NEBRASKA
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DEPARTMENT OF TRANSPORTATION

RESEARCH SUMMARY

A more durable concrete pavement patching material will endure the durability and traffic demands of Nebraska's aggregates.

Developing a Quick-Curing and Long-Lasting Concrete Patching Material

When a cracked concrete pavement needs patching, the Nebraska Department of Transportation (NDOT) typically uses a concrete mix with a high proportion of cement and accelerators so that the patch cures quickly and the road can reopen to traffic within a few hours. However, in addition to being relatively expensive, NDOT's traditional patching mix is prone to shrinkage and cracking due to alkali–silica reaction (ASR), and it must be replaced every few years. To create a more durable patching material, NDOT funded a research study to develop new formulations that can cure quickly while continuing to perform well over time.

THE CHALLENGE

Concrete pavements subjected to freeze–thaw deterioration, ASR and chemical attack commonly exhibit scaling, cracking, breaking, chipping and fraying. In Nebraska, severe forms of these distresses—such as transverse cracking, shattered slabs and corner breaks—frequently require full-depth patching. Because repaired sections must reopen to traffic quickly, high early strength is essential. However, achieving rapid strength gain with high-cement mixtures increases material cost and leads to elevated drying and autogenous shrinkage, higher heat of hydration and greater cracking susceptibility.

"The new repair mixture developed through this research will help us get more life out of our patches and lower costs over time."

— Wally Heyen, Nebraska DOT

The absence of supplementary cementitious materials further reduces durability and increases vulnerability to ASR. Premature failures highlight these limitations. Therefore, there is a clear need for patching materials capable of developing rapid early strength while offering improved long-term durability and reduced cost.

To ensure that the state's concrete pavements can be maintained less frequently and at a lower cost, NDOT sought to develop a more durable and cost-effective patching mix that has a cure time comparable to its current formulation.

THE RESEARCH

The goal of this study was to develop cost-effective and durable high-performance rapid patching materials for full-depth concrete pavement repair. To achieve this goal, two specific objectives of this study were to develop cost-effective patching materials that provide sufficient early strength (a minimum 3,000 psi compressive strength in four to eight hours) for proper traffic opening and ensure long-term performance by diminishing durability issues (such as ASR) in the current pavement repair mixes.

After the completion of the research, NDOT placed the mixes on a segment of Columbus South Highway 81 during the 2022 construction season and monitored the segments for several years to evaluate their durability and long-term performance.

THE RESULTS

Based on the field evaluation results, one mixture demonstrated notably strong strength development and exceptional resistance to cracking under extreme temperature fluctuations. It also achieved rapid curing, enabling traffic to resume in as little as 10 hours. In June 2025, this mixture was selected for a full-scale road repair demonstration project and used in place of NDOT's traditional patching material.

Although performance monitoring of the demonstration section will continue for several years, early findings—while not fully meeting the targeted early-strength requirement—indicate that the mixture performs effectively as a patching solution for relatively young pavement. NDOT continues to pursue even faster-setting patching materials that can deliver both rapid strength gain and long-term durability.

THE BENEFITS FOR NEBRASKA

With the development of a more durable and economical patching material, NDOT can expect to make fewer repairs to its concrete pavements. The patching material could feasibly last twice as long as NDOT's traditional patching mixture, which would allow the agency to save significantly on materials and labor over time, improve safety by reducing workers' exposure to highway traffic, and minimize road closures and delays for Nebraska's travelers.

ABOUT THIS PROJECT

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