VERMONT
AGENCY OF TRANSPORTATION

FACT SHEET

2018 Research Symposium & STIC Annual Meeting

Acoustic Emission Monitoring of Prefabricated and Prestressed Reinforced Concrete Bridge Elements and Structures

RESEARCH PROJECT TITLE

V-TRC 16-3: Monitoring Condition of Structural Elements during Accelerated Bridge Construction

STUDY TIMELINE

September 2016 – August 2018

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Fact sheets can be found for additional projects featured at the 2018 Symposium at http://vtrans.vermont.gov/planning/research/2018symposium

Additional information about the **VTrans Research Program** can be found at http://vtrans.vermont.gov/planning/research

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Introduction

This project is to design and implement a reusable instrumentation system for evaluating the condition of prefabricated and prestressed reinforced concrete structural elements used in bridge construction, with an emphasis on fabrication and transport steps. 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.

Acoustic emission (AE) monitoring is a method for effectively identifying, locating and classifying cracking in solid materials. The operating principle is that cracking and other damage-related events generate elastic ultrasonic waves that can propagate throughout a structural element and be detected at a remote surface mount location. AE testing is an established technique for conventional concrete but has yet to be applied extensively to Quality Assurance/Quality Control (QA/QC) activities for prestressed and prefabricated concrete.

Methodology

To date acoustic emission tests have been performed on concrete elements in the laboratory and on full-scale prefabricated and pre-stressed concrete bridge girders during detensioning, craned removal from formwork and transport to bridge sites. Typical results appear in Figure 1 to Figure 3.

Fig. 1 Transport test

Fig. 2 AE equipment

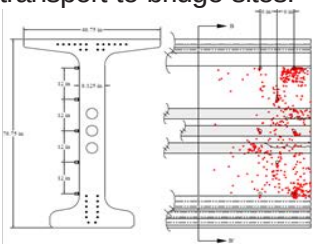

Fig. 3 AE event locating

Conclusions and Future Steps

Laboratory and field tests indicate that AE sensing is a practical QA/QC process for PBES elements as there is observational correlation to observed cracks and AE event locations. Planned future work includes statistical analyses of collected laboratory and field data to classify the source and severity based on the unique waveform signatures of each recorded AE event.

Potential Impacts and VTrans Benefits

This research project addresses the issue of (QA/QC) of prefabricated pre-stressed concrete girders used in bridge construction through the use of a portable and reusable AE sensor system. If successful, the technique could be extended to monitoring girders during installation and in-service of the bridge, and future QA/QC efforts. The long-term impact is the potential for increased serviceability values for bridges by reducing the level of cracking in prefabricated reinforced concrete elements.