Executive Summary and Implementation

Condition Assessment of Bridge Decks with Asphalt Overlay

Research Objectives

The project objectives were to evaluate accuracy of GPR evaluation on asphalt overlaid concrete bridge decks and make recommendations based on laboratory and field evaluations. The ultimate goal was to develop NDT evaluation guidelines for asphalt overlaid bridge decks and provide a tool for NDOR to make rehabilitation decisions.

Research Benefits

As the only available NDT method that can be applied to asphalt overlaid bridge deck, GPR data can be helpful to NDOT in obtaining a quantitative assessment and estimation of the scope of the required rehabilitation work. The reliability of GPR evaluation of bridge decks with asphalt overlay is undermined by difficulties in choosing the threshold value through a lack of validation.

In order to address these problems, this project evaluated the accuracy of GPR data using ground truth data obtained from a real bridge and develop guidelines for evaluation of asphalt overlaid bridge decks using GPR and supplemental methods.

Therefore, the proposed research was expected to improve the reliability of asphalt overlaid bridge deck inspections and provide NDOT an NDT tool for effective decision making in bridge maintenance.

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Background

Ground penetrating RADAR (GPR) is a widely used nondestructive testing (NDT) method for bridge deck evaluation. However, the current GPR signal and data processing software and algorithms are not able to provide comprehensive information about bridge deck condition. Although the original objective of this research project was to develop GPR analysis algorithms for condition assessment of bridge decks with asphalt overlay, the scope of work has been expanded to concrete bridge decks with or without overlays.

Conclusion

In this study, the research team developed a complete GPR analysis procedure that includes the following components: 1) obtained zero-time for GPR reflection at the deck surface; 2) extracted the electromagnetic wave velocity in the cover depth (from surface to top reinforcement mat) using migration method; 3) identified rebar positions using automated rebar picking algorithm; 4) extracted migrated amplitude at each rebar location; 5) calculated rebar depth using the extracted velocities for all rebars; 6) normalized rebar reflection amplitude and further correct the amplitude using rebar depth. These analyses provided the following images of bridge deck: surface deterioration condition, cover thickness, velocity in cover concrete (and asphalt overlay), and attenuation. Comparing the amplitude correction methods based on travel time, the proposed depth correction method provides more accurate evaluation of bridge deck deterioration conditions. The developed GPR analysis algorithms have been validated on bridge decks with different types of overlays.

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Final report is available at:
NDOT Research Website

Recommendations for Implementation

As a follow up of this research, Bridge Division requested the Principal Investigator (PI) submit a new proposal so the PI can work on the Missouri Mormon Bridge to obtain more data to identify the testing capabilities for GRP and UAV inspection.

Winnebago - Homer, NE is scheduled for repair construction in Summer 2020. NDE data collection on this long bridge during the repair will provide valuable information to improve the accuracy of the NDE technologies that will be applied for other aging bridges. This phase I project will focus on data collection **prior to** and **after** the asphalt removal. The main tasks include field data collection using GPR and UAV imaging system, data analysis and final report.

The goal of this research project was to implement NDE technologies to evaluate the condition of Missouri River bridge deck. Results from this research will help improve the NDE reliability and application to other bridges with asphalt overlays. The objectives in this Phase I research included;

1. Collect GPR and imaging data on Missouri River bridge prior to removal of asphalt overlay. UAV will be used to acquire imaging data on both top and bottom surfaces.
2. Analyze GPR data, top surface images, and bottom surface images. Estimate repair area and compare to actual repair area.
3. Evaluate performance of UAV aided visual inspection based on GPR results and develop an NDE data analysis system for future application to other Nebraska bridges with overlays.

Technology Transfer

How acoustics can be an early warning system for bridges. Nebraska Today, August 9, 2017.
https://news.unl.edu/newsrooms/today/article/how-acoustics-can-be-an-early-warning-system-for-bridges/

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