concrete pavement
findings

Diamond ground surfaces are proving to be the quietest concrete pavements.

Sensitivity of the Human Ear to Changes in Sound Level

Increase in Sound Level (db)	Change in Apparent Loudness
1	Imperceptible
3	Just Barely Perceptible
6	Clearly Noticeable
10	About Twice as Loud
20	About Four times as Loud

Adapted from SR902P.

Noise levels drop as sound waves travel away from their source.

Concrete and Asphalt: Misinterpretations Cloud the Issue

Research results published recently by the National Center for Asphalt Technology (NCAT) show concrete pavements are just as quiet as asphalt pavements, but that's not what NCAT is saying. Their interpretation of the study contends that asphalt is quieter. In reality, noise differences between concrete and asphalt pavements were as minimal as two or three decibels (dBA).

The Federal Highway Administration's (FHWA) "Highway Traffic Noise Analysis and Abatement Policy and Guidance" clearly states that, "the use of specific pavement types or surface textures must not be considered as a noise abatement measure." Despite this, many specifiers still look for comparisons between materials. At least two recent studies show concrete and asphalt pavement noise levels are comparable.

What's The Noise About?

It's not just roadway neighbors who are concerned about noise. According to the FHWA, projects using federal funds must pass a noise pollution evaluation as part of an environmental assessment. Noise is measured at ground level near surrounding buildings, and a measured level exceeding 67 dBA requires a noise-abatement feasibility analysis.

Noise levels drop as sound waves travel away from their source. Studies show typical noise levels generated by high-speed travel on asphalt and concrete surfaces are about 69 to 72 dBA at distances of about 8 m (25 ft) from the pavement. In most U.S. cities, residential buildings built to code are situated about 15 m (50 ft) or more from the edges of roadways, reducing the intensity of noise levels by as much as 6 dBA.

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Slight noise differences from road surface type are insignificant compared to proximity of buildings to roadways.

In fact, the diamond ground concrete pavements were quieter than four out of five asphalt sections, and within 1 dBA of the other asphalt section.

Concrete pavements also provide:

- Sure traction for a safer ride
- Brighter pavements that are easier to see and safer in all conditions
- Longer lasting pavements that reduce maintenance cycles and congestion
- Light and heat reflecting surfaces that reduce heat build-up and help mitigate urban heat island effects
- Safer, longer lasting, quieter, smoother pavements and cooler communities

Slight noise differences from road surface type are insignificant compared to proximity of buildings to roadways. While a variety of components contribute to roadway noise, such as engine and exhaust noise, one factor is tire/road noise. Surface texturing techniques employed to reduce hydroplaning and increase skid resistance can also increase tire/road noise, sometimes in the form of tire whine.

Tire whine depends on the specific tone created by tire/road interaction; the higher frequency of the tone, the louder and more prominent it is perceived to be. Research performed in Wisconsin in 1997 showed that uniformly spaced transverse tines produce prominent tones, while randomly spaced and longitudinal tines do not. Likewise, drag, diamond ground and abraded textures do not produce prominent tones or whine. These studied facts suggest that specifying agencies look closely at their texturing selections when building with concrete to assure that they optimize the noise reduction characteristics.

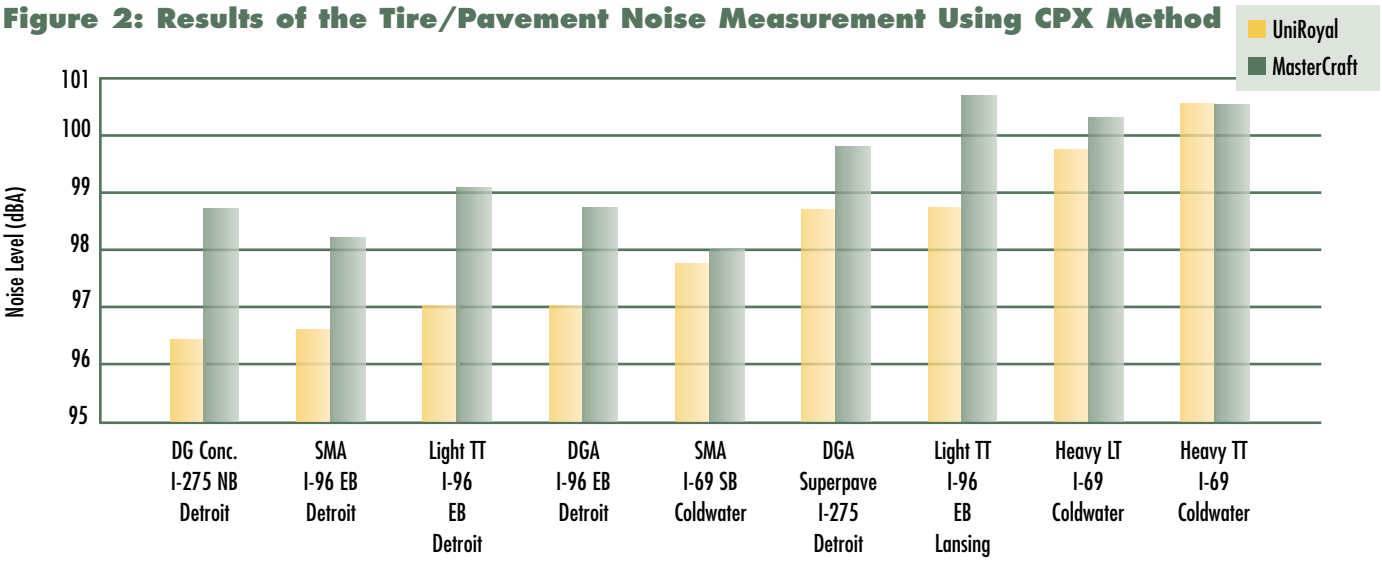
Re-examining NCAT's Results

Results of the NCAT study (performed for the Michigan Department of Transportation) were released in October 2002, and proved that concrete pavements can be just as quiet as asphalt pavements. The study compared nine test sections, including a variety of concrete pavement surfaces: diamond ground, light transverse tined, heavy longitudinal tined and heavy transverse tined, as well as asphalt surfaces.

While test results show the noise levels of nearly all nine sections were within 3 dBA of each other, NCAT presents the results in a way that makes concrete pavements appear loudest. By averaging the results of all the concrete sections, including heavily textured surfaces mandated by MDOT, the study includes a graphic that would make concrete seem louder than asphalt.

In fact, the diamond ground concrete pavements were quieter than four out of five asphalt sections, and within 1 dBA of the other asphalt section. Even the widest disparity in noise level was only about 3 dBA.

Figure 2: Results of the Tire/Pavement Noise Measurement Using CPX Method



Section	Surface Type
DG Conc. I-275 NB Detroit	Diamond Ground Concrete
SMA I-96 EB Detroit	Stone Matrix Asphalt
Light TT I-96 EB Detroit	Light Transverse Tined Concrete
DGA I-96 EB Detroit	Dense Graded Asphalt
SMA I-69 SB Coldwater	Stone Matrix Asphalt
DGA Superpave I-275 NB Detroit	Dense Graded Superpave Asphalt
Light TT I-96 EB Lansing	Light Transverse Tined Concrete
Heavy LT I-69 Coldwater	Heavy Longitudinal Tined Concrete
Heavy TT I-69 Coldwater	Heavy Transverse Tined Concrete

The CPX method is not recommended by the FHWA for measuring highway noise levels for noise abatement and mitigation.

Highway noise cannot be characterized by one single type of noise measurement.

Experts call into question the test method used by NCAT. The close proximity method (CPX) is not recommended by the FHWA for measuring highway noise abatement and mitigation. CPX measures noise at the tire, providing measurements not suitable for environment impact analysis. The preferred method—standard pass-by method—measures noise at ground level near the receptors (surrounding buildings), providing a more realistic noise measurement.

Wisconsin Research Points to Equality

In 1999, a series of tests at 57 sites in six states measured noise levels of both concrete and asphalt pavements. Sponsored by the Wisconsin Department of Transportation and the FHWA and performed by Marquette University and HNTB Corporation, the study examined pavements in Colorado, Iowa, Michigan, Minnesota, North Dakota and Wisconsin.

Recognizing highway noise cannot be characterized by one single type of noise measurement, the study's authors conducted exterior, interior, subjective and prominent frequency noise analysis. They also measured surface textures with both a Road Surface Analyzer and sand patch tests.

The similarity between some asphalt and concrete samples is striking.

Resource List

- *Noise and Texture on PCC Pavements: Results of a Multi-State Study,* by David A. Kuemmel, et al, Marquette University, June 2000.
- *Tire/Pavement Noise Study for Michigan Department of Transportation,* National Center for Asphalt Technology, October 2002.
- *Optimizing Surface Texture of Concrete Pavement,* by Chung-Lung Wu and Mohamad A. Nagi, Portland Cement Association, 1995.
- *Special Report: Concrete Pavement Surface Textures,* American Concrete Pavement Association, 2000.
- *Highway Traffic Noise Abatement Policy and Guidance,* Federal Highway Administration, June 1995.

Some of these reports, plus additional materials, are available at ACPA's web site: www.pavement.com.

The result? Simply put, concrete pavements matched asphalt pavements. Of the best four pavements for exterior noise, three were concrete: longitudinally tined, random skewed tined, and random transverse tined. The same four were considered among the best for interior noise.

According to the research, the similarity of noise results between asphaltic concrete (AC) and the longitudinally tined and skewed tined concrete pavements was "striking," in measurements of both interior and exterior noise levels. Overall, differences in noise levels between most of the concrete and asphalt pavements were negligible.

Final Thoughts

Some proponents insist on making noise comparisons between concrete and asphalt, even though research shows they are comparable. Even organizations like the Noise Pollution Clearinghouse (a national, non-profit group that fights to reduce noise) argue that noise should not be addressed with "quick fixes" like asphalt overlays that offer fleeting results at a high cost. Instead, they argue, we should focus our efforts on bringing about lasting, measurable change, starting with reducing truck noise.

In their final report, authors of the Wisconsin research cite the comments of an FHWA Technical Work Group that concluded pavement" material type selection should not be based solely on noise considerations from the tire/pavement interaction." Even so, there are still those who feel the need to specify pavement materials using noise consideration as a major factor. Those individuals and organizations that specify concrete pavements can do so with confidence. As both the NCAT and Wisconsin research prove, when it comes to noise, concrete can match asphalt mile for mile.

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