

Research Summary

Post-Fire Damage Inspection of Concrete Structures

Research Need

Visual inspections to assess damage to a tunnel after a fire can be difficult as the occurrence of this inspection is rare, and damage may not be visually observable. Currently, there is a lack of an inspection protocol which leads to an uncertainty in tunnel closure decisions.

Goals/Objectives

The objective of this project is to provide a better understanding of post-event condition through visual observations and non-destructive tools using a chart/checklist.

The final outcome will be used to populate the fire section of the MassDOT tunnel inspection guidelines.

In brief, the goals of the project were:

- Extensive literature review of fire damage to structural elements, with a focus on tunnels.
- Development of a flow chart/checklist that will be used as a tool for post-fire inspection protocols specific to MassDOT tunnel materials and components. It will also contain photos of actual fire damage.
- Recommendations for physical test program.



Methodology

This research developed a review of current state-of-the-art in terms of material behavior, inspection procedures, past events of tunnel fires and methods for assessing the residual capacity of damaged concrete components from fire events. A preliminary experimental program and specific test methods was followed in order to determine the feasibility of testing. First a high temperature setup was developed and critical components and materials of tunnels were identified and prioritized for preliminary testing. The testing involved subjecting samples to the new heat system and measuring thermal gradient through concrete with different levels of reinforcement. Based on the preliminary testing, an extensive experimental research program is proposed for future work.

Key Findings

- A survey of post-fire inspection procedures at transportation organizations across the country revealed a lack of existing post-fire inspection procedures for tunnels.
- A preliminary post-fire inspection checklist was developed, based on a review of existing literature.
- A proposed radiant heating system for heating tunnel components was tested and validated.

Use of Findings

- The radiant heating system will be used to heat a variety of typical tunnel components in second phase of the project. These tests will help determine the visual damages caused by heat exposure, and the corresponding strength losses of key structural and non-structural elements (ceiling panels, steel hanger rods, steel angle supports, light fixtures).
- The preliminary post-fire inspection checklist will be further developed and refined, using the results of the experimental testing to be completed in the second phase of the project. This checklist will include pictures of heat damage of various elements at different temperature exposures, expected strength losses due to different temperature and time exposures, and residual strength-based criteria for non-destructive testing.

Project Information

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