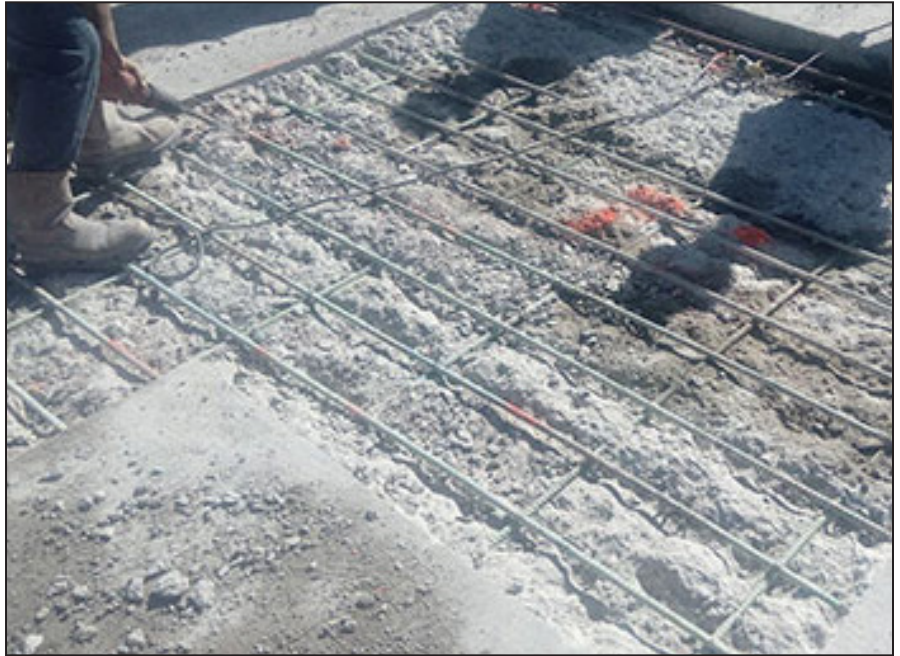


MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 24-540 (project 661) | August 2024

Improved Sustainability and Efficiency of Partial-Depth Concrete Bridge Deck Repair



the **ISSUE**

There have been significant advances in the development of rapid setting cementitious materials for partial-depth bridge deck repair. The rapid set times of these materials allow for traffic to be reopened onto the bridge deck in several hours versus days once the material has been placed. However, much time is still spent on removing damaged and deteriorated bridge deck and in preparing the concrete cutouts for placement of the rapid set material. This partial deck removal is a much more delicate process than full deck or pavement roadway removal because the soundness of the concrete surrounding and below the cutout must be maintained. Therefore, the patch preparation process is extremely labor intensive. With the recent development of autonomous machinery, this labor-intensive process could become more efficient. However, prior to developing autonomous machines to prepare the patches, foundational research on methods that reduce the preparation time and that can be easily automated needs to be conducted.

the **RESEARCH**

The study's overall objective is to examine different concrete removal methods to decrease traffic closure time due to the preparation process for partial depth replacement. This effort is intended to improve the efficiency of concrete removal methods as well as evaluate the life cycle sustainability of the techniques. To achieve this objective, the following specific research objectives are identified:

- Identify from the existing literature commonly used concrete patch removal methods used in partial depth bridge deck repair.
- Quantify the removal time for commonly used concrete patch removal methods.

(continued)



A University Transportation Center sponsored by the U.S. Department of Transportation serving the Mountain-Plains Region. Consortium members:

Colorado State University
North Dakota State University
South Dakota State University

University of Colorado Denver
University of Denver
University of Utah

Utah State University
University of Wyoming



Lead Investigator(s)

Andrew D. Sorenson
adsorensen@tamu.edu

Research Assistant(s)

Israi Abu Shanab, GRA PhD

Project Title

Environmentally Sustainable
Accelerated Partial Bridge
Deck Concrete Removal
Methods Analysis

Sponsors | Partners

USDOT, Research and
Innovative Technology
Administration

the RESEARCH (continued)

- Identify additional techniques that decrease the removal time of partial deck patches and that may be automated.
- Determine the environmental sustainability of different concrete removal techniques relative to partial bridge deck removal.
- Determine an optimized removal method that accounts for both the time efficiency and environmental impact.

the FINDINGS

Researchers found that increasing the saw cutting lines decreases the jackhammering time for different concrete strengths and increases the concrete removal volume. The saw and patch method can be influenced by many factors, such as the operator's skills and health/energy level, saw blade sharpness, and jackhammer pull-off angle. Method IV, which has the largest number of saw cut lines, is the optimal concrete removal method among the other proposed methods and saves approximately 35% of the required concrete removal time. Also, it has the potential for future automation.

the IMPACT

The benefits of this project are reduced lane closure time and decreased environmental impact from partial depth concrete repair.

For more information on this project, download the Main report at <https://www.ugpti.org/resources/reports/details.php?id=1183>

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.



This publication was produced by the Mountain-Plains Consortium 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.



NDSU 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 201, 701-231-7708, ndsueoaa@ndsu.edu.