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## Abstract

Prefabricated and prestressed reinforced concrete structural elements are often used in modern highway bridge construction. Acoustic emission (AE) monitoring is a method for effectively identifying, locating and classifying cracking events in these elements.



Figure 1. Acoustic Emission Monitoring of Concrete Girders (Courtesy Physical Acoustics Corp.)



Figure 2. Inclined and Horizontal End Cracking on Girder (Photograph by Concrete Bridge Views)

## Background

Prefabricated and pre-stressed concrete bridge girders often suffer from cracking, with the majority of the cracks appearing as diagonal cracks at the ends. These cracks are unlikely to be of structural concern, but may pose aesthetic and serviceability issues. This project focuses on developing reusable instrumentation for monitoring prestressed concrete girders during fabrication and transport.

## Instrumentation

Acoustic emission tests are performed on pre-stressed concrete girders using the following instruments.

1. MISTRAS Group 8 Channel Sensor Highway III
2. 60 Hz Sensors, Low Power, AST (qty:8)
3. 30m BNC/SMB Cables (qty:8)
4. Custom 2 in by 2 in Steel Mounting Boxes (qty:8)



Figure 3. Armored AE Sensor



Figure 4. Sensor Array on Concrete Beam

## Laboratory Test Results

AE sensing software is used to detect the emission of transient elastic waves and record the location, voltage, and amplitude produced by internal and surface cracking of reinforced concrete test specimens.



Figure 5. Pullout Testing

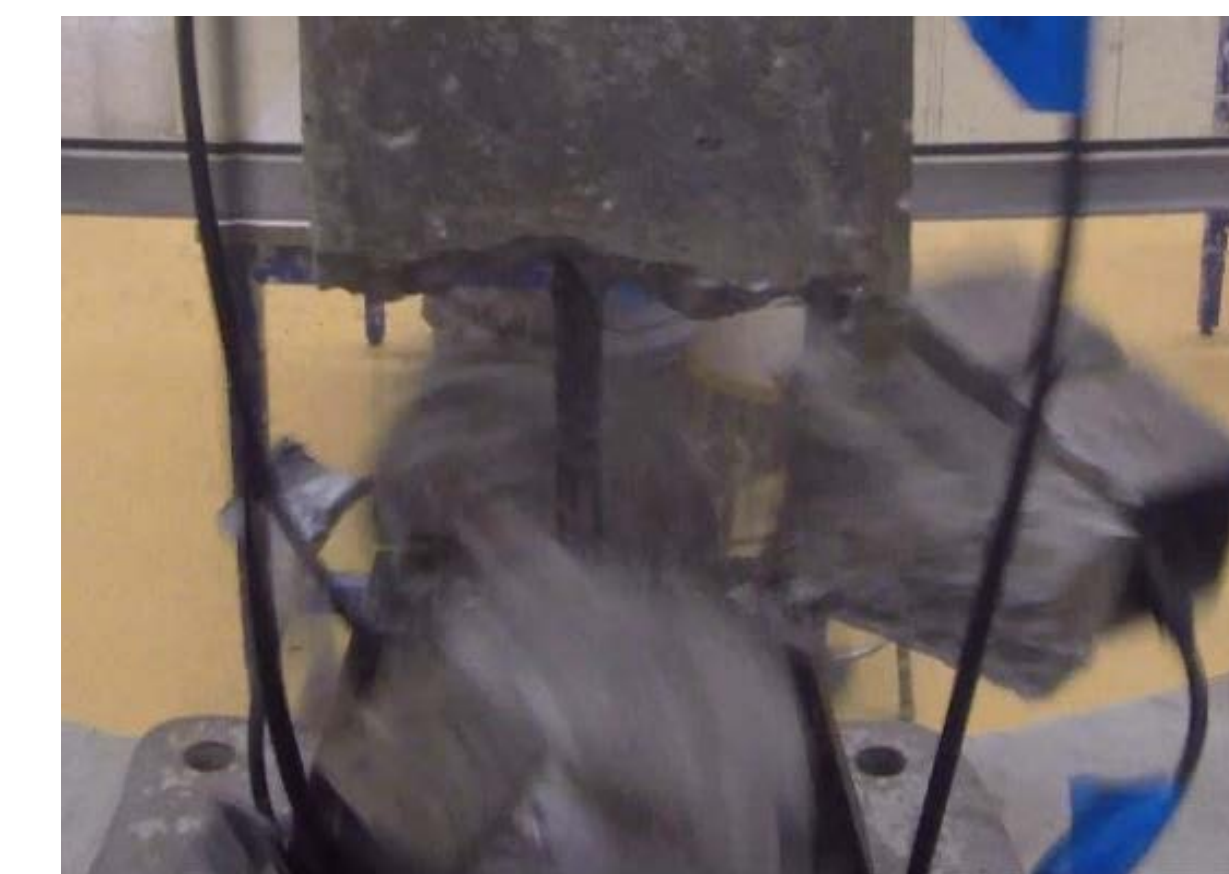


Figure 6. Beam Failure

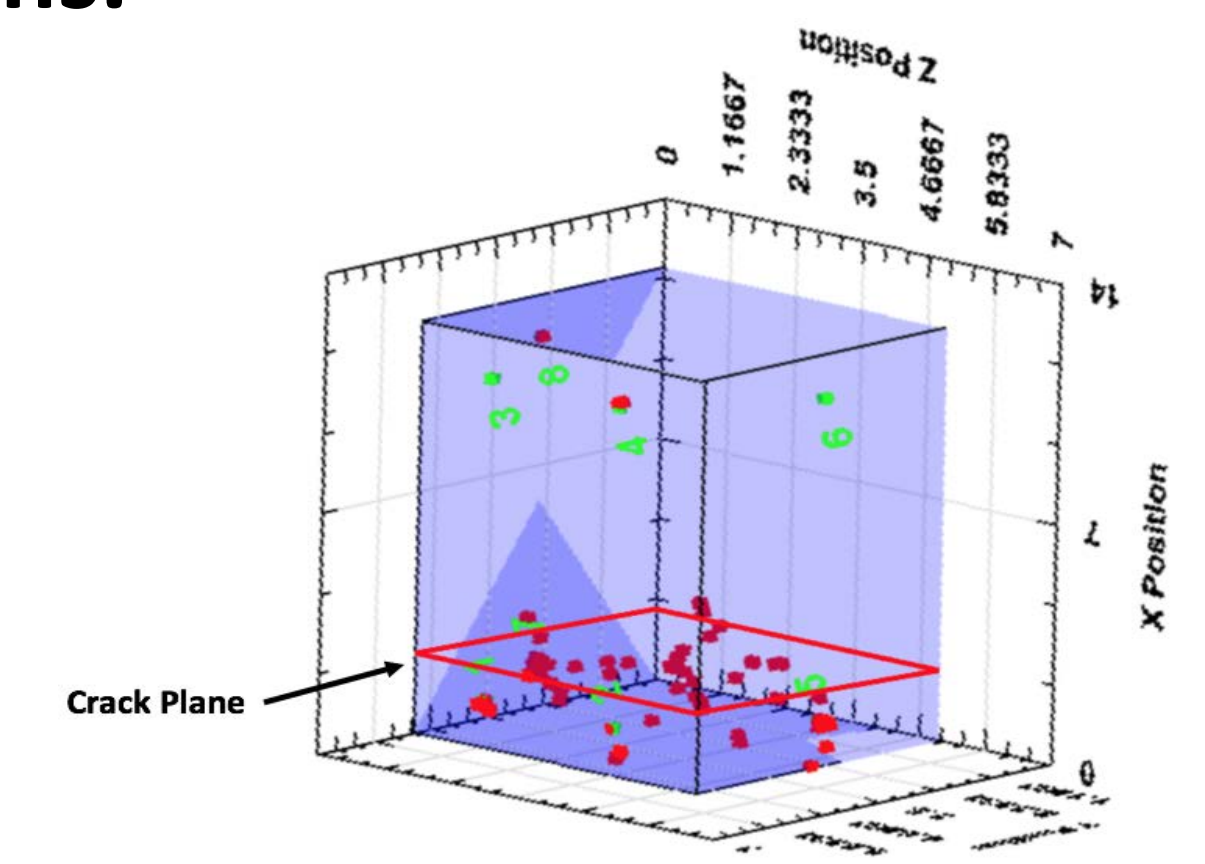


Figure 7. Recorded AE Hits at Failure Plane

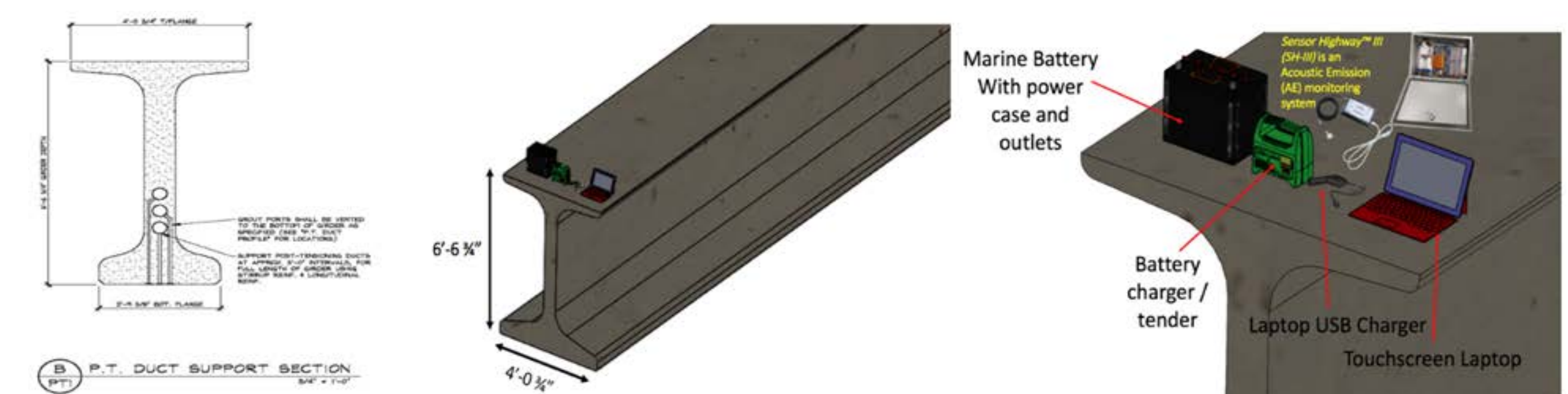


Figure 8. Proposed Rockingham AE Monitoring System

## Conclusions and Future Work

Laboratory results indicate the viability of AE sensing technology for monitoring the condition of prefabricated concrete girders during fabrication and transport. If successful, the technique could be extended to monitoring girders during installation and in-service of the bridge, and future QA/QC efforts.

Planned future work includes measurement of acoustic emission events on prestressed girders during fabrication and transportation to the Rockingham I-91 IM 091-1(66) bridges in collaboration with J.P. Carrara and Sons, Middlebury Vermont.

## Acknowledgments

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## References

Town of Rockingham Route No.: Interstate 91, Bridge 24N and 24S – Shop Drawings prepared by J.P. Carrara & Sons, Inc., Last Revised August 10, 2017.