Kansas Department of Transportation

TECHNICAL SUMMARY

Acoustic Emission Monitoring on Fiber Reinforced Bridge Panels

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Introduction

Two fiber-reinforced polymer (FRP) bridge deck specimens were analyzed by means of acoustic emission (AE) monitoring during loading cycles performed at various locations on the composite sandwich panels' surfaces. These panels were subjected to loads that were intended to test their structural response and characteristics without exposing them to a failure scenario. This allowed the sensors to record multiple data sets without fear of having to be placed on multiple panels that could have various characteristics that alter the signals recorded.

Project Description

The objective throughout the analysis was to determine how the acoustic signals respond to the loading cycles and how various events could affect the acoustical data. In the process of performing this examination several steps were taken, including threshold application, data collection, and sensor location analysis. The thresholds are important for lowering the size of the files containing the data, while keeping important information that could determine structurally significant information. Equally important is figuring out where and how the sensors should be placed on the panels in relation to other sensors, panel features, and supporting beams.

The data was subjected to analysis involving the response to applied loads, joint effects, and failure analysis. Using previously developed techniques, the information gathered was also analyzed in terms of what type of failure could be occurring within the structure itself. This ability greatly helped during an unplanned failure event and the subsequent analysis to determine what may have led to the occurrence.

The basic analyses were separated into four sets, starting with the basic analysis to determine basic correlations to the loads applied. This was followed by joint and sensor location analyses, both of which took place using a two-panel setup. The last set was created upon matrix failure of the panel and the subsequent investigation.

Project Results

Based on the analyses conducted during this project, a variety of conclusions can be made from the results determined and included in this report.

While not initially intended to be tested for, the majority of the results show that the panel is capable of resisting long-term damage if a load over 30 kips occurs for at least a short period of time. However, repeated occurrences could affect the interior structure and eventually lead to localized failures.

Panel failure type can be, at least in part, determined by use of the Duration-Amplitude graph, by looking at what region has more acoustic activity occurring at the time. The most likely form of panel failure will come in the form of matrix failure from within the structure. When a force is applied to the outer layers, they tend to provide some resistance to the force, while the inner structure is incapable of providing the same. Due to this property, the inner layers tend to buckle and fail through means of matrix failure and compressive forces.

Project Information

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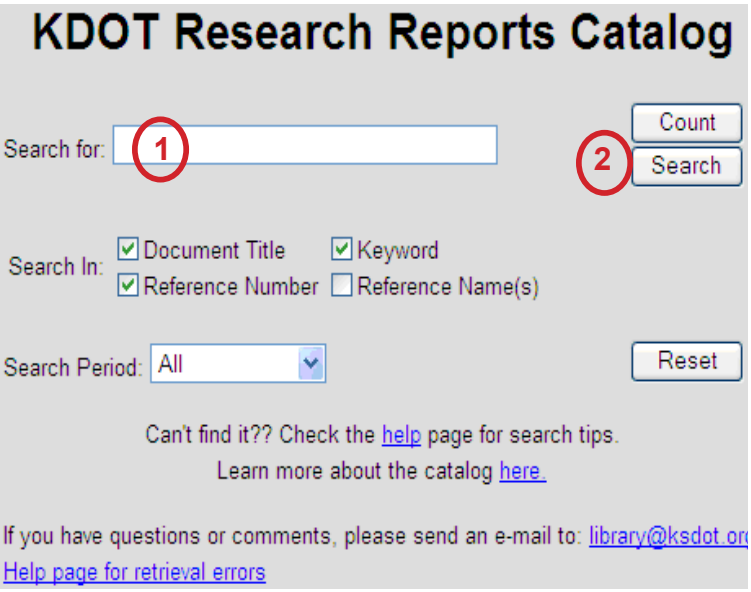

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