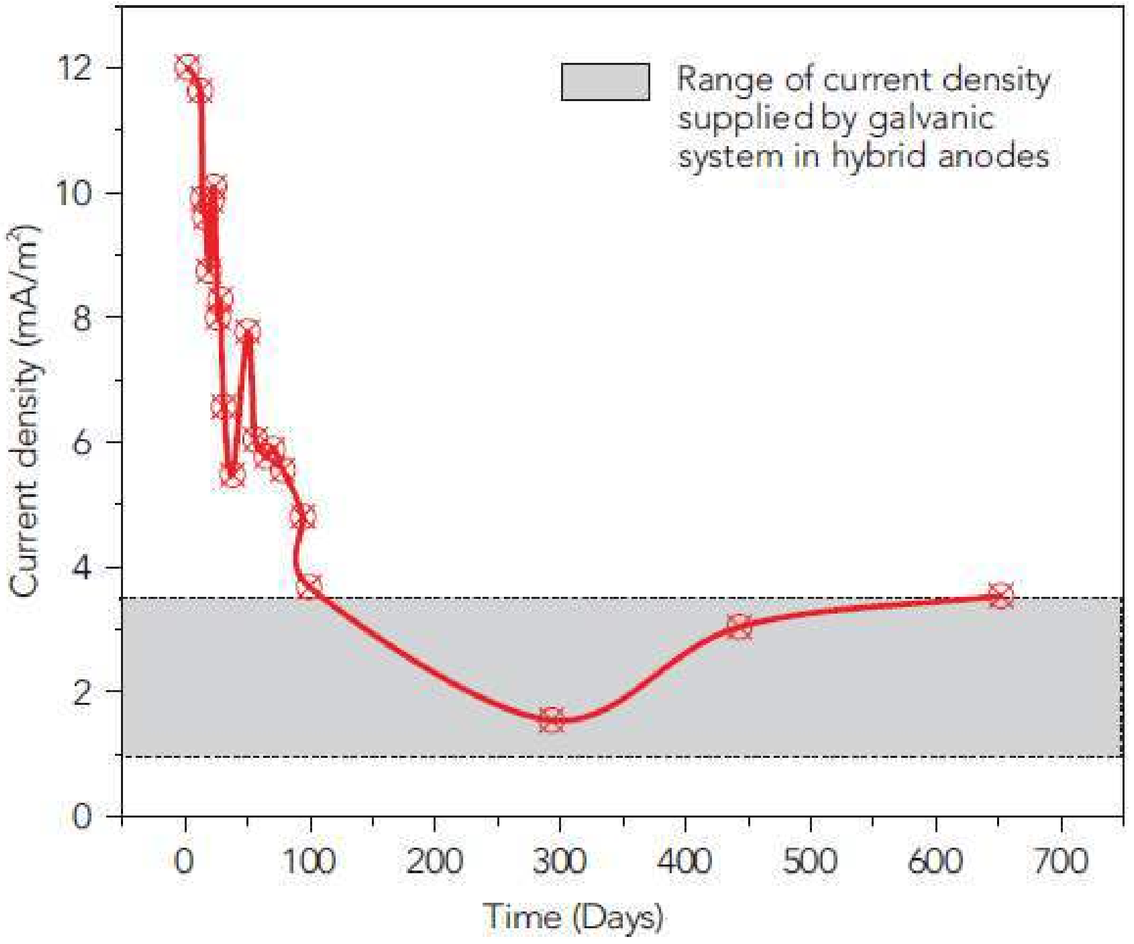
Installation

The Monitoring



Variation of ON potential and current density with time





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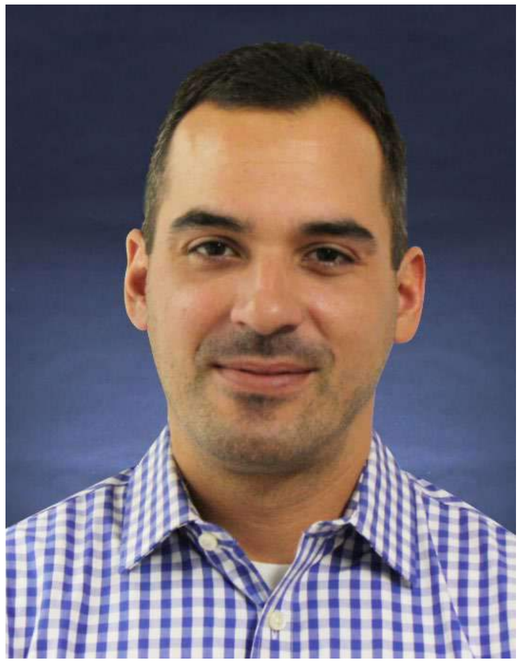
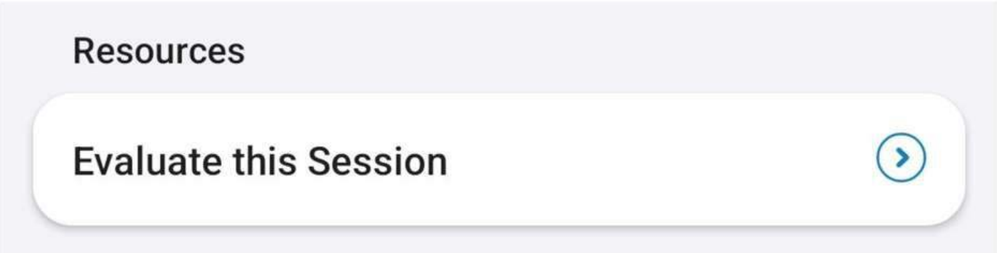


SESSIONEVALUATION



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ANY QUESTIONS?