Research Notes

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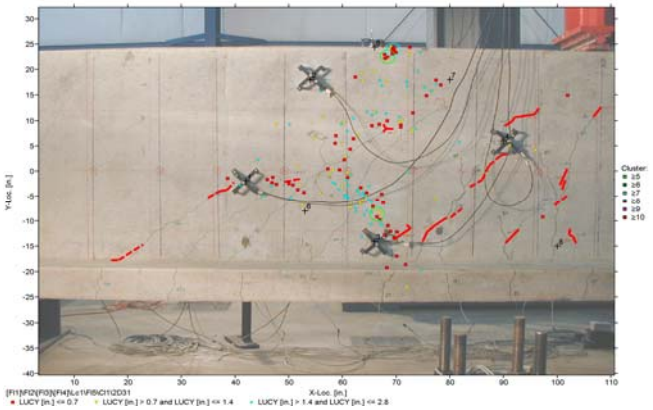
Listening to Bridges

The Federal Highway Administration requires owners of structurally deficient bridges to repair, replace, restrict truck loads, or conduct analysis and testing to maintain a safe highway system. Past experiments on reinforced concrete beams showed acoustic emission (AE) testing, which "hears" the "sound" given off by the material when it is damaged, to be a highly sensitive method for detecting damage. In an effort to evaluate how AE can be used to assure safe operation of aging bridges, ODOT sponsored research into the capabilities of AE testing for cracked Reinforced Concrete Deck Girder (RCDG) bridges.



Locating AE sources on a laboratory beam

Testing was conducted on large-scale reinforced concrete bridge girders that were loaded to mimic in-service conditions. Additional tests were conducted on smaller concrete specimens to evaluate fundamental questions on sound propagation through reinforced concrete and the response of AE sensors to detect these sound waves. The experiments addressed methods for deploying sensors, acquiring data, and interpreting the significance of detected sound signals. Though the sound is beyond the range of human hearing, the number of sound signals detected by the sensors is very large. Therefore, data synthesis and methods to relate data to structural damage were major efforts in the research.

Some of the important findings and conclusions were:

- Cracks forming and growing are the main sources of AE in reinforced concrete.
- AE techniques can be used to locate new damage when it occurs.
- There are no standard threshold levels that relate damage state to characteristic AE quantities. Therefore, interpretation of AE data for a structure requires the critical values to be customized for the structure.
- AE is suited for long-term monitoring and real-time detection of structural degradation. However, to accomplish this monitoring, the AE data must be interpreted in conjunction with past and current bridge performance.

The research effort produced guidelines for practitioners without AE expertise on how to employ AE monitoring for reinforced concrete bridges. The guidelines cover sensor placement, data collection, and data interpretation and can be used to implement a short-term structural performance test or develop a long-term structural health monitoring system.

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The final report for this project was published in September 2008 and is available on the Research Unit web page: