



RESEARCH SERVICES

OFFICE OF POLICY ANALYSIS,
RESEARCH & INNOVATION

TECHNICAL SUMMARY

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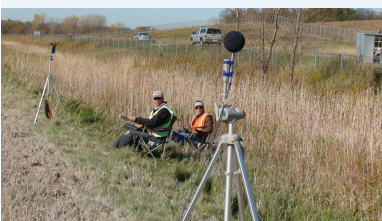
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PROJECT COST:

\$58,319



For each test section, researchers placed microphones at 100 feet from the road, 50 feet and very close to the pavement.

The Influence of Pavement Surface Texture on Traffic Noise

What Was the Need?

Highway traffic noise is a common and expensive form of noise pollution, with the sound barriers used to mitigate it costing nearly \$3 million per mile. Highway noise comes primarily from vehicle engines, exhaust systems and tires.

At highway speeds, tire-pavement contact is the most important contributor to road noise. The level of tire-pavement noise varies significantly with the texture of the pavement surface. In the case of concrete pavements, these surface textures are added during road construction to create friction and skid resistance, which are especially critical in wet weather. The textures are created by dragging various materials across the fresh concrete to create surface grooves or tines before it completely hardens. The width, depth and spacing of grooves affects not just skid resistance but also tire noise.

Three common types of concrete pavement surface textures follow:

- Transverse tine is produced by dragging a metal rake laterally across the width of the pavement. Tining is the most common texture on highways but was abandoned in 1988 by Mn/DOT due to noise levels.
- Burlap drag is typically used for lower speed streets and local roads, produced by dragging moistened coarse burlap over the pavement surface.
- Diamond grind is produced by cutting longitudinal grooves into a pavement using closely spaced, diamond-coated saw blades and shaving a thin layer off the top to smooth surface irregularities. Diamond grinding was originally developed to restore smoothness and skid resistance to aging pavements, but engineers found that it produced pavements with significantly less tire noise than tining, so Mn/DOT began using it on newly constructed pavements.

To further reduce tire-pavement noise, [Purdue University's Institute for Safe, Quiet, and Durable Highways](#) developed the innovative/ultimate diamond grind, which produces wider grooves with smoother peaks. Research was needed to evaluate this technique, comparing the noise produced by pavements developed this way to the other options available.

What Was Our Goal?

The purpose of this project was to compare the relative tire-pavement loudness of various pavement surface finishes by evaluating several test sections at Minnesota's [MnROAD facility](#) and the regional freeway system in Minnesota.

What Did We Do?

Researchers used digital audio and video recording equipment to make traffic noise measurements on several 500-foot test sections on MnROAD's northbound I-94 facility. Test sections included concrete pavements with transverse tined, conventional diamond grind and innovative/ultimate diamond grind surface finishes. Researchers also tested a burlap drag surface and another innovative/ultimate grind surface on the regular

Researchers compared the relative loudness of several concrete pavement surface finishes by evaluating test sections. Results showed the innovative/ultimate diamond grind to be the quietest, followed by the burlap drag, conventional diamond grind and transverse tine.

“Using the right pavement surface textures can be a cost-effective method for reducing the tire-pavement noise component of highway traffic noise, and could potentially reduce the size of costly noise walls.”

—**Tim Casey**,
Environmental Acoustics
Program Manager, HDR
Engineering, Inc.

“This project made critical progress in meeting the challenge to develop a pavement finishing method that minimizes road noise without compromising friction.”

—**Bernard Izevbekhai**,
Concrete Research
Operations Engineer,
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The innovative/ultimate grind (right) has wider and flatter grooves than the conventional diamond grind (left) and can reduce tire-pavement noise over it by as much as 4 decibels, or 67 percent.

freeway system in the region, where they could evaluate sections that were longer than the 500-foot MnROAD cells. The burlap drag pavement was chosen as a control for the regional innovative/ultimate pavement section and consisted of the same material, age and original finish. For the innovative/ultimate grind freeway section, researchers measured traffic noise at two comparable locations along a stretch of Interstate: one with underground pavement and the other with the innovative/ultimate grind.

For each test section, researchers placed microphones at varying distances from the road to record several hours of sounds made by passing vehicles. They also made video recordings to help correlate collected audio data to distinct pass-by events and prevent contamination by noise from other vehicles and pavements.

Finally, using the Federal Highway Administration’s statistical pass-by measurement method, researchers averaged the results for these pass-by events to calculate a mean vehicle sound level for each pavement type, allowing them to rank pavements by relative tire-pavement noise.

What Did We Learn?

Results showed that the innovative/ultimate grind was clearly the quietest pavement for four-wheel passenger cars. For dual-axle and multi-axle heavy vehicles, the innovative/ultimate grind was quieter than all surfaces except the conventional grind, for which there was insufficient data to make a comparison. For all vehicle types, the transverse-tine pavement surface was loudest, and the burlap drag quieter than the conventional grind but louder than the innovative/ultimate grind.

For both passenger and heavy vehicles, there was a notable difference in noise levels for the MnROAD and regional innovative/ultimate grind pavement specimens. This is probably because the grind for the regional test section was conducted more recently than the grind of the MnROAD test cell, and concrete surfaces generally become quieter over time.

What’s Next?

The innovative/ultimate diamond grind is a promising method for minimizing road noise without compromising friction. Several projects are under way at MnROAD to further evaluate the relationship between tire noise and pavement texture, including [a pooled fund study on HMA surface characteristics](#) and another to establish a portland cement concrete diamond grinding specification.

This Technical Summary pertains to Report 2010-40, “Influence of Pavement on Traffic Noise—Statistical Pass-By Measurements of Traffic on Several Interstate Pavements,” published November 2010. The full report can be accessed at <http://www.lrrb.org/PDF/201040.pdf>.