

Public Abstract

First Name:Rilya

Middle Name:

Last Name:Rumbayan

Adviser's First Name:Glenn

Adviser's Last Name:Washer

Co-Adviser's First Name:

Co-Adviser's Last Name:

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Title:MODELING OF ENVIRONMENTAL EFFECTS ON THERMAL DETECTION OF SUBSURFACE DAMAGE FOR CONCRETE BRIDGES

This study developed a numerical model to predict thermal contrasts for subsurface delaminations based on a given set of environmental conditions. The finite element method (FEM) was used to perform 3-D, transient heat transfer analysis of a concrete block with voids intended to provide an idealized model of delaminations. The effectiveness of the modeling was evaluated by comparing the thermal contrasts predicted by the model to those obtained from experimental testing of an actual concrete block of the same dimensions. The correlation and error analysis between the model and the experimental testing results indicated that the model could be an effective tool for the prediction of anticipated thermal contrasts. Key parameters were studied using the verified model, such as the depth and thickness of a delamination, materials present in the delamination, asphalt overlays, and the material properties of the concrete. The effect of these parameters on the thermal contrast developed on the surface above a delamination was assessed. An example model analysis was presented to illustrate the model application for the thermal measurements during a field test. The model results provided valuable information on the expected responses when using thermography to detect delaminations in a concrete bridge deck. A practical equation was also proposed using a statistical approach for predicting the maximum thermal contrast at various void depths under various environmental conditions. The results compared well to the FEM model and to the experimental testing