TN TDOT Department of Transportation

Research Summary

# Evaluating the Performance of Inverted Pavements in Tennessee

**Project Number:**
RES2020-12

**TDOT Lead Staff:**
Sampson Udeh
Roadway Design

**Principal Investigator:**
Dr. Baoshan Huang
University of Tennessee, Knoxville

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## *WHAT WAS THE RESEARCH NEED?*

The concept of inverted pavement was developed in South Africa in the 1950s, and many effective applications have been reported in Georgia, Louisiana, and Mississippi, among others. In the inverted pavement design, an unbound aggregate layer, which is usually used as a subbase beneath the stabilized base, is sandwiched between the asphalt surface layer and the cement stabilized base. TDOT has long been trying to evaluate and adopt this technology due to its significant cost benefits. This research project has continued TDOT's effort to apply this technology in Tennessee.

## *WHAT WERE THE RESEARCH OBJECTIVES?*

The objectives of the proposed research were to:

1. Evaluate the usage and spread of inverted pavements in the USA using a survey.
2. Monitor the short- and long-term performance of inverted pavements in Tennessee.
3. Provide TDOT recommendations on inverted pavements best practices and life-cycle cost analysis.

## *WHAT WAS THE RESEARCH APPROACH?*

The research team completed a synthesis of literature review and state DOT survey on the design, construction, and rehabilitation methods of inverted pavements in the US, especially in the Southeastern region. Then, they identified the potential and economic feasibility of inverted pavement projects in Tennessee. The team then

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conducted field testing and long-term field performance monitoring of the inverted pavement project. Lastly, a cost-benefit analysis of inverted pavements in comparison to conventional flexible pavements under the same traffic level was performed.

## *WHAT WERE THE FINDINGS?*

The key findings based on this project can be concluded as follows:

- Based on the numerical simulations, the nonlinear stress-dependent characteristic of unbound aggregates is significant in the inverted pavement, but little effect can be found in the conventional flexible pavement.
- Based on the field investigation of Vulcan inverted pavement, the deformation of the inverted pavement surface detected by the Benkelman beam test was less than that of conventional pavement. According to the road surface profile data, the inverted pavement structure showed better performance in roughness, cracking condition, and rutting depth.
- Based on the falling weight deflectometer (FWD) data, using the deflection basin parameters (DBPs)-based method with the FWD test can evaluate the structural conditions of the individual layer in the inverted pavement in a shorter time and without any damage to the pavement structure.
- Based on the results of the accelerated pavement testing, the inverted pavement has a better or comparable performance on the surface's permanent deformation compared with conventional pavement.

## *IMPLEMENTATION AT TDOT*

Based on the final results and conclusions from this project, the inverted pavement is recommended for future research. The inverted pavement structure displays different structural responses from the conventional flexible pavement structures under the same loading conditions. The stress-dependent property of the unbound aggregate layer in the inverted pavement is obvious, leading to the unconventional stress and stiffness distributions within the pavement layers. In addition, this study shows that the inverted pavement structure outperformed conventional flexible pavement structure in rutting, cracking and roughness.

However, more field projects of inverted pavements should be investigated to verify the conclusions of this study. Despite the demonstrated potential, future studies are needed to facilitate the application of inverted pavement in the USA. And since the Volkswagen inverted pavement in Chattanooga, Tennessee has not been finished due to the COVID-19 pandemic, the preliminary cost-benefit analysis was conducted based on the data in Vulcan testing pavements in this study. Therefore, the future research is suggested to be conducted.

## *MORE INFORMATION*

Find the final report here: https://www.tn.gov/content/dam/tn/tdot/long-range-planning/research/final-reports/res2020-final-reports/RES2020-12_Final_Report_Approved.pdf.

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