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Tech Brief

Joint Slap Evaluation and Prevention

Introduction

An often overlooked aspect of quiet pavement design is the impact of transverse joints on the overall tire-pavement noise level. This aspect is important both for the design of new pavements and the rehabilitation of existing pavements. This impact always increases the overall tire-pavement noise levels experienced by the consumer.

As a tire passes over a transverse joint in a concrete pavement, a "transient" noise is generated which is commonly referred to as joint slap. This noise is a result of the vibration in the tire tread and carcass created by the impact with the pavement joint.

The magnitude of this "transient" noise is a function of the amount of faulting of the joint, the joint opening width, the sealant level in the joint, and the speed of the vehicle as it passes over the joint.

The increase in overall tire-pavement noise level due to the "transient" noise is a function of the noise level of the existing pavement texture and the joint spacing in the roadway. The noisier the existing pavement texture, the less impact the joint slap has on overall tire-pavement noise. Therefore, as pavement textures become quieter, the impact of the joint slap effect becomes greater

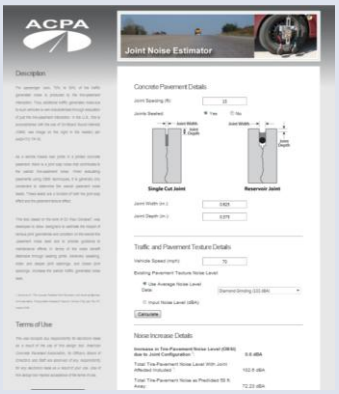

Figure 1 ACPA Joint Slap Estimator Tool

Similarly, the more frequent the transverse joints are encountered either due to speed or joint spacing, the greater the effect on overall tire-pavement noise.

The American Concrete Pavement Association (ACPA) recently developed a web tool that can be used to estimate the increase in overall tire-pavement noise level for a given joint geometry, existing pavement texture noise level, and vehicle speed. With this tool, it is now possible to determine the optimum joint configuration for a new pavement design, or the benefit of a sealed joint in an older existing pavement.

The web tool is based on an analysis conducted by Dr. Paul Donavan of Illingworth and Rodkin, Inc.[1] and the joint slap research conducted at Purdue University[2]. The ACPA web tool is available at http://apps.acpa.org/apps/.

The ACPA web tool, see Figure 1, has two outputs. The first, is an estimate of a single design condition and the second (Fig. 2) is a plot which indicates the impact for various joint

opening widths as illustrated. The lower plot in Figure 2 indicates the noise level at two offset distances.

Impact of Joint Geometry on New Construction Tire-Pavement Noise Level

Using the ACPA web tool, it is possible to determine the maximum joint opening width for which there will be a negligible increase in overall tire-pavement noise level (i.e. < 0.5 dBA). Although this is a function of the existing pavement texture noise level, the joint spacing, and vehicle speed, for a traffic speed of 70 mph and a 15 ft joint spacing, a sealed joint opening can be up to approximately 3/8 " wide (for the sealed joint configuration indicated) before it contributes to overall tire pavement noise levels. So for new construction, narrow sealed joints with reservoir widths up to 3/8 inch can be used.

Impact of Joint Geometry on Existing Pavement Tire-Pavement Noise Levels

Perhaps the greatest benefit to using the ACPA web tool is in predicting the benefit of sealed transverse joints for existing pavements. Older existing designs commonly used reservoir cuts approximately 5/8" in width and 1 ½" in depth. For this original configuration, if the sealant has failed and the material removed or allowed to deteriorate, exposure of the the original reservoir design can increase overall tire-pavement noise levels by 5 dBA for highway speeds of 70 mph. This is a significant increase in overall level and meets the FHWA definition of a substantial reduction for noise abatement.

Designing Quiet Pavements

When designing quiet pavements, the impact of the joint configuration on the overall tire-pavement noise level should be determined. It should further be noted that the "transient" joint slap effect impacts the consumer at two levels; as a repetitive annoyance on the interior of a vehicle and as an increased overall tire-pavement noise level at the abutting properties. The annoyance factor attributable to the repetitive interior noise levels induced by joint slap is presumably more significant than estimated by the web tool which is based only on the overall noise level.

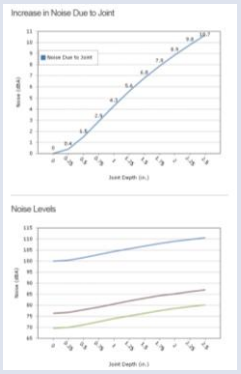

Figure 2 Noise Levels Versus Joint Opening Width

The following procedures should be considered in the design of quiet pavements:

- The ACPA Web Tool should be used to evaluate transverse joint design in new construction for the expected roadway speeds.
- For roadways which were originally constructed as a sealed transverse joint with a reservoir cut design, the Web Tool should be used to evaluate the impact of not resealing the joints. Evaluation of this condition for typical older designs suggests that a significant increase in tire-pavement noise level may occur if the joint is not properly resealed.

References:

1. Donavan, Paul, "The Acoustic Radiation from Pavement Joint Grooves Between Concrete Slabs, TRR 10-3765
2. Dare, T., et al, "The Effect of Joints in Portland Cement Concrete Pavements", Purdue University's Institute of Safe, Quiet, and Durable Highways, HL2008-7
3. Highway Traffic Noise- Analysis and Abatement Guidance: http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/analysis_and_abatement_guidance/polguide02.cfm