ABSTRACT

Pudipeddi, Gnana Teja M.S, Purdue University, July 2013. Modeling the effect of overweight truck traffic on the durability of reinforced and pre-stressed concrete bridges. Major Professor: Dr. Arun Prakash.

Durability of concrete bridges is greatly influenced by environmental factors such as seasonal and diurnal temperature changes, presence of corrosive elements, application of salt for deicing, ettringite formation, alkali-silica-reaction etc. In addition to environmental factors, traffic and usage patterns such as high incidence of overweight truck traffic on a bridge can also affect its service life. In this study a finite-element-based durability model for reinforced and pre-stressed concrete bridges is presented. The model is capable of capturing damage of various bridge components caused by overweight truck traffic, and can be used to predict the reduction in service life of a bridge under such a scenario. The damage is modeled as a reduction of material moduli at all the material points of a detailed finite element model of the bridge and is calculated using a fatigue based model to account for the deterioration caused due to the cyclic nature of traffic loading. The resulting deterioration curves for the condition rating of the bridge and its components can be calibrated with data from the inspection reports of several representative bridges in the state of Indiana.

This durability model can be an effective tool for planning the infrastructure needs of a community and the approach can also be extended to study the durability of constructed facilities in general.