Research Summary

Post-Fire Damage Inspection of Concrete Structures Phase II - Experimental Phase

Research Need

Visual inspection protocols to assess damage to a tunnel after a fire. Currently, there is a lack of a concise inspection protocol based on visual observation of non-structural & structural fire damaged tunnel components.

Goals/Objectives

The objective of this project is to provide a better understanding of post-event condition through visual observations using a 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 are:
- Report experimental results of heating structural and non-structural elements using the new heating setup at the Brack Structural Testing Facility at UMass.
- Conduct residual strength tests of structural components.
- Provide an updated/improved flow chart/ checklist that will be used as a tool for post-fire inspection protocols specific to MassDOT tunnel materials and components.
- Further investigate the efficiency of non-destructive testing techniques.
- Provide recommendations for future research.

Methodology

For Phase II, testing included heating structural elements to given temperatures for given durations and performing residual strength tests afterward to determine the extent of strength & stiffness loss after a known heat exposure, correlating the visual condition of these components, heating non-structural components to given temperatures to observe and document their visual condition, and investigating the use of non-destructive testing tools for post-fire inspection. Experimental testing involved samples of precast prestressed concrete ceiling panels (including metal anchors and inserts), precast prestressed concrete wall panels, concrete sidewalk specimens, a ceiling panel hanger rod, phenolic conduit, aluminum wireways, a light fixture, and a range of miscellaneous metals (steel and aluminum).

Key Findings

Key findings include a collection of visual and mechanical data, enhancing the understanding of post-fire conditions through visual observation. Visual data includes the condition of various materials, such as - but not limited to - concrete, steel, and aluminum when at elevated temperatures and in the residual condition. Mechanical data details the flexural capacity of concrete ceiling panels in the control condition and in the residual condition after being exposed to a fire scenario.

Use of Findings

The findings of this study may be used to enhance post-fire inspection protocol through visual observation. The data collected through experimental work is detailed in the associated report, which consolidates important visual and mechanical responses of specimens to heat in a post-fire checklist which includes a qualitative and quantitative assesssment guide for a post-fire event in conjunction with a flowchart for condition state evaluation. The outcomes presented from this research may be used to populate the fire section of the MassDOT tunnel inspection guidelines.

In brief, the use of findings of this project are to enhance post-fire inspection as related to experimental results detailing:
- The flexural capacity of ceiling panel specimens in the control condition and the residual condition after heat exposure.
- The associated visual and mechanical responses of a wide range of materials including - but not limited to - concrete, steel, and aluminum when exposed to a fire scenario.
- Common non-structural components of MassDOT-owned tunnels (phenolic conduit, light fixture, & aluminum wireway) exposed to heat and associated visual and mechanical conditions.

Research and Technology Transfer Section
MassDOT Office of Transportation Planning
Planning.Research@dot.state.ma.us

Project Information

This project was completed as part of the Massachusetts Department of Transportation (MassDOT) Research Program with funding from Federal Highway Administration (FHWA) State Planning and Research (SPR) funds.

Principal Investigators:
Dr. Simos Gerasimidis and Dr. Scott Civjan

Performing Organization:
University of Massachusetts Amherst

Project Champion:
John Czach, PE, MassDOT

Project Start Date:
June 2021

Project Completion Date:
February 2023

MassDOT Research Project Number:
114201

Key Words:
Post-fire inspection & residual condition

massDOT
Massachusetts Department of Transportation