Using Acoustic Monitoring to Extend the Life of Post-Tensioned Cable Supported Bridges

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Summary

Acoustic monitoring of cable supported structured has developed into a useful and reliable tool for engineers. The information provided by proper monitoring gives owners and structural advisors confidence in tracking any deterioration that is occurring in the post-tensioning system on presetressed concrete bridges. When visual inspections reveal problems in some of the strands supporting the structure, a structure-wide deployment of an acoustic monitoring system can buy the owner time to secure funds, design, plan, procure, and build a replacement structure. In the meantime, the tracking of active deterioration allows the owner to make decisions regarding safe loads, or load restrictions and to gain maximum utility from the bridge.

Keywords: acoustic monitoring; post-tensioning; cable supported bridges; aging infrastructure.

1. Introduction

As bridge infrastructure ages, the need for confidence in these structures becomes more relevant. Once a structure cannot provide the required utility, specifically due to advanced deterioration and loss of structural capacity, the structure will need to be replaced. Oftentimes the discovery that a bridge cannot support its intended loads comes at an inopportune time. A replacement structure takes time to design, procure, and build. Public infrastructure budgets may also not be able to immediately accommodate the corresponding expense. From the utility point of view, the traffic on the bridge may need to be restricted.

At the same time, acoustic monitoring has developed into a practical tool for bridge engineers and owners over the past decade. The technique offers the ability to track the progress of deterioration on cable supported structures. The failure rate of individual tension elements and the location of the failures within the structure can determined on a continuous, nearly uninterrupted basis. Engineers have superimposed past inspection data with the current deterioration information in order to better predict the load capacity of the bridge.

This type of assessment of structural risk has given some bridge owners increased confidence to operate actively deteriorating structures for an extended period of time - providing them more time for design, budget allocation, and construction of a replacement structure.

Rather than provide a history of acoustics used in health monitoring, this paper discusses the current state of the art. Overall performance statistics are given based on the authors' experiences regarding acoustic monitoring over the past 12 years. The equipment, as well as the automated processing of the data is discussed.

A recent example is presented as a case study: A large post-tensioned box girder bridge in the United Kingdom. The bridge was operated with the aid of acoustic monitoring until a replacement was put in place, and the original structure has now been decommissioned, and removed.

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