Structural Monitoring System for Lock Structures to Prevent Failure

Problem

USACE owns or operates 236 locks at 191 sites, more than half of which have surpassed their 50-year design life. There are increasing concerns about their continued reliability even though they generally perform quite reliably. As the locks age and their components wear and otherwise deteriorate, there is a greater need for closer monitoring of the infrastructure. Many critical components are submerged, making inspections difficult and expensive. Inspection intervals are often not frequent enough to identify some structural problems before they deteriorate to the point when failure will occur. This all drives a desire for detection of imminent failure in order to minimize unscheduled closure.

Approach

The project shall develop new technologies to monitor and sense critical elements and components to detect potential failure of critical lock components. Detailed evaluation and analysis of past lock failures, as well as modeling and analyses, will be used to identify these critical areas. Inspection and sensing technologies will be developed to predict when critical elements and components are subject to failure. Numerical techniques such as damage locating vectors and model updating will be studied and developed to improve the reliability of damage detection algorithms and to provide indications of probable damage locations.

Products

Research will develop sensing technologies to detect immanent failure of critical components. A structural monitoring system (SMS) model on an existing lock will be completed – including a user interface, analysis software, system documentation, database, and decision support protocols. Guidance will be written for the overall implementation of a SMS at a lock structure, including modeling for the determination of critical features, sensor locations, damage detection algorithms, and system architecture. This document shall provide the technical information that can provide the basis of an Engineering Manual for a lock SMS.

Benefits

Detection of potential failure of critical components will provide a reduction in unscheduled closures, thus providing cost savings and safety to both the Corps and the waterways industry. This research is targeted for multiple users in the civil works navigation program. Alarms will signal lock operators when conditions indicate a significant problem may have occurred. At the operations level, future repair issues will be identified based on changing conditions. At the engineer level, long term data will be available to study the structural behavior of the lock and perform analyses on the existing condition of the structure.

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