FHWA-NJ-2024-001
January 2024



Research at a Glance

Technical Brief

# Innovative Pothole Repair Materials and Techniques – Asphalt Pavement

**Principal Investigator**

Dr. Hao Wang

Professor

Dept. of Civil and Envi. Eng.

School of Engineering

Rutgers University

848-445-2874

hwang.cee@rutgers.edu

## Research Problem Statement

Pothole repair is one of the most important and frequent maintenance activities for highway agencies. Significant amounts of costs and resources are spent in pothole repair for material, labor, equipment, and traffic control. Cost-effective pothole repair methods can reduce or eliminate the possibility of re-patching and save future repair costs. The good condition of pothole repair with less cracking will also prevent reflective cracking when asphalt overlay is placed. Preheating the excavated pothole prior to repair has been found to improve the interface bonding between existing pavements and hot filling material, which can help enhance the overall performance of asphalt patches. The long lifespan of patch will reduce travel delay due to work zone and safety risk of highway users and workers. These will better preserve the condition of highway infrastructure and provide better service to the travel public. On the other hand, as it has been found feasible to incorporate recycled material in asphalt pavement pothole repair, the usage of recycled material can reduce the production of new material, which can contribute towards a more sustainable approach of roadway repair with economic and environmental benefits.

## Research Objectives

This project aims to identify and evaluate innovative tools, technologies and materials for pothole repair in New Jersey. In particularly, the use of hot-mix asphalt, cold mix asphalt, and recycles asphalt material with preheating is investigated.

## Methodology

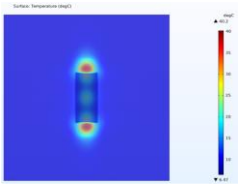
An integrated research methodology composed of literature synthesis, experimental and numerical investigation, and life-cycle cost analysis is used.

- Conduct comprehensive literature review on 1) traditional pothole repair techniques with advantages and limitations, 2) potential preheating methods and working principles, material requirements, and heating efficiency. 3) cold mix asphalt (CMA) materials used in pothole repair.
- Summarize field performance of asphalt patches repaired by traditional techniques and new heating techniques with various patching materials. Conduct life-cycle cost analysis (LCCA) of pothole repair with heating method to analyze the cost-effectiveness as compared to traditional methods.
- Investigate the performance of microwave and infrared heating methods in the test section. Adopt appropriate heating procedure to repair artificial potholes

in the test section, and then conduct laboratory analysis to evaluate the effect of preheating on performance enhancement of asphalt patch.

- Evaluate mechanical performance of patching materials in laboratory, including bulk CMA, different commercial CMA, and hot mix asphalt (HMA) with recycled asphalt pavement (RAP). Determine the optimal RAP content for pothole repair in the test section and conduct laboratory analysis to evaluate the feasibility of using RAP in asphalt pavement pothole repair.
- Develop microwave and infrared heating models and validate them against the field measurements. Predict the required heating time for pothole repair under different filed conditions.





## Results

Preheating can be achieved using infrared radiation and microwave. The heating trial tests were performed in a test section with artificial potholes, and the heating performance of different heating methods were evaluated. The results show the infrared radiation can efficiently heat the pothole surfaces and lead to remarkable temperature increase in a short time. Compared with infrared heating, although microwave can heat both surface and internal pavement materials, its heating efficiency is lower. Therefore, infrared heating was adopted as preheating method to repair the potholes in the test section. Subsequently, laboratory analysis was conducted on field cores taken from repaired potholes to verify the effectiveness of preheating. It was found that preheating can enhance not only the interface bonding strength between patching material and surrounding pavement, but also the strength of patching materials themselves.

With the application of preheating, the feasibility of using recycled asphalt pavement (RAP) in pothole repair was investigated. Based on laboratory testing results of the HMA with 0% to 50% RAP contents, HMA with 30% RAP was selected for pothole repair in the field test section because it can lead to satisfactory performance with traditional HMA without preheating method. After repair, field cores were collected for additional laboratory analysis to evaluate the performance of asphalt patch with recycled material. The results show that with the application of preheating, asphalt patches repaired by HMA with 30% RAP can achieve comparable or better performance than that made with traditional HMA.

The application preheating method can help provide the enhanced performance of asphalt patch and thereby reduce frequency of a second repair. The usage of recycled material in pothole repair will help save energy and natural resources, and reduce greenhouse gas (GHG) emission generated from producing new HMA.

**Research Project Manager**

Giri Venkiteela, PhD

Research Scientist

NJDOT Bureau of Research

609-963-2239

Giri.Venkiteela@dot.nj.gov

U.S. Department of Transportation
Federal Highway Administration

This brief summarizes FHWA-NJ-2024-001, Innovative Pothole Repair Materials and Techniques, Volume I: Asphalt Pavement, produced through the New Jersey Department of Transportation Bureau of Research, 1035 Parkway Avenue, P.O. Box 600, Ewing, NJ 08625 in cooperation with the U.S. Department of Transportation Federal Highway Administration.