Performance of FRP Connectors for Seismic Rehab of Michie Stadium

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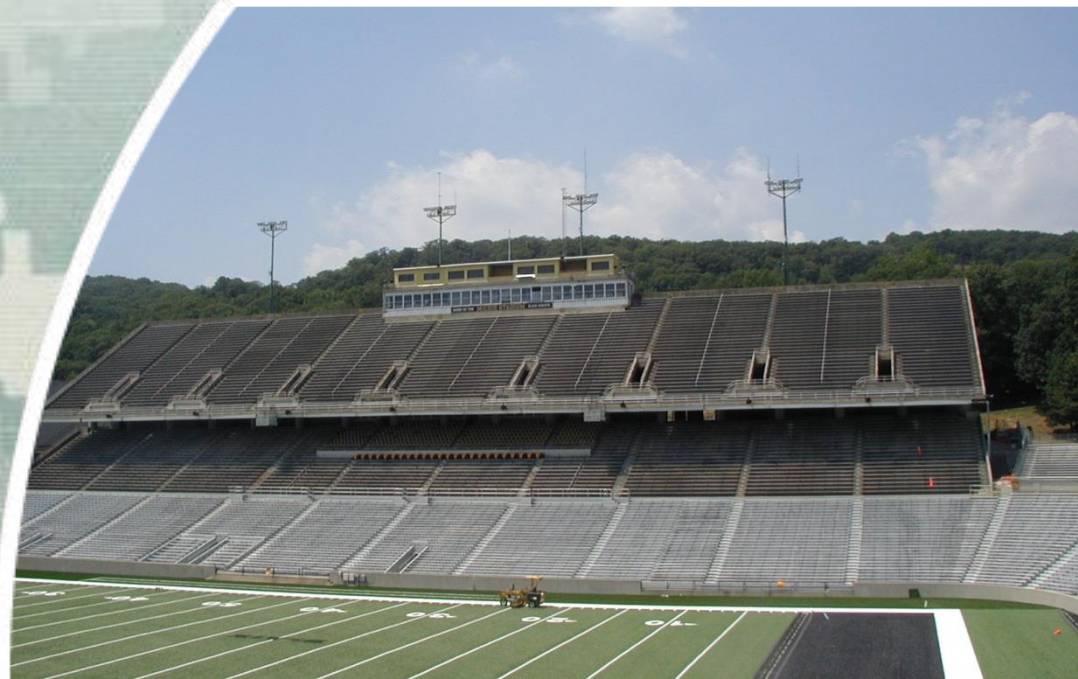

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Outline

- Technical Objective
- Background
- Acoustic Guide Wave Technology
- Performance Evaluation
- Results
- Conclusions

Technical Objective

The objective of this project order was to inspect two hundred and fifty (250) FRP composites patches used for service life extension of Michie Stadium at the USAMA, West Point, NY, using Acoustic Guide Wave technology

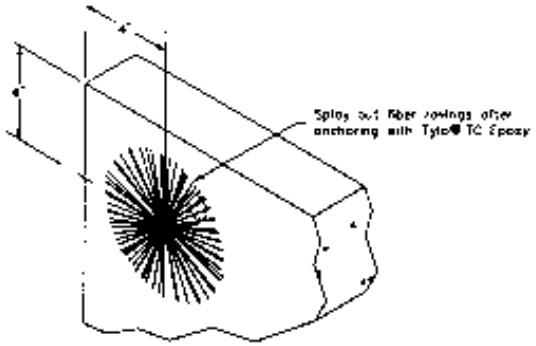
West Side Bleachers

Background

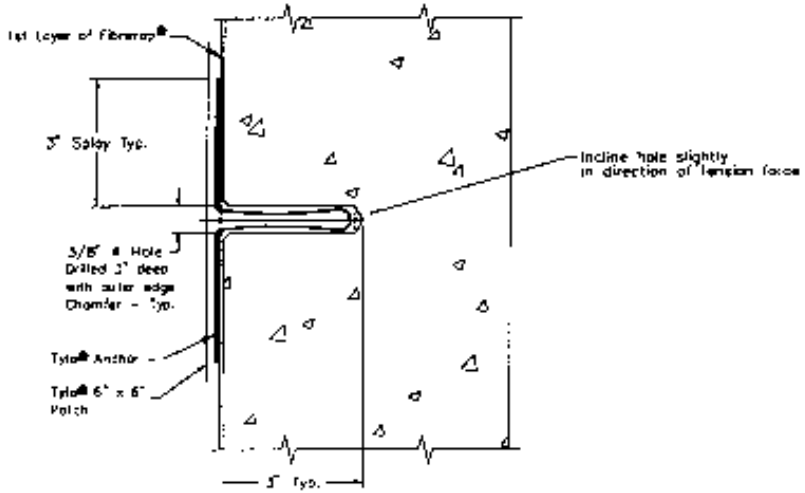
Background

Background

Background



ISOMETRIC DETAIL
Not to Scale



TYPICAL SECTION

Background

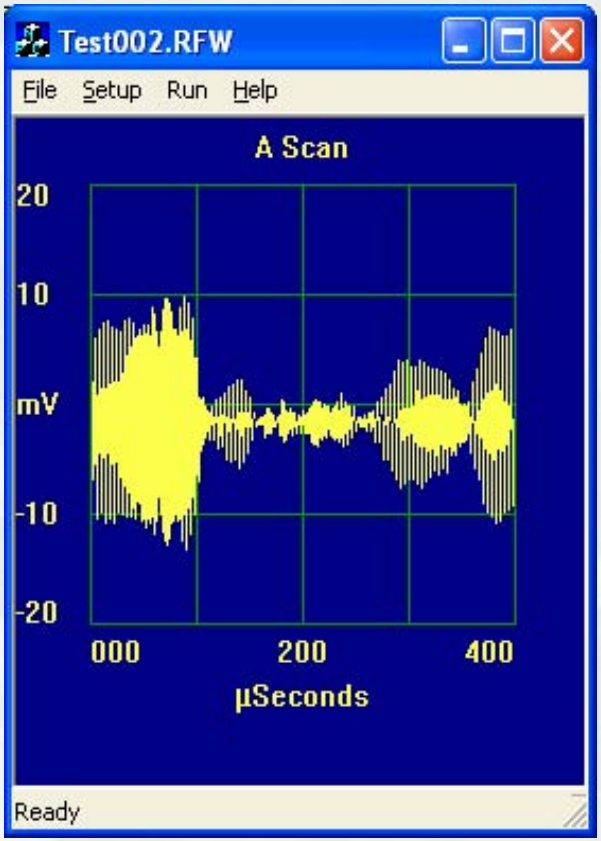
Acoustic Guide Wave Technology

- Acousto-Ultrasonic (AU) technology developed Physical Acoustic Corporation (PAC) as an inspection technique for nondestructive evaluation of structures such as FRP composite and graphite epoxy

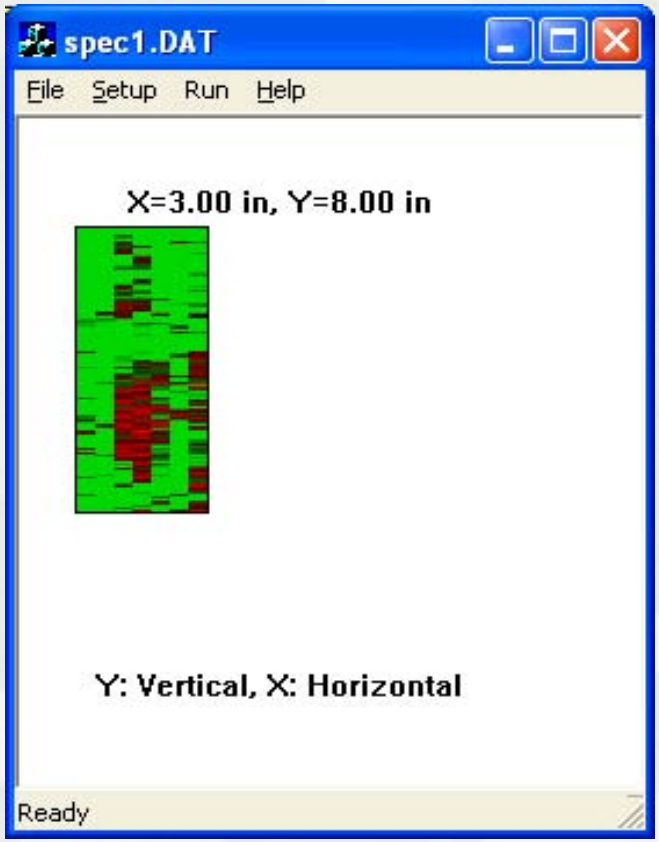
Acoustic Guide Wave Technology

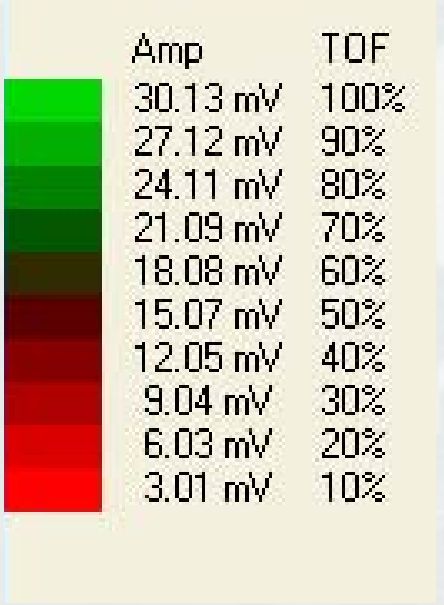
- System based on AU technology
- acoustic waveform bursts (100-500 kHz) directed into the material being inspected
- AU receiver recognizes these waveforms and AGW device processes the results and displays them as A-Scan waveforms and C-Scan image maps.
  - The acoustic signal features include gated Amplitude and Time of Flight parameters,
    - change when the acoustic bursts travel through the material and encounter defects and discontinuities, cracks, material property changes, delamination and debonding.
  - Defects can be identified from the C-Scan images.

Acoustic Guide Wave Technology



Example A-Scan



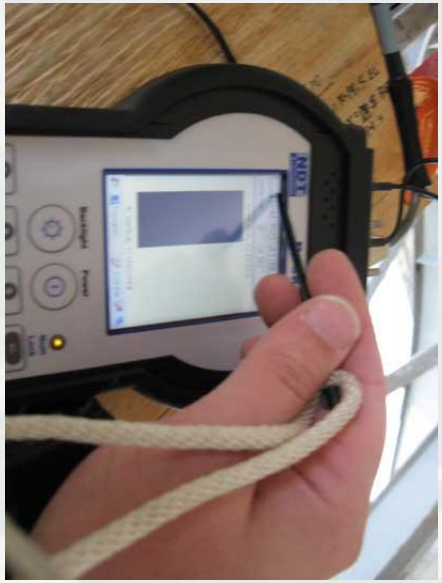


Example C-Scan

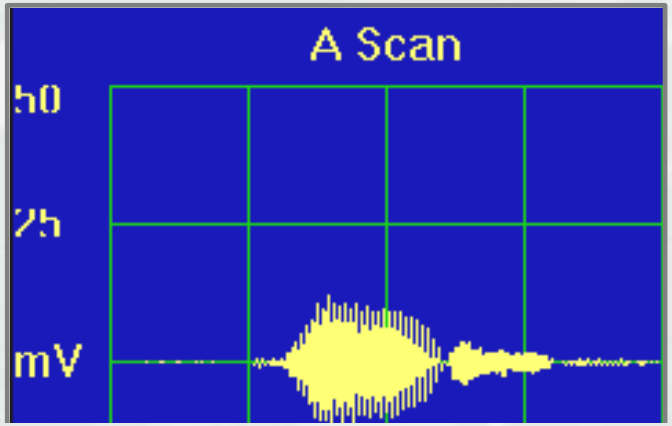
Performance Evaluation

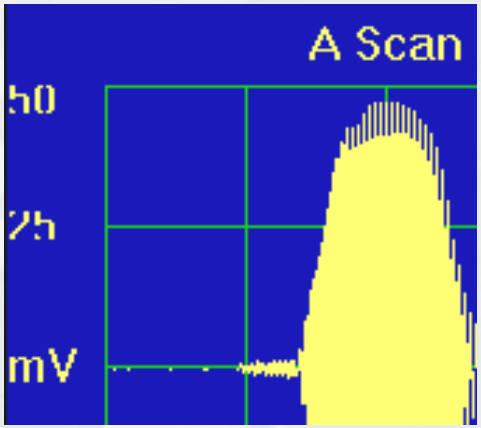
- Tasks:
  - Pre Work visit for selection of two hundred and fifty (250) patches
  - Inspect the preselected patches
  - Document photographically all the inspected patches
  - Perform analysis and submit the results

Performance Evaluation

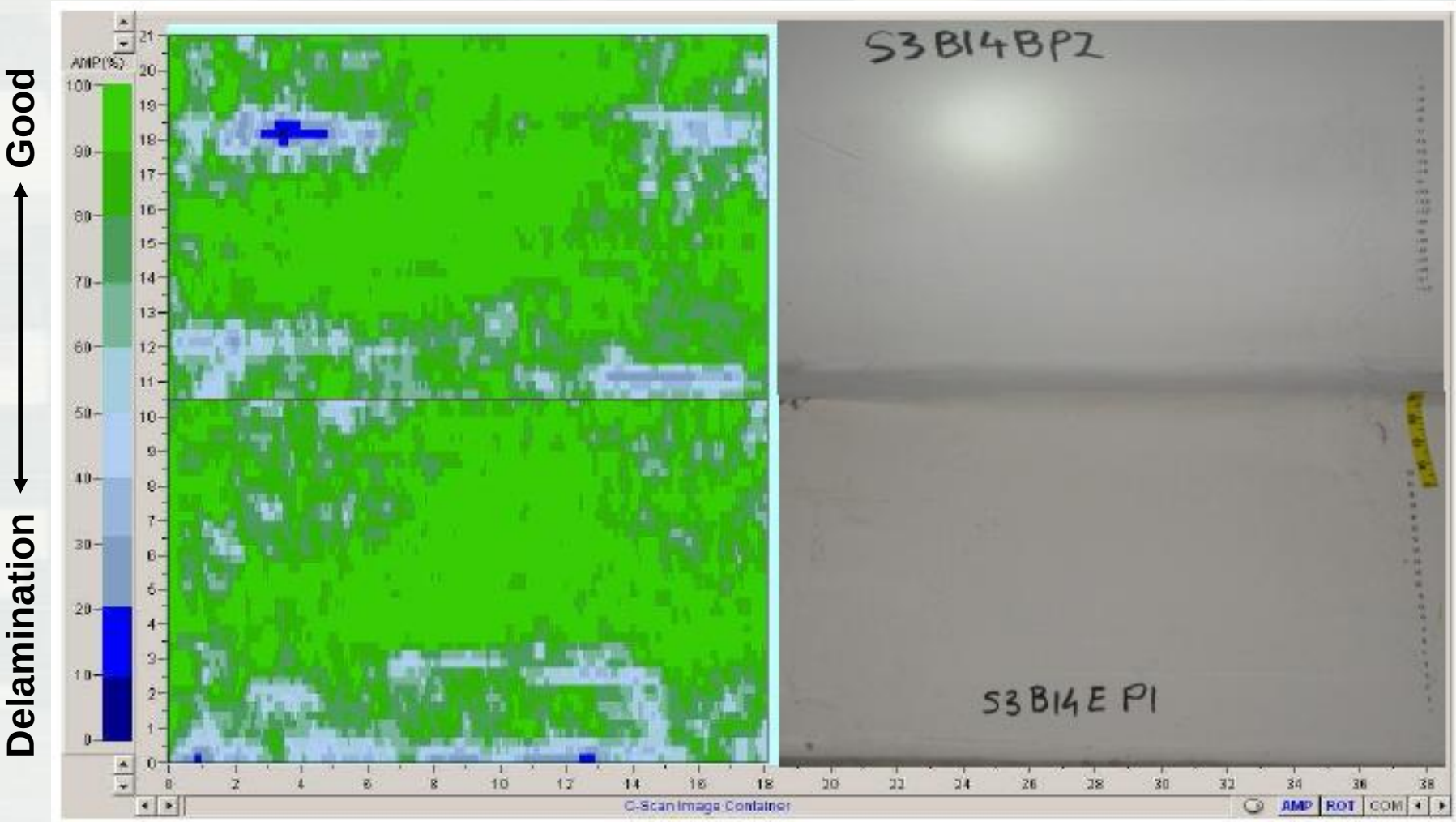


Performance Evaluation
A–Scan

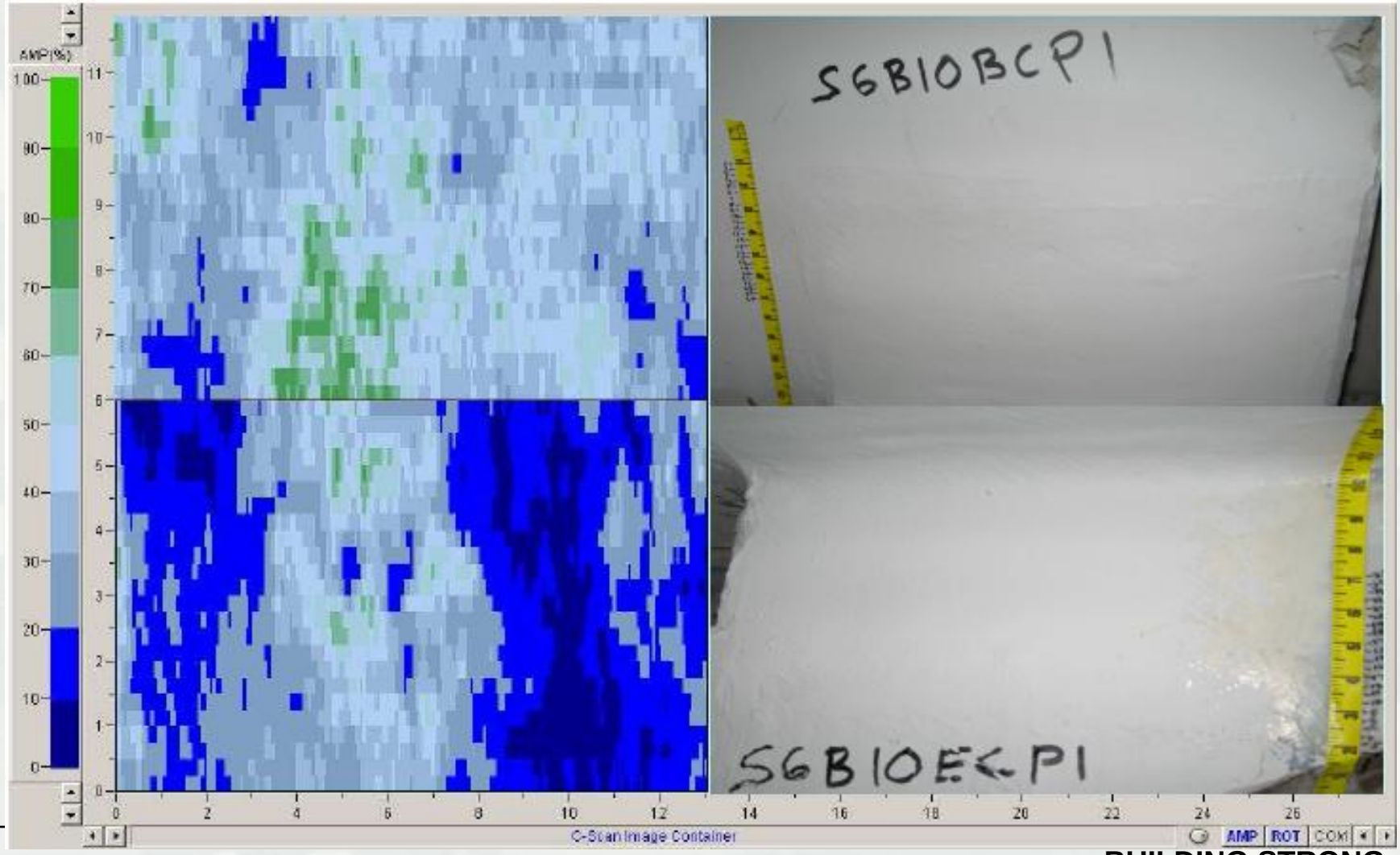




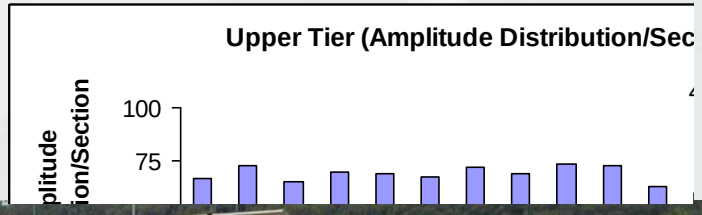
Performance Evaluation
C-Scan

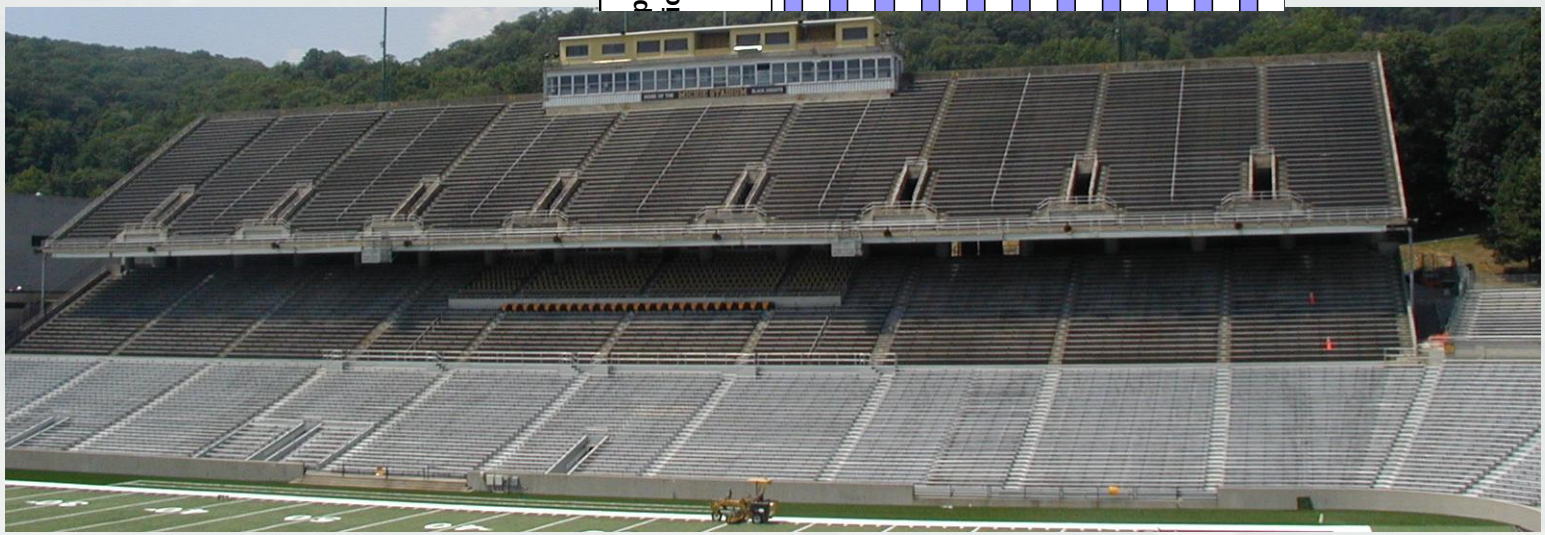


Performance Evaluation
C-Scan

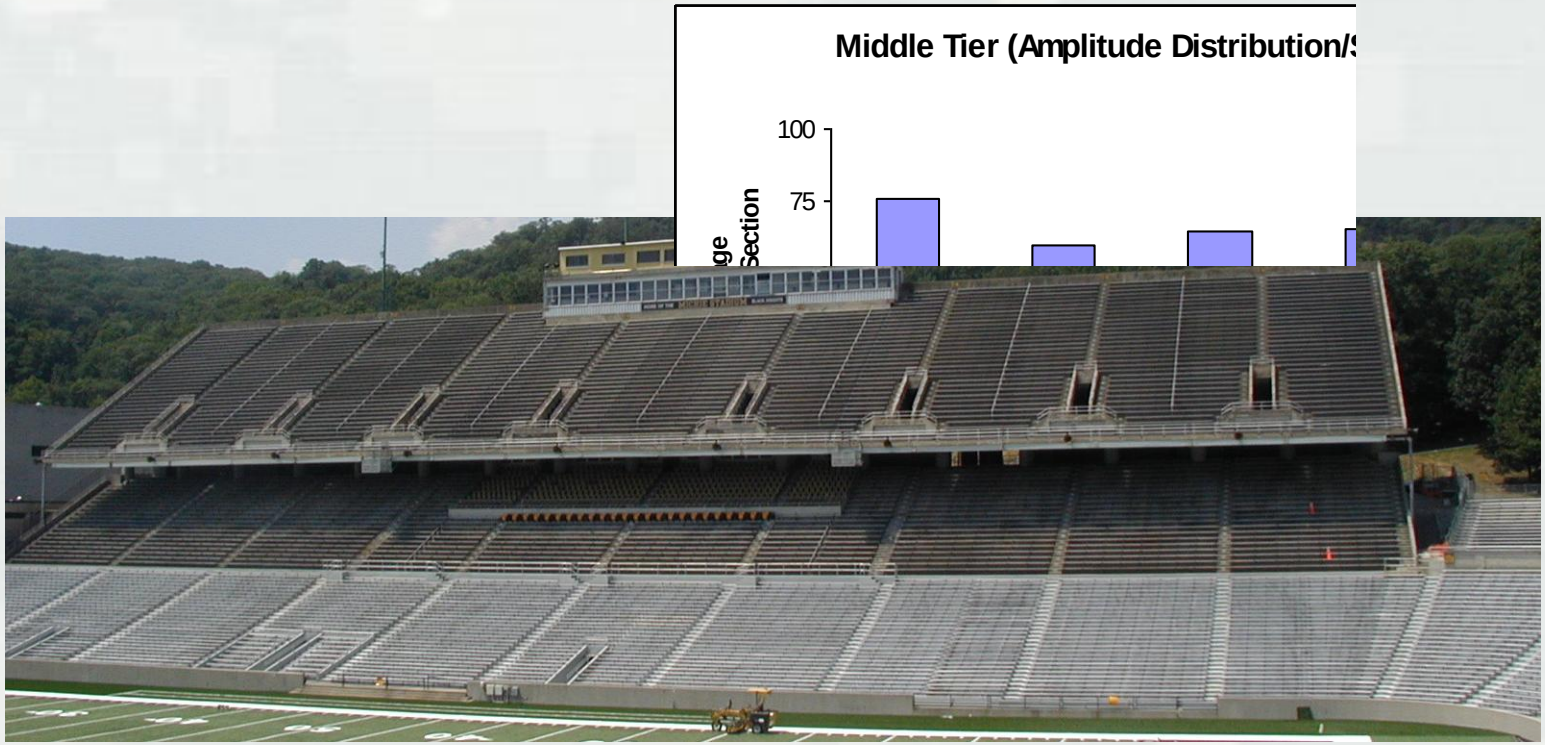


Results

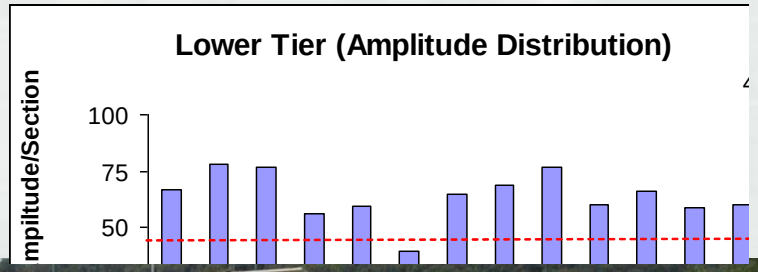


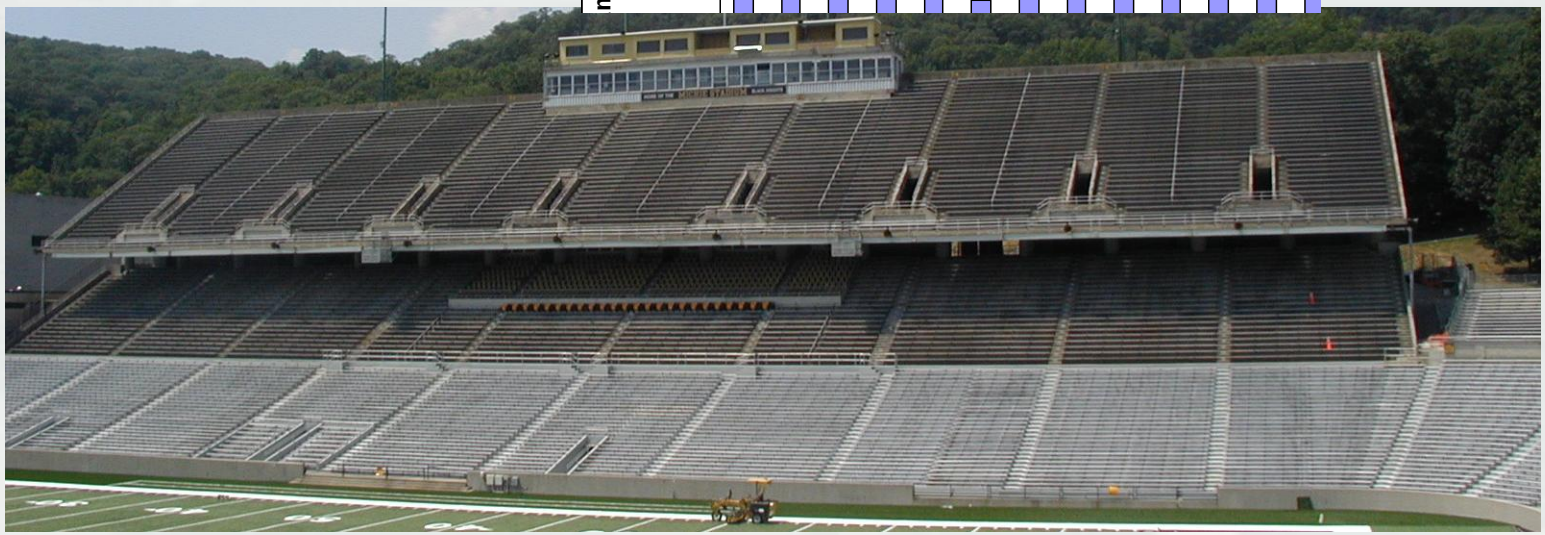


Results



Results


Lower Tier (Amplitude Distribution)
mpiltude/Section
100
75
50



Results

Conclusions

- The results were obtained in the form of C-scan images in which the color pixel of the different areas in the image is related to the amplitude of the acoustic signal reflected from the different areas of the panel.
  - In this case, the green areas are associated with signals reflected from good areas of the FRP panel, whereas the blue areas of the C-scan are associated with delaminations in the panel.
- Section-6 on lower tier and section-14 on upper tier should be investigated for bond failure.

Conclusions

- The AGW system with rolling sensor probe has been successfully used in the quality inspection of thick composite material on concrete structure rehabilitation with fiber-reinforced concrete polymer.
- The system also has many distinctive features that make it ideally used in the field and in applications where other traditional NDT methods are not practical or successful.

Discussions