

PREDICTIVE ANALYTICS FOR HOLISTIC LIFECYCLE MODELING OF CONCRETE BRIDGE DECKS WITH CONSTRUCTION DEFECTS

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ABSTRACT

During the construction of a bridge, more specifically a concrete bridge deck, there are sometimes defects in materials or workmanship, resulting in what is called a construction defect. These defects can have a large impact on the lifecycle performance of the bridge deck, potentially leading to more preventative and reactive maintenance actions over time and thus a larger monetary investment by the bridge owner. Bridge asset managers utilize prediction software to inform their annual budgetary needs, however this prediction software traditionally relies only on historical condition rating data for its predictions. When attempting to understand how deterioration of a bridge deck changes with the influence of construction defects, utilizing the current prediction software is not appropriate as there is not enough historical data available to ensure accuracy of the prediction. There are two-dimension numerical modeling approaches available that capture the internal physical and chemical deterioration processes, and these models can account for the change in deterioration when construction defects are present. There are also numerical models available that capture the effect of external factors that may be affecting the deterioration patterns of the bridge deck, in parallel to the internal processes. The goal of this study is to combine a mechanistic model capturing the internal physical and chemical processes associated with deterioration of a concrete bridge deck, with a model that is built strictly from historical condition rating data, in order to predict the changes in condition rating prediction of a bridge deck for a standard construction case versus a substandard construction case. Being able to measure the change in prediction of deterioration when construction defects are present then allows for quantifying the additional cost that would be required to maintain the defective bridge deck which is also presented.