

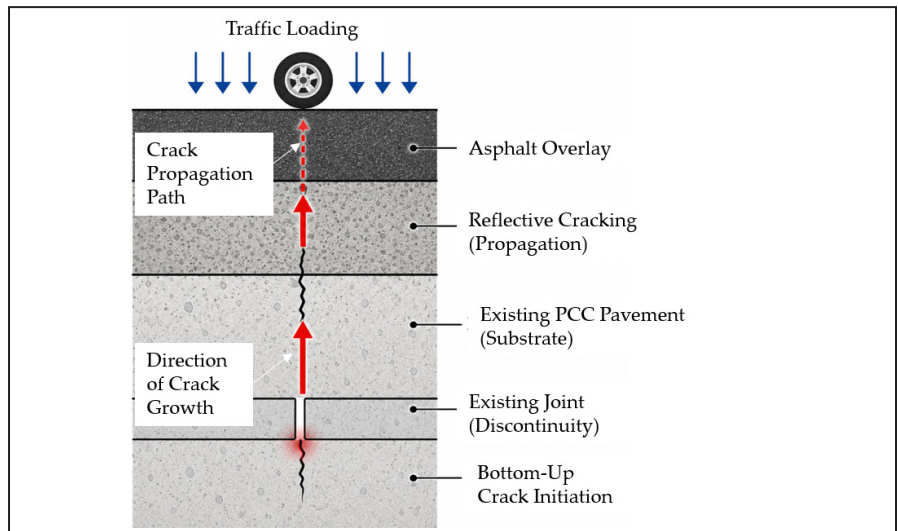
RESEARCH BRIEF

CTIPS-26-006

(project CTIPS-002)

August 2026

Assessing Condition of
Rehabilitated Concrete Pavement
with Slab Fracturing and Asphalt
Overlay Using Distributed Fiber
Optic Sensors



the ISSUE

Many roads repaired with asphalt overlays develop hidden cracks originating in the underlying concrete. Current inspection methods often detect damage only after it becomes visible, resulting in costly repairs, shortened pavement life, and increased maintenance needs. More effective methods are needed to identify early pavement deterioration before significant damage occurs.

the RESEARCH

This project investigated a new approach for monitoring rehabilitated pavements using distributed fiber optic sensors, laboratory testing, and computer simulations. Laboratory pavement specimens were subjected to controlled loading while fiber optic sensors continuously measured strain, enabling researchers to detect crack initiation and monitor crack growth before surface damage became visible. Computer models were used to validate the experimental results and improve understanding of the cracking process.

A University Transportation Center sponsored by the U.S. Department of Transportation serving the Center for Transformative Infrastructure Preservation and Sustainability members:

Colorado State University
Fort Lewis College
North Dakota State University
South Dakota State University

United Tribes Technical College
University of Colorado Denver
University of Denver
University of North Dakota

University of Utah
University of Wyoming
Utah State University



Lead Investigator(s)

Dr. Pan Lu
pan.lu@ndsu.edu

Co-Investigator(s)

Dr. Ying Huang
ying.huang@ndsu.edu

Research Assistant(s)

Dr. Luyang Xu
Research Scientist

Dr. Dawei Zhang
Research Scientist

Yasir Mamood, GRA, PhD

Project Title

Assessing Condition of
Rehabilitated Concrete
Pavement with Slab
Fracturing and Asphalt
Overlay Using Distributed
Fiber Optic Sensors

Sponsors | Partners

UGPTI, in-kind support

NDSU Civil Engineering
Dept., in-kind support

USDOT, Research and
Innovative Technology
Administration

the FINDINGS

This study demonstrated that distributed fiber optic sensors can detect the early development of cracks in rehabilitated pavements before damage becomes visible at the surface. Laboratory testing showed that cracks initiated in the underlying concrete and propagated into the asphalt overlay. The sensors continuously monitored strain changes, accurately identifying crack initiation and growth throughout the tests. Computer simulations closely matched the experimental results, confirming the reliability of the monitoring approach and improving understanding of reflective crack development. Together, the experimental and numerical results validated a practical framework for pavement condition assessment and structural health monitoring.

the IMPACT

The study showed that fiber optic sensing can provide continuous, high-resolution monitoring of pavement condition and detect early deterioration that traditional inspection methods may miss. This continuous monitoring can provide transportation agencies with earlier and more detailed information about pavement condition than conventional inspection methods. This approach can support more timely maintenance decisions, extend pavement service life, reduce repair costs, and improve the efficiency of pavement management.

The research also demonstrated the potential of fiber optic sensing as a practical tool for continuous infrastructure monitoring, providing higher-quality condition information than traditional visual inspections. With future field implementation, the technology could reduce maintenance costs, minimize traffic disruptions, improve roadway reliability, and support more cost-effective investment in transportation infrastructure.

For more information on this project, download the Main report at <https://www.ugpti.org/resources/reports/details.php?id=1285>

For more information or additional copies, visit the Web site at www.ctips.org, call (701) 231-7767 or write to Center for Transformative Infrastructure Preservation and Sustainability, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.



This publication was produced by the Center for Transformative Infrastructure Preservation and Sustainability at North Dakota State University. The contents of this brief reflect the views of the authors, who are responsible for facts and the accuracy of the information presented herein. This document is disseminated under the program management of the USDOT, Office of Research and Innovative Technology Administration in the interest of information exchange. The U.S. Government assumes no liability for the contents or use thereof.



North Dakota State University does not discriminate in its programs and activities on the basis of age, color, gender expression/identity, genetic information, marital status, national origin, participation in lawful off-campus activity, physical or mental disability, pregnancy, public assistance status, race, religion, sex, sexual orientation, spousal relationship to current employee, or veteran status, as applicable. Direct inquiries to Vice Provost, Title IX/ADA Coordinator, Old Main 100, (701) 231-7708, ndsu.eoaa@ndsu.edu.