Research Summary

Revised Load Rating Procedures for Deteriorated Prestressed Concrete Beams

Research Need

A number of precast, prestressed concrete bridges in Massachusetts have exhibited corrosion-induced deterioration over the years. The level of deterioration can vary from moderate to severe, so reliable load-rating methods are needed to provide safe estimates of the capacity of these bridges. A high percentage of deteriorated precast, prestressed bridges correspond to adjacent box beams or adjacent slabs. Therefore, this research project will focus on these two types of bridges although some of the findings may be extended to other types of precast, prestressed concrete bridges exhibiting similar deterioration patterns.

Goals/Objectives

This project seeks to accomplish the following objectives:

1. Categorize the severity of deterioration of precast, prestressed concrete bridges as it relates to their safety.

2. Develop engineering procedures to estimate the remaining capacity of deteriorated precast, prestressed concrete beams based on severity of the deterioration encountered. These procedures will be based on solid engineering principles verified by calibrated finite element analyses using laboratory testing of existing deteriorated components extracted from bridges scheduled for replacement.

3. Develop a reliable rating methodology that results in safe predictions of working capacity applicable to the range of deterioration encountered in existing precast, prestressed concrete bridges in Massachusetts. The rating methodology will be connected to the engineering procedures described in Objective 2.

Methodology

The objectives of the project will be met by conducting the following research tasks:

Task 1: Literature review

Task 2: Collecting and reviewing inspection reports of precast, prestressed concrete bridges

Task 3: Identify and categorize typical bridge damage as found from the review of inspection reports

Task 4: Select candidate bridges in the process of being replaced to extract deteriorated beams for structural testing in the laboratory

Task 5: Finite element modeling of damaged precast, prestressed concrete beams

Task 6: Document damage and structural testing of beams obtained in Task 4

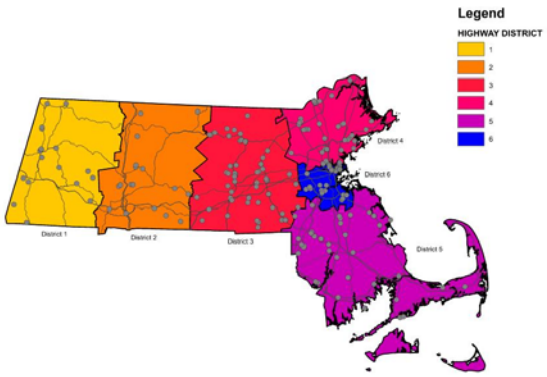
Task 7: Develop load rating procedures for precast, prestressed deteriorated beams for inclusion into the MassDOT bridge manual

Task 8: Research report development providing details of the project findings

Key Findings

This research project resulted in the following key findings:

1. A study of the distribution of deteriorated precast, prestressed concrete bridges in Massachusetts through the NBI database did not reveal parameters that influenced concentration of deteriorated bridges with respect to geographic location, feature crossed, traffic volume, or MassDOT District.



2. The majority of corrosion-deteriorated bridges were built in the 1980s. A higher percentage of precast, prestressed adjacent box beams and deck slabs experienced deterioration compared with precast, prestressed beam bridges.

3. Physical testing of precast, prestressed box beams resulted in lower load than calculated based on an estimate of strand reduction using current MassDOT Bridge Manual procedures.

4. Prestressing strands located above unsound concrete that spalled during testing were determined to have significant corrosion, which led to the lower measured capacities in the laboratory.

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Use of Findings

Findings from this study were used to propose updates to the MassDOT Bridge Manual for load rating procedures precast, prestressed concrete beams that have suffered deterioration due to corrosion of strands and/or stirrups.

The procedure to account for reductions in strand area based on observed deterioration of beams was proposed. This procedure resulted in better predictions of remaining capacity of deteriorated beams compared with results from laboratory testing.

Project Information

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

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Project Start Date:
May 2021

Project Completion Date:
November 2023

MassDOT Research Project Number:

Key Words:
Precast/prestressed concrete beams, deterioration, load rating

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Massachusetts Department of Transportation