

Long Live Quiet!



Using Quiet Concrete Pavements as the Noise Solution

THE INTRODUCTION OF THE AUTOMOBILE in the early 1900s also introduced a new factor with which owners and designers had to contend with: transportation noise. Congress passed its first attempt at noise regulation in 1972 with its Noise Control Act. Since that time, many changes in technology and population have occurred. Today, in many urban areas, noise is simply a quality of life issue. Owners and agencies are challenged to balance noise with the competing factors of safety, smoothness and capacity.

>>> NOISE BASICS

Highway noise is the result of vehicular travel along a roadway and is a function of the volume and speed of the traffic. It consists of all the noise produced by each vehicle's drivetrain, exhaust, tires, air turbulence and other design features such as horns and braking operations. For typical highway applications, the noise contribution of cars and large trucks is quite different. Passenger cars generate about 70 to 90 percent of their total noise through the tire-pavement interaction. This fact implies that modification of the roadway surface and/or the tire type can meaningfully impact the overall tire-pavement noise. The total noise for autos can also be represented by a noise source at or near the roadway surface level.

Although large trucks have similar types of noise sources, the magnitude and location of these sources is quite different. The drivetrain noises are positioned much higher and the exhaust stacks are approximately 11-12 feet above the roadway surface. These higher locations create the potential for the noise to be heard over longer distances. Truck tires also interact with pavement differently than car tires and generally the surface texture does not have a significant effect on the tire-pavement noise level.

>>> THE IMPORTANCE OF GOOD DESIGN

Noise mitigation is typically conducted in the design phase of a project and is intended to limit the maximum noise level in the adjacent neighborhoods. Up until the late 1960s, many of the concrete roadways constructed in the U.S. used a burlap drag type texture. This texture



provided a quiet pavement and proved useful when speeds and traffic volumes were low. However, as highway speeds and traffic volumes increased, friction became a growing concern. In 1979, the Federal Highway Administration (FHWA), required other surface texture types to be used for roadways above 40 mph. This led to the widespread use of uniform transverse tining as the texture of choice on concrete pavements in the United States. Since the late 1990s, a number of states have moved to longitudinal tining since it does not possess the volume and tonal aspects associated with the transverse option.

Recently, there has been a growing interest in controlling noise at the source through the type of pavement selected. For existing highways with noise issues, diamond ground surfaces are the solution of choice for producing quiet concrete pavements. This can be accomplished using conventional diamond grinding techniques or the recently developed Next Generation Concrete Surface (NGCS).

The conventional diamond ground surface is the less expensive of the two surfaces. The NGCS represents more of a manufactured surface and the texture produced during construction is very consistent. It also has produced the quietest non porous concrete pavements measured to date.

▲ The IGGA, American Concrete Pavement Association and Portland Cement Association have recently partnered in a research initiative with Purdue University that has led to the development of the quietest concrete surface texture known to the industry, NGCS. Pictured above is the Purdue Tire Pavement Test Apparatus.

>>> REDUCING THE JOINT SLAP EFFECT

MOST CONCRETE PAVEMENT is constructed with transverse joints spaced every 13 to 20-feet with a 15-foot spacing being very common. These joints can contribute to the overall noise level of the roadway in two ways. First, if inadequate load transfer exists and the joint becomes faulted, the tires will produce a “joint slap” every time they contact a joint. The best way to avoid this situation is to dowel the pavements and/or provide a design which will not fault under the traffic conditions. If a roadway has already faulted, then diamond grinding will remove the fault and restore both the noise and ride qualities.

The second way in which joints can produce additional noise is through the joint opening size. The wider the joint opening, the greater the joint slap produced. To minimize joint slap during the design stage, joints should be narrowed and sealed. A sealed joint will be quieter than an unsealed joint. Joints with widths greater than 1/8-inch can produce joint slap, however, it typically takes widths 3/8 inch or more to produce noticeable joint slap. Well designed concrete pavements should consider the joint design in regards to its contribution to pavement noise. Joints should be narrow and sealed from a noise perspective.

>>> ACOUSTIC LONGEVITY – WHY CONCRETE IS THE BEST SOLUTION

PERHAPS THE MOST MISUNDERSTOOD aspect of pavement noise from the consumer side is acoustic longevity. Consumers develop impressions based on their driving experience and if the interior of the car is quiet, they perceive the roadway as quiet. However, the acoustic property of a pavement surface changes over time. Unfortunately, this scenario has created the misconception that asphalt pavements are quieter than concrete pavements. Although, at the time of construction, some asphalt pavements are quieter than properly textured concrete pavements, com-

What's Next?

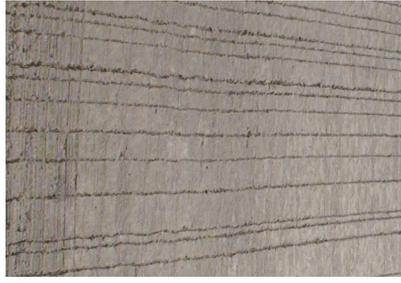
The Next Generation Concrete Surface (NGCS), a term used to identify a class of pavements that has evolved through research, is proving to be ideal for long-lasting, economical, noise-reducing pavement surfaces. The pavements are designed to provide a consistent profile absent of positive or upward texture. Since the NGCS is more of a “manufactured” surface, it is more consistent and predictable than more traditional surfaces.

Developed by Purdue University on their Tire Pavement Test Apparatus, the NGCS surface has been constructed at four locations across the U.S. with at least one more planned for 2009. Test sections currently exist in Minnesota, Kansas, Illinois and Wisconsin, with a fifth planned for Seattle, Wash. The field test sections allow evaluation of the NGCS effectiveness over time under various traffic conditions and concrete pavement constructions. Larry Scofield, the American Con-

crete Pavement Association Director of Pavement Innovation, stated that, with the wide array of aggregates that have been used to construct concrete pavements, it is important to evaluate both the acoustic and frictional longevity of these surfaces when constructed on different types of concrete. Through the field evaluations, contractors will get a better understanding of the constructability of these surfaces and their cost effectiveness, he added.

In addition, NGCS LITE is in development. Designed as a cost-effective “Perpetual Surface Texture,” NGCS Lite is intended to provide an efficient means to enhance the micro texture on the lands of the NGCS surface. Since very little material removal is necessary, this process is significantly faster and more cost-effective than traditional diamond grinding. This provides a significant pavement preservation tool for concrete pavements.

Transverse Tining



Conventional Diamond Grinding



Longitudinal Tining



Next Generation Concrete Surface

Figure 1: The upper range of the transverse tine level is 110 dBA, while the diamond ground surfaces (e.g. two right most surfaces) can produce approximately 100 dBA surfaces. This 10 dBA difference indicates the transverse tined surface can be twice as loud. In addition, the transverse tined surface can also have undesirable tonal qualities exacerbating the annoyance even further.

paring asphalt pavements to loud transverse tined pavements is a very misleading comparison since it is the transverse grooves and not the concrete that is creating the issue.

The second issue that complicates this discussion is longevity. Since concrete pavements last longer than their asphalt counterparts, these older pavements were likely textured with transverse tining. As the urban areas build up, these pavements are then perceived as noisy and subsequently covered with asphalt overlays. However, consumers must be aware that a quick solution that appears to result in low-noise should be questioned if it must be repaired after only a few years, resulting in great disruption to the public.

ABOUT THE IGGA

The International Grooving and Grinding Association (IGGA) is a non-profit trade association founded in 1972 by a group of dedicated industry professionals committed to the development of the diamond grinding and grooving process for surfaces constructed with Portland cement concrete and asphalt. The IGGA/ACPA CPR Division now serves as the technical resource and industry representative in the development and marketing of optimized pavement surfaces, concrete pavement restoration and pavement preservation around the world. To learn more about making concrete pavement quite visit www.igga.net.