

UTC Project Information	
Project Title	MPC-372 – A Novel Methodology for Quantifying the Performance of Constructed Bridges in Cold Regions: Development, Assessment, and Repair
University	University of Colorado Denver
Principal Investigator	Jimmy Kim (PI) Frank Yazdani (Co-PI) Mijia Yang (Co-PI)
PI Contact Information	<p>Jimmy Kim, Ph.D. Associate Professor Department of Civil Engineering University of Colorado Denver Phone: (303) 352-3653 Email: jimmy.kim@ucdenver.edu</p> <p>Frank Yazdani, Ph.D. Professor Department of Civil Engineering North Dakota State University Phone: (701) 231-7878 Email: frank.yazdani@ndsu.edu</p> <p>Mijia Yang, Ph.D. Assistant Professor Department of Civil Engineering North Dakota State University Phone: (701) 231-5647 Email: mijia.yang@ndsu.edu</p>
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Agency ID or Contract Number	DTRT12-G-UTC08
Project Cost	\$100,000 (\$64,421 transferred)
Start and End Dates	January 1, 2012 – December 31, 2013
Project Duration	2 Years
Brief Description of Research Project	<p>Research Needs</p> <p>The American Society of Civil Engineers reported that 27.1% of the 590,750 bridges in the United States were structurally deficient or functionally obsolete. A budget of \$9.4 billion will be required to eliminate these deficient bridges (ASCE 2005). Potential economic impact due to deteriorated bridges is significant, provided that structurally deficient bridges should be restricted to selected vehicles or should be closed by posting. This is a particularly important issue for the Midwest region of the US where heavy trucks are required to transport commodities.</p>

Constructed bridge structures experience a number of deterioration mechanisms, over time, induced by traffic volume and environmental conditions. Adequate evaluation of the present state of existing bridges is an important step to establish an effective bridge management program. Roelfstra et al. (2004) developed a condition evaluation approach for existing bridges with emphasis on corrosion damage. An evaluation model was suggested to be used when limited inspection data were available. Jiang and Rens (2010) evaluated the applicability of Bridge Health Index in Pontis Bridge Management System for constructed bridges. A total of 615 bridges in Denver, Colorado were used for this purpose. It was found that the Pontis Bridge Health Index (AASHTO 2003) would need to be improved to generate more realistic evaluation results. Wang et al. (2011) assessed the rating of existing bridges using a system reliability approach. Legal trucks in Georgia were employed for a comparative study between the AASHTO rating methods and refined finite element models. A need for developing refined evaluation criteria was discussed.

Advanced composite materials such as carbon fiber reinforced polymer (CFRP) are a strong candidate for repairing deteriorated bridges. Numerous research projects demonstrated the efficacy of CFRP-repair (Bakis et al. 2002). The application of CFRP for structural rehabilitation in cold regions, however, has been limitedly reported. Kong et al. (2005) studied the response of CFRP-confined concrete cylinders exposed to freezethaw cycles (-18°C) associated with a sustained compression load. Strength reduction due to freeze-thaw was not noticeable. El-Hacha et al. (2010) studied the effect of harsh environmental conditions on the behavior of CFRP-wrapped concrete cylinders, including freeze-thaw at -18 °C and high temperature exposure at 45°C. CFRP confinement showed substantial increases in strength and stiffness of concrete cylinders.

Despite the research efforts discussed above, there still remains limited information with regard to the condition evaluation of bridges and corresponding rehabilitation, in particular for cold climate regions. This research project aims at addressing such an identified research gap. Of interest is the behavior of constructed/repared bridges subjected to non-conforming traffic that is commonly observed in Midwest to transport commodities, and subjected to aggressive environment. Upon successful completion of the proposed research, effective bridge management and planning in Midwest will be accomplished.

Research Objectives

The objectives of the research are:

- To develop a comprehensive evaluation methodology for bridges subject to cold region environment and heavy traffic load, based on National Bridge Inventory (NBI) data
- To examine the efficacy of advanced composites for repairing deteriorated bridge members in aggressive service conditions
- To propose practical guidelines for the evaluation and rehabilitation of existing bridges in cold regions

Describe Implementation of Research Outcomes (or why not implemented)	
Place Any Photos Here	
Impacts/Benefits of Implementation (actual, not anticipated)	
Web Links <ul style="list-style-type: none">• Reports• Project Website	https://www.ugpti.org/resources/reports/details.php?id=767