



TECHNICAL SUMMARY

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LRRB PROJECT COST:
\$31,040



Researchers recommend avoiding sealant overbanding on the sides of cracks.



RESEARCH SERVICES

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Preventing the Occurrence of Bumps in HMA Overlays

What Was the Need?

As pavements age, they are subject to cracking and other deterioration. To rehabilitate them without engaging in expensive reconstruction, Minnesota state and local highway agencies sometimes rehabilitate these pavements with one or more layers of asphalt after filling existing cracks with sealant.

An asphalt overlay can sometimes develop bumps near or directly above the sealed cracks in the original pavement, especially when the overlay consists of only one layer. If large enough, these bumps can significantly affect the ride quality of the road as experienced by motorists.

The Local Road Research Board supported a [project](#) to investigate the causes of these bumps. Researchers surveyed local agencies on bump prevention methods and theories, and then evaluated these methods in the laboratory, disconfirming a common hypothesis that bumps were caused by the thermal expansion of sealants. These results were used to develop a manual, *Common Practices for Avoiding Bumps in Overlays*, for predicting, preventing and mitigating the effects of overlay bumps by using specific crack sealants and construction methods. Because of this manual, local agencies are already reporting fewer bumps in overlays. However, because this project did not fully establish the causes of these bumps, additional research was needed to further investigate them and to refine prevention methods accordingly.

What Was Our Goal?

The objective of this project was to identify crack sealant types and construction methods for avoiding and mitigating the occurrence of bumps in hot-mix asphalt overlays, and to update the manual of practice for doing so.

What Did We Do?

Researchers evaluated the influence of the following factors on bumps in overlays:

- The type of sealant used, including its stiffness or elasticity.
- Crack geometry, or reservoir structure, the depth and width to which cracks are routed before they are filled with sealant. Traditionally, enough sealant is applied to overflow the crack and create an overband, or a layer of sealant on each side.
- Construction methods, including the speed, pattern and operation of the rollers used to spread and compact the asphalt layer, and the temperature of this layer during compaction.

Researchers conducted two experiments to monitor these factors; the first focused on sealant type and crack geometry, and the second on construction methods. For the first experiment, researchers monitored a site on CSAH 5 in Jackson County, Minnesota, consisting of 19 250-foot sections. Each section involved the same construction methods but a different combination of crack geometry and crack sealant type (such as hot-poured crumb rubber, hot-poured elastic and hot-poured extra-low modulus elastic). As

Researchers identified construction methods and materials for preventing the occurrence of bumps in hot-mix asphalt overlays, finding that best practices include using specified rolling techniques during warmer weather, low-modulus sealants, and narrow and shallow crack sealant reservoirs while avoiding overbanding.

“Thanks to the findings in this study, local and county agencies now have some great techniques to help reduce the occurrence of bumps in overlays.”

—John Brunkhorst,
McLeod County Engineer

“We found that the occurrence of bumps can be significantly decreased by avoiding high air temperatures when placing overlays, using low-modulus sealants and using the right rolling techniques.”

—W. James Wilde,
Professor, Minnesota
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Researchers often found bumps during the first field visit, including this 1/2-inch tall bump with hairline cracking, indicating that compaction equipment had been operated when the HMA temperature was not optimum.

a control, the cracks in some sections were not routed, and others were not filled with sealant.

For the second experiment, researchers monitored sites at four locations in Lincoln County, Minnesota, on CSAH 5 and CSAH 15. These sites received the same sealant and crack geometry treatment but were subject to different construction methods and conditions, including roller operation and air and pavement temperatures.

Researchers then monitored all of these sites over two years by measuring bump height with a level and ruler, recording bump locations with Global Positioning System equipment and collecting profile data using a lightweight profiler.

What Did We Learn?

Results showed that while the occurrence of bumps in overlays is directly related to sealant type and reservoir geometry, the more significant causes of bumps are rolling techniques and warmer air and pavement temperatures. The project report recommends the following methods for minimizing the occurrence of overlay bumps:

- Rolling when air and pavement temperatures are lower, below 80°F and 125°F, respectively, and possibly slightly delaying rolling operations so that the overlay mat cools while the underlying sealant material heats up.
- Using low-modulus and crumb rubber sealant types, and possibly allowing sealant materials to age at least one year before applying the overlay.
- Routing narrow and shallow crack reservoirs, avoiding sealant overbanding, and possibly leaving sealant material below the pavement surface or removing it before overlay construction.
- The use of pneumatic rollers for breakdown compaction through 200°F followed by a single steel finishing roller.
- The use of nonvibratory breakdown rollers.

What's Next?

Researchers used project results to update the manual *Common Practices for Avoiding Bumps in Overlays*. More research is required before the causes of bumps can be definitively identified, and future results may help further refine bump mitigation strategies.

This Technical Summary pertains to the LRRB-produced Report 2010-31, “Predicting the Occurrence of Bumps in Overlays,” published August 2010. The full report can be accessed at <http://www.lrrb.org/PDF/201031.pdf>.

This project builds on the results detailed in a previous report, 2005-28, “Occurrence of Bumps in Overlays,” which can be accessed at <http://www.lrrb.org/PDF/200528.pdf>.