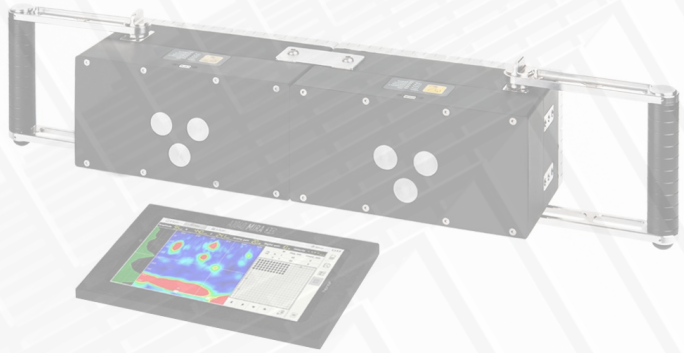
Advanced Infrastructure Design, Inc.

NJDOT BRIIT Research Showcase Tech Talk May 2025
NDT Methods for Bridge Deck Forensic Assessment
May 14th, 2025



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Outline

- AID Introduction
- Notable Projects
- NDT Methods for Structural Assessment
- Problem Statement
- Ground Penetrating Radar (GPR)
- Ultrasonic Testing (UT)
- Supplementary Assessment (Bolt Penetration

Advanced Infrastructure Design, Inc. (AID)

25 years providing engineering services (Established in 1998)

- Pavement Engineering
- Structural and Infrastructural Assessments
- Geotechnical Engineering & Ground Improvements
- Material & Construction Services
- Specification Development
- Asset Management & Database Development
- Forensic & Utility Investigation
- Drainage Design and Highway Design

Owns and operates many state-of-the-art/practice testing technologies

- Ground Penetrating Radar (GPR)
- Ultrasonic Technology (MIRA)
- Infrared Thermography Technologies (IRT)
- Drone/UAV Technologies
- Falling Weight Deflectometer (FWD)
- Ride Quality/IRI
- LCMS (Laser Cracking Measuring System)
- Video (a 4-HD Video system integrated with GPS)
- Coring & Augering
- Dynamic Cone Penetrometer (DCP)
- Light Weight Deflectometer (LWD)
- Seismic Mapping of subsurface (MASW & ReMi)
- Other NDTs (PSPA, Ultrasonic, Impact Echo,

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Notable Projects

Pavement Evaluation & Design
- Multiple 3-Year Term Agreements with NJDOT (2005-Present)
- Many NJDOT Capital Projects

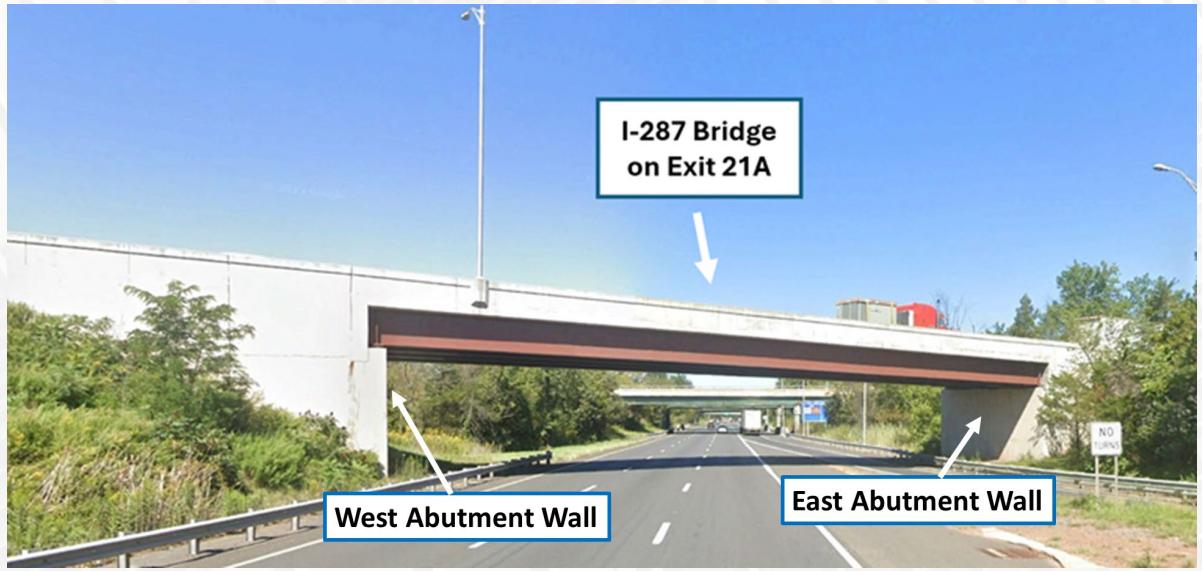
Pavement/Asset Management
- Pavement data collection and assistance with PMS for NJ Turnpike and GSP (3000 lane miles)
- Pavement data collection and assistance with PMS for AC Expressway
- 7 Counties in NJ
- Other Counties & Municipalities in various States
- Puerto Rico

Structural Assessment
- NYC Bridge Deck Evaluation
- Tuscarora Tunnel Condition Assessment
- Rehabilitation of Driscoll Bridge MSE Ealls

Airports
- Baltimore Washington International and Martin State, Maryland
- Philadelphia International Airport, Pennsylvania
- Atlantic City International Airport, New Jersey
- Stewart New York International Airport, Newburgh & New Windsor, New York

Lab Testing
- AASHTO Certified Lab

Problem Statement



Forensic Investigation of the I-287 Bridge.

Location: Northbound direction, near Exit 21A.

Applied Non-Destructive Testing (NDT) Methods:

- Ultrasonic Testing (UT)
- Ground Penetrating Radar (GPR)

HNTB retained AID to provide technical services for locating and mapping reinforcement rebars, measuring concrete cover, and identifying possible extensions of cracks and potential large voids on the backwalls of the bridge

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Ground Penetrating Radar (GPR)

Technology Overview

- **Hand-Held GPR System**
  - Frequency: 2.6 GHz
  - Type: Ground-coupled antenna
  - Manufacturer: GSSI

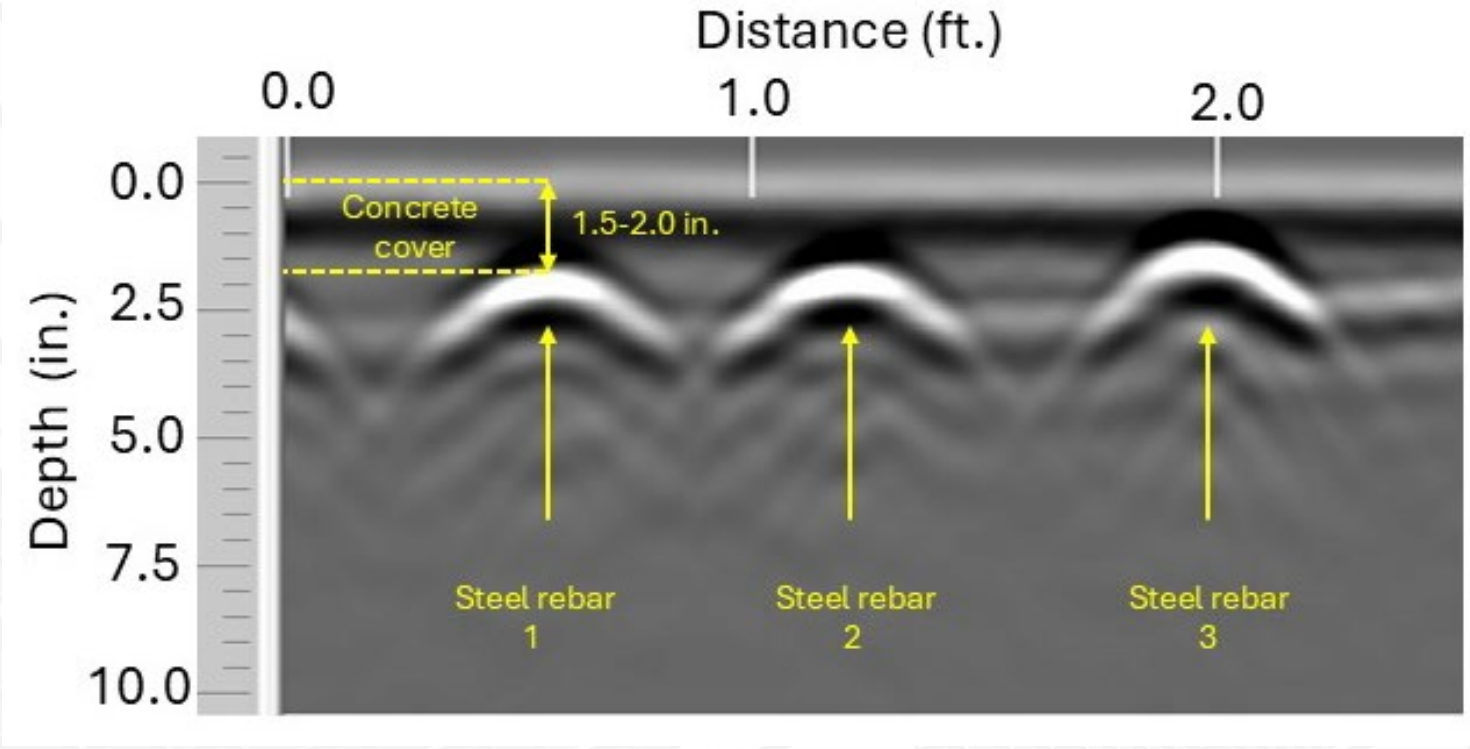
Process Workflow

- **Survey Data Collection**
  - Compile all survey lines from the hand-held GPR
- **Data Analysis**
  - Use RADAN software for data analysis
- **Data Visualization**
  - Overlay GPR data onto CAD drawings
  - Integrate actual images with as-built

Ultrasonic Testing (UT)

GPR Presentation of Data in RADAN

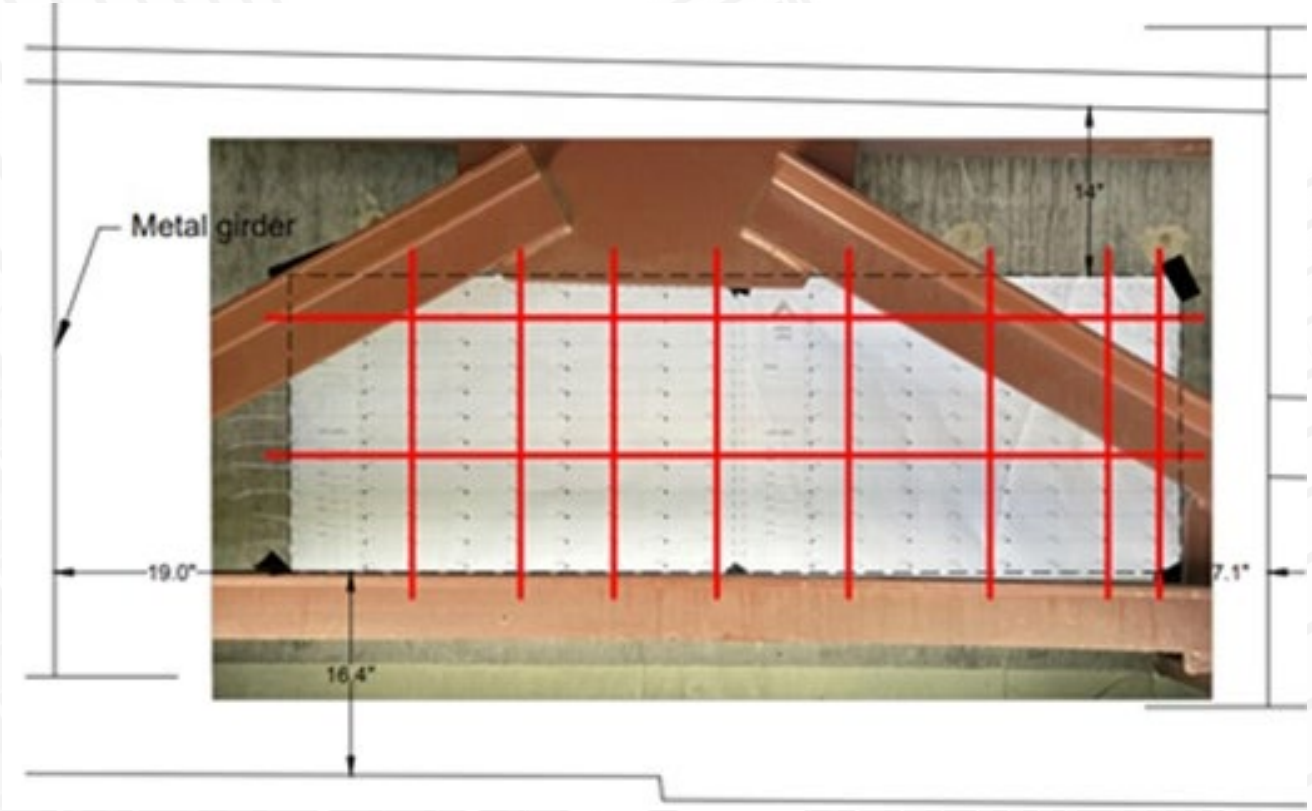
- The horizontal axis indicates distance (ft),
- The vertical axis represents depth of penetration (in.) in the material as nanoseconds (ns).



Note: Reflections from steel rebars visible as inverted hyperbolas.

Ultrasonic Testing (UT)

Overlay of GPR Scans on the Rebar Layout



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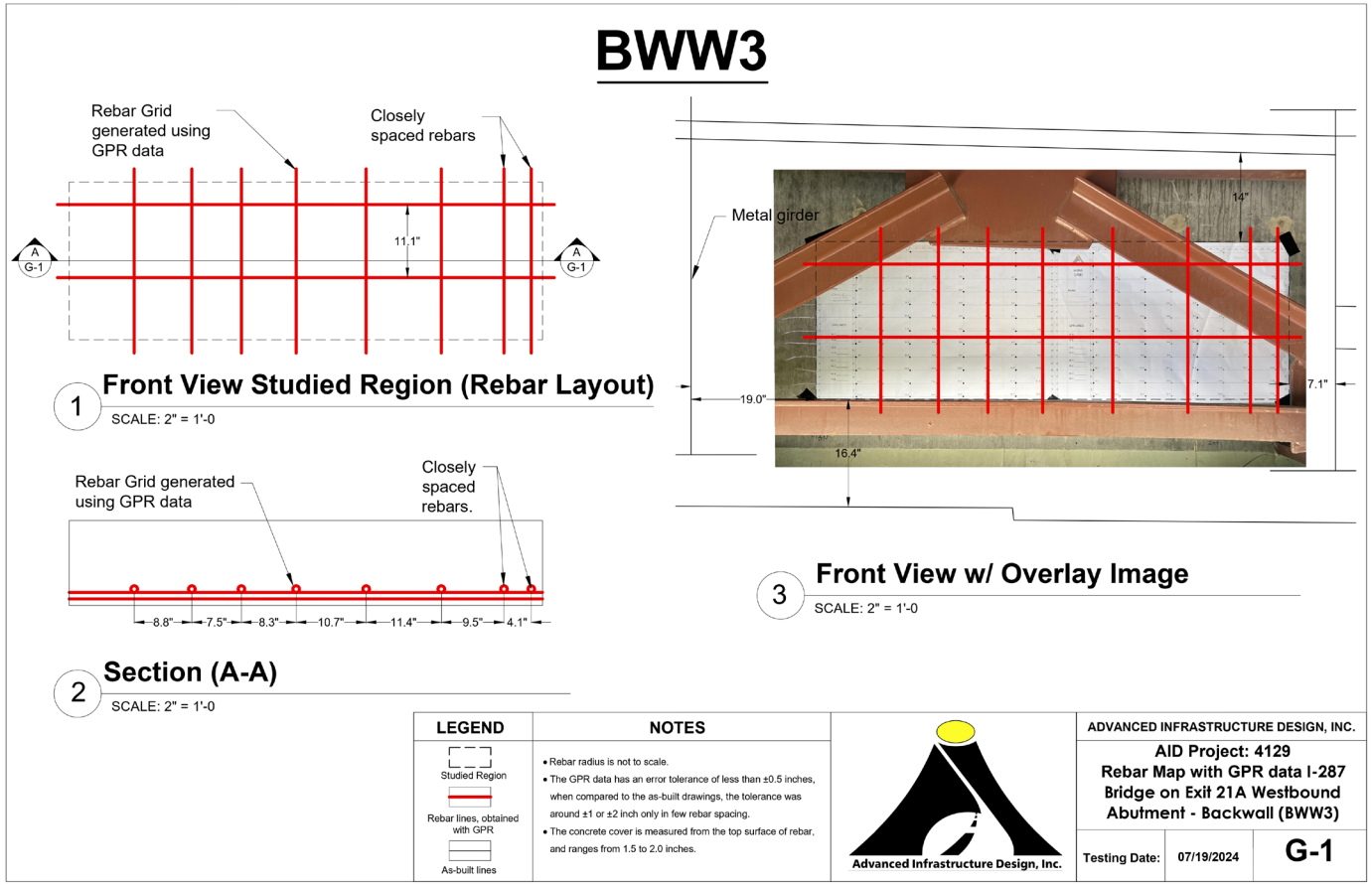
Ultrasonic Testing (UT)



Typical GPR finding deliverable

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Ultrasonic Testing (UT)

Technology Overview

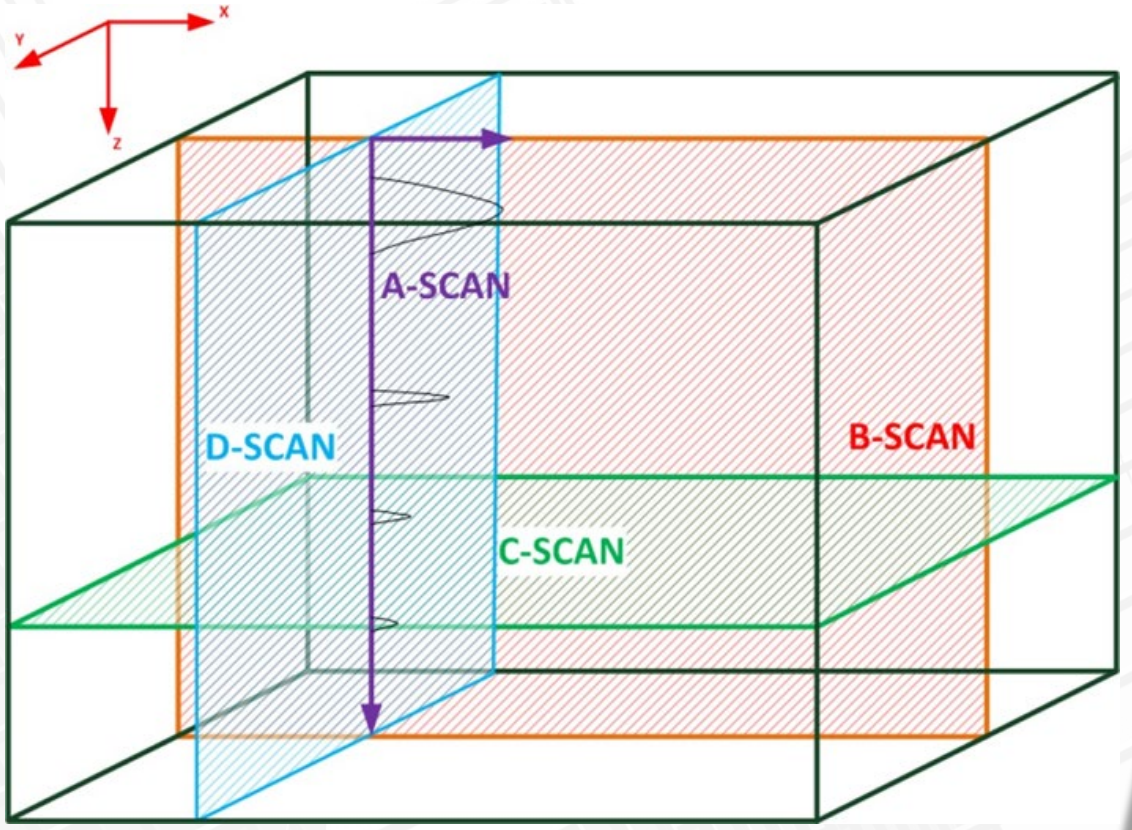
AID utilizes the advanced ultrasonic tomography system, the A1040 MIRA 3D PRO, which can analyze multiple ultrasonic signals between transmitters and receivers distributed along a linear aperture.

Key Features and Benefits:

- **Detailed Cross-Sections:** The system provides a comprehensive cross-section view of acoustic interfaces within the object, along the axis of the array. This enables a precise visualization of internal structures.
- **Enhanced Measurement Capability:** By conducting measurements in a grid pattern, we achieve a thorough assessment of the concrete element. This grid-based approach ensures detailed and accurate data collection.

Ultrasonic Testing (UT)

Advanced Imaging Options:
The ultrasonic device offers the ability to generate transverse cross-sections (D-Scans) and slices at various depths (C-Scans), providing additional layers of detail and insight into the object's internal composition.

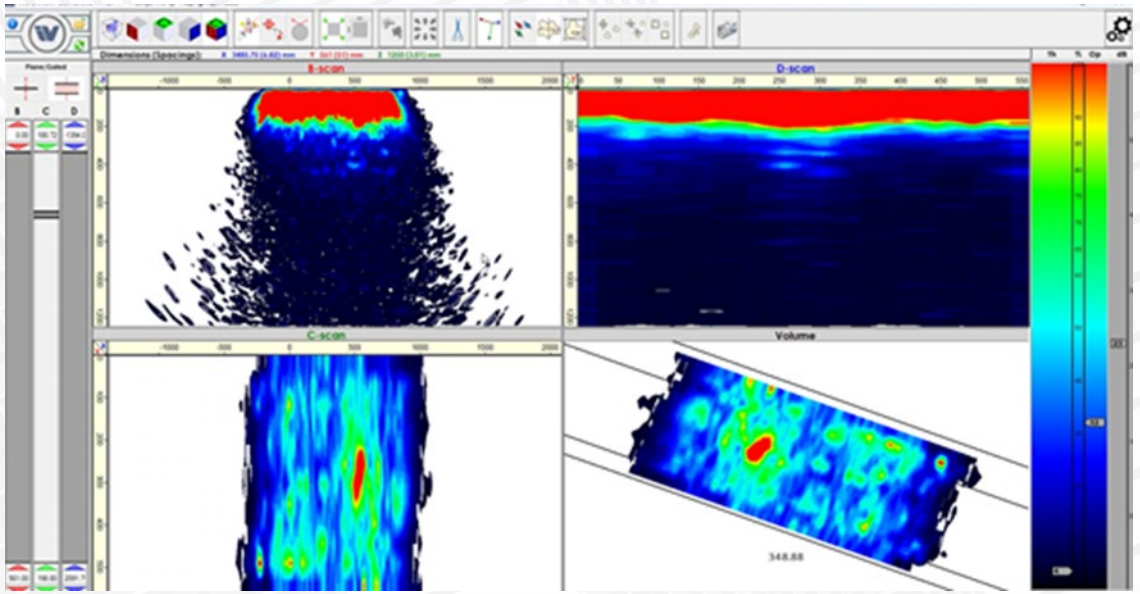


Patrick Stiglmair, 2022

Ultrasonic Testing (UT)

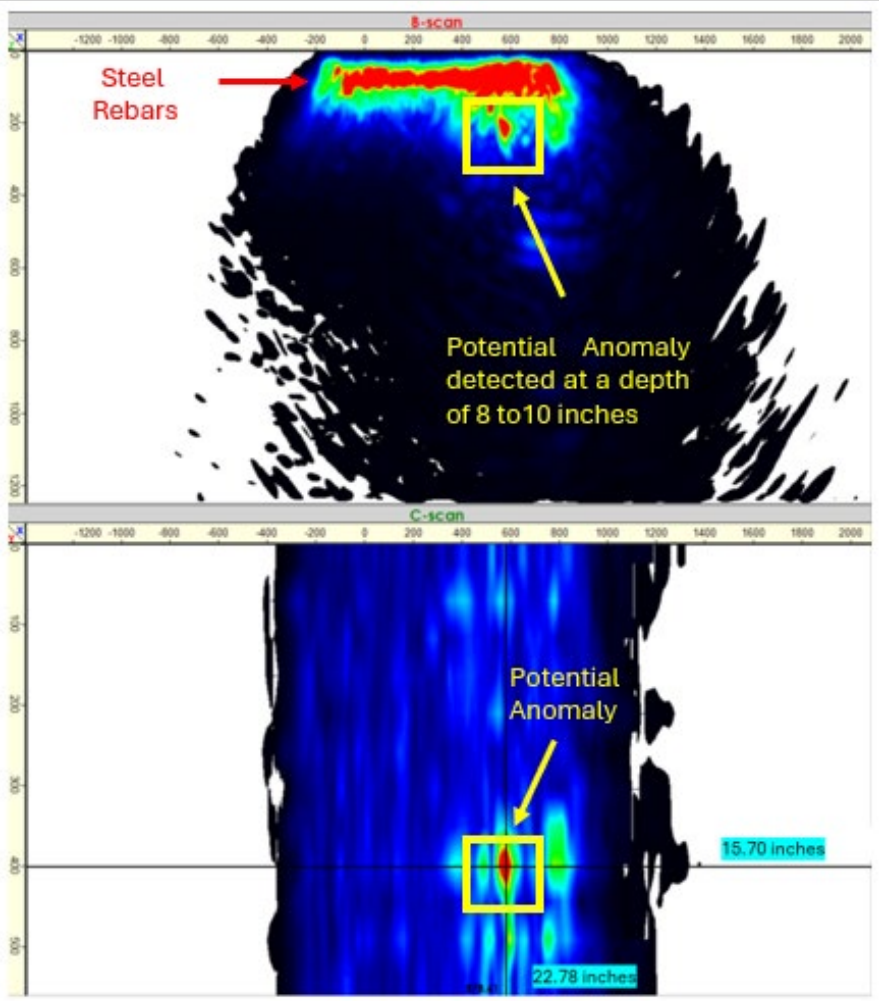
Data Evaluation and Post-Processing

- **Software Used:** IntroView
- **Purpose:** Evaluate and post-process data
- **Output:** SAFT (Synthetic Aperture Focusing Technique) images
- **Detail:** Generates a SAFT image for each line of the grid
- **Function:** Illustrates the acoustic reflectors.



Ultrasonic Testing (UT)

SAFT Image Displaying Raw Acoustic Data from IntroView Software



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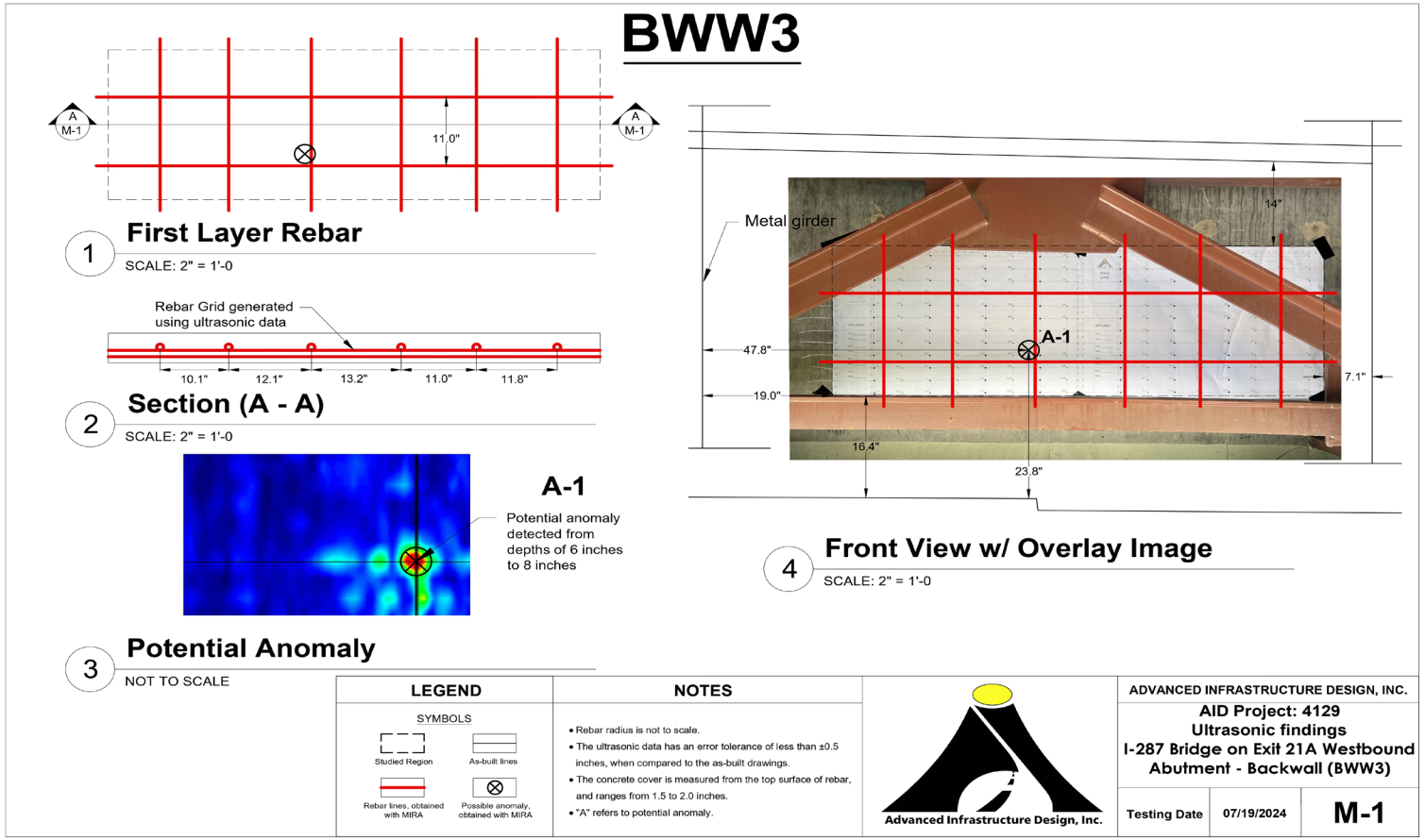
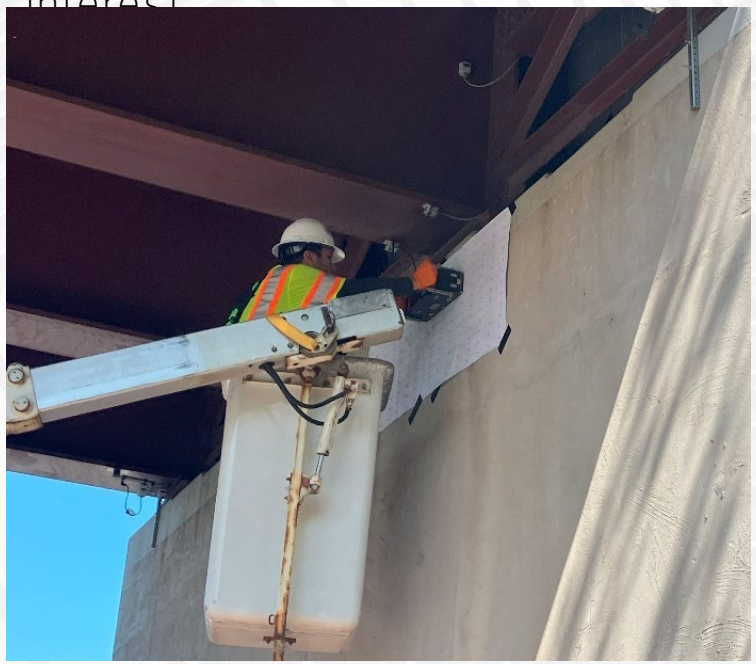
Ultrasonic Testing (UT)



Typical Ultrasonic Finding Deliverable

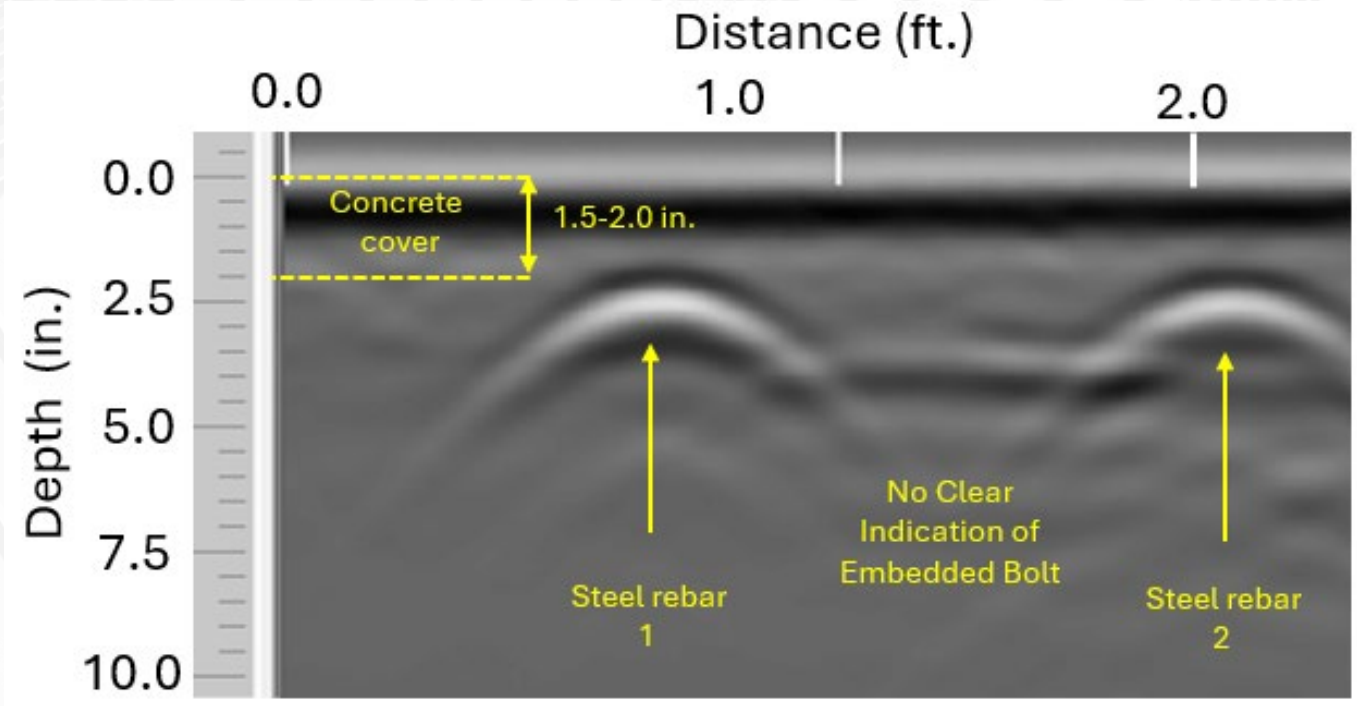
Supplementary Assessment (Bolt Penetration Study)

AID conducted non-destructive testing (NDT) to assess the depth of embedded bolts in the abutments of the I-287 Bridge. The objective was to utilize UT and GPR to determine the bolt depths, providing essential data to support HNTB's design and rehabilitation project for the bridge of interest.



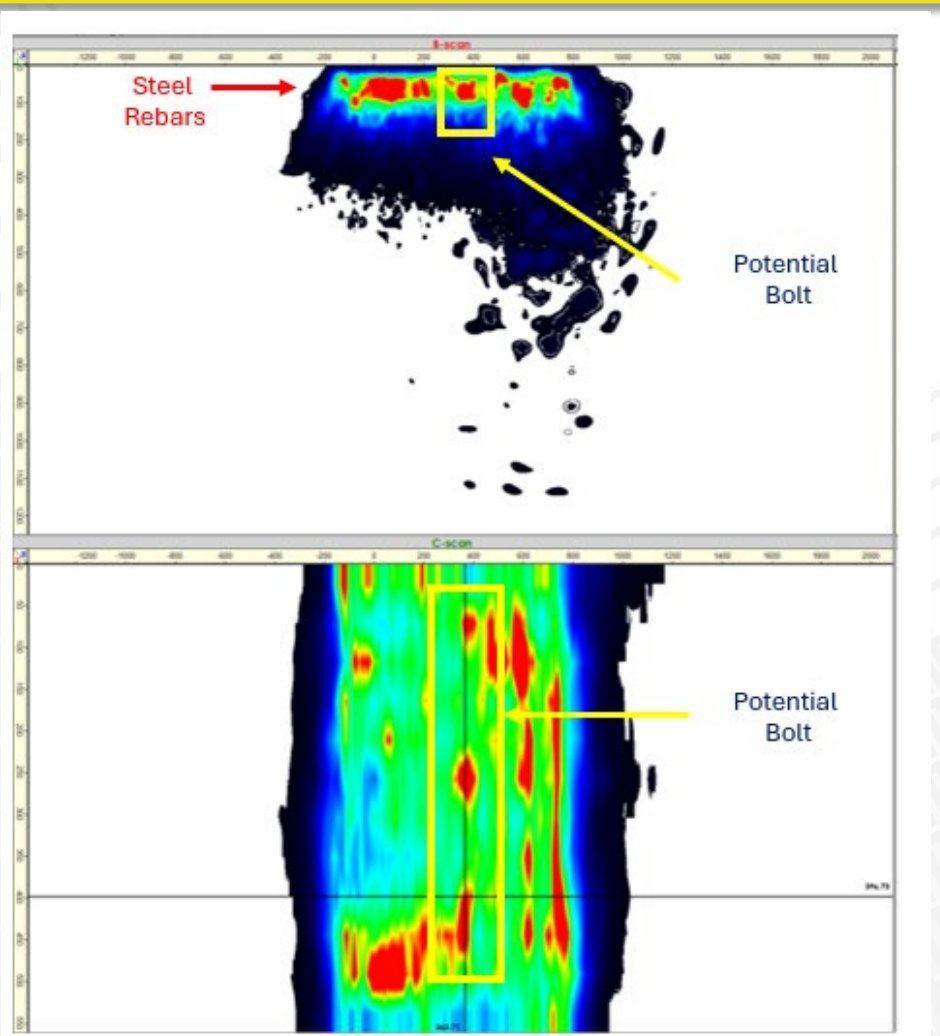
Supplementary Assessment (Bolt Penetration Study)

GPR scans of the abutments were analyzed and evaluated using Radan manufacture's software. During the analysis, a few reinforcements steel rebars were detected and documented, but no clear indication of the embedded bolts was identified.



Supplementary Assessment (Bolt Penetration Study)

The UT results provided valuable data that conclude a better understanding of the embedded bolt depths in both East and West abutments. Notably, the analysis indicates that the embedded bolts are deeper in the west abutment compared to those in the east abutment.



Summary

- Ultrasonic testing (MIRA) was conducted on the backwalls (on both East and West abutment walls), to identify the rebar mapping layout and any potential anomalies (including voids or delamination) on the tested areas. AID has successfully integrated many innovative, unique NDTs.
- Hand-held Ground Penetrating Radar (GPR) was used as a complementary NDT method at the same areas of interest on the bridge's structural elements on the East and West abutment backwalls. GPR was used to map the first layer of the steel reinforcement rebars, and concrete cover on the backwalls.

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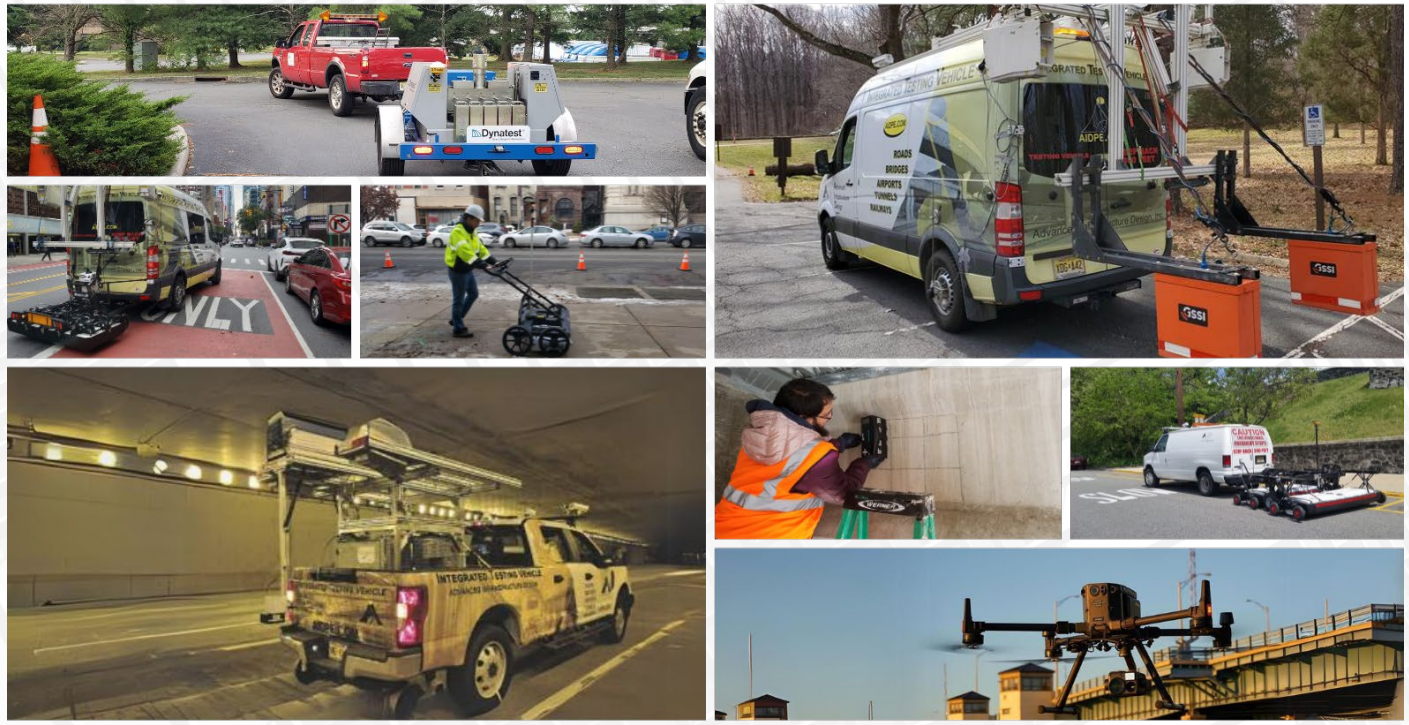
“ Thank You ”



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