Roadside Safety Pooled Fund

Research Problem Statement

2020-01-BR

Project Title:	**Synthesize and Quantification of the Strength Capacity of Older Bridge Deck Designs**
Project Synopsis:	This research is to survey and synthesize three most common older bridge cantilever deck sections to quantify the minimum structural strength capacity. At first, a hybrid approach, through a combination of experimental impact testing with augmented simulations will be used to establish a mean. Then the model be expanded and calibrated to quantify the strength capacity of each deck design within reasonable variations of the tested samples. The results of this research can be used to determine if the rehabilitation of bridge parapet wall overstresses the existing deck capacity, especially at cantilevered sections.
Project Goal(s):	Provide a synthesized quantification and analytical guidance of the strengths of common older bridge deck designs. By referring guidance designers could analyze if the proposed bridge parapet performance will have an adverse impact on the existing bridge deck during the bridge rehabilitation (retrofit) projects.
Project Background:	As states DOT's and user agencies update their bridge parapet railing to MASH, state transportation agencies facing the task of quantifying if their exiting deck is adequate for withstanding the loading requirement of the desired test level rating. This becomes a challenging task given that some decks may have designed using less reinforcement area with lower grade of streel, and a thinner concrete deck when compared with the current practices Current strength analyses procedures are believed to yielding conservative designs and detailed finite element analyses are impractical for every design given the requirement to have simulation expertise with DOT's The idea of this project is first to poll the pool fund state DOTs for the design variations of these older decks including parameters such as deck depth, reinforcement layout, reinforcement grade and other applicable details. The first stage to conduct controlled impacts (bogie tests) with sample barriers and decks reflected of older deck designs The second stage of the project is to synthesize the capacity of these decks via simulating quasi-static push test of railing elements. The railing elements could be a discrete post and base plate for a discrete loading and a representative section of concrete barrier for a continues loading. The ensemble of analyses will be fed into a parametric analysis tool such as graphs or tables to enable designers to quantify the capacity of specific deck given a post and railing configuration. The tool is envisioned to save user agencies time and effort in quantifying the fitness/strength of such decks.
Proposed Work Plan: Work with TTI	Task 1: Literature Review of Older Deck and identify Representative Deck Deigns • Review older bridge deck designs via polling state DOT • Identify dominate older bridge deck designs for evaluation • Select three deck configurations for experimental evaluation Task 2: Pendulum Impact Testing • Preform six pendulum impact testing on the three configurations selected based on polling and feedback from poolfund state DOT's • The experiments will be instrumented to capture signals such as forces in key bars and the pendulum for subsequent calibration. Task 3: Computer Simulations • Build a validated finite element model of the three sample deck variations.

	• Establish a confidence level of the model by comparing the finite results to the experiments measurements and calibrate as needed. • Simulate the deck design variations that were established from Task 1 • Develop a classification scheme to identify regions of the design space (deck thickness, rebars spacing and size..etc..) that fall into either possessing sufficient strength for a given applied load or not Task 4: Synthesis Development and Final Report • Provide final report, including documentation of the experimental procedures, validation confidence and the synthesis charts for use by state DOT's
Deliverables:	A report providing details of work conducted
Urgency and Expected Benefit:	As states DOT's allocate resources to MASH updates and retrofits, more realistic understanding of the current system capacities becomes more relevant. Is it envisioned that a mode refined yet straight forward analyses aid can help designers better quantify the strength capacity of older decks.
Problem Funding and Research Period: Work with TTI	Estimated cost is $160,000. Project Duration is 24 months.
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