

Minimize Wheel-Slap: Keep Your Joints Narrow

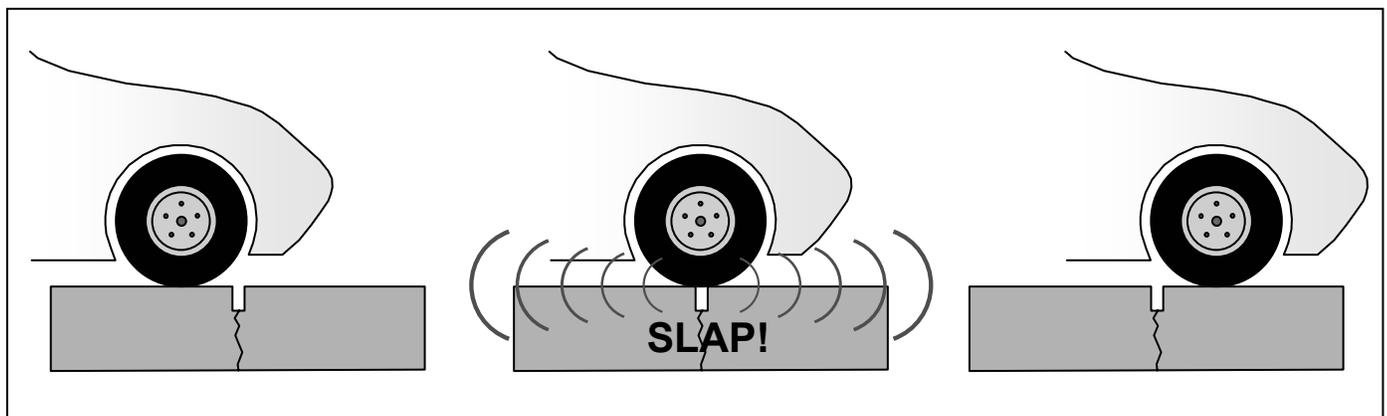
With the ever-increasing attention on tire/ pavement noise, we have decided to once again address the effect that joint width plays in the creation of tire/pavement noise. The question about joint noise first came up about six years ago in April 1998. Back then, our research found that almost nothing was available to address the question, so we surveyed a few pavements to see what we could find.

We found that that tires crossing transverse joints can induce a noticeable slap sound when the joints are about 5/8-inch wide or more. In our study, we drove over 10 projects with various joint designs, noting the joint width and any noise both inside the vehicle and outside of the vehicle.

We now refer to the noise as “wheel-slap.” We believe wheel-slap noise is simply a result of the impact of a tire’s surface onto the far side of a joint reservoir, analogous to the mechanism of clapping hands. To some people, wheel-slap sounds similar to the noise generated when tires cross severely faulted transverse joints. But wheel slap is not caused by roughness; that is, a perfectly smooth pavement with wide joints can sound rough, even though it is brand new.

The following summarizes our observations from the original study:

- Wider joint reservoirs produce louder wheel-slap noises.
- Joints that are 1/2 inch-wide or less produce no noticeable wheel-slap noise
- Wheel-slap noise becomes noticeable when crossing joints 5/8 inch-wide or more; wheel-slap noise is clearly noticeable when the joint width exceeds 3/4 inch.
- In a vehicle, wheel-slap noise only becomes noticeable at speeds over about 40 mph, even for 1-inch wide joints.
- Outside, wheel-slap noise is noticeable from the edge of pavement even at slow speeds.
- The presence or absence of joint sealant has little effect on noise generation when joint reservoirs are less than 1/2 inch wide.
- Joints completely filled with sealant (no recess) may prevent the generation of wheel-slap, even for wider reservoirs (observed at 3/4 inch).
- The pavement surface texture does not alter the development of wheel-slap noise or perceived wheel-slap loudness on the projects surveyed.



Pavement	Location	Date of Review	Weather Conditions	Surface Texture	Pavement Condition Notes	Faulting (avg.)	Joint Sealant	Joint Width		Wheel Slap		Notes
								Range	Avg.	Inside Vehicle	Outside Vehicle	
Illinois 137	From Interstate 94 east to US 41; Lake Bluff, IL	4/2/04	Sunny & cool; 55°F	Uniform Transverse Tining; shallow and/or starting to wear away	Hinge Joint Design; very good condition	0.0 in.	Preformed compression seal	1/2 to 5/8 in.	9/16 in.	None at 40 mph; Barely noticeable at 45 mph	Barely noticeable, only at compression seal joints	Compression seal is at a constant recess, fairly close to surface. Results in little wheel slap.
							Hot-pour	3/16 in.	3/16 in.	None	None	Hinge joints effectively filled to surface.
Illinois 120 (Belvidere Rd.)	Between IL 60 and US 12; Volo, IL	4/25/04	Sunny & cool; 65°F	Uniform Transverse Tining (~1 in. spacing)	Hinge Joint Design; good condition	0.0 in.	Preformed compression seal	5/8 to 3/4 in.	3/4 in.	None at 35 mph; Noticeable at 40 mph; Clearly noticeable at 45 mph	Noticeable at compression seals	Wheel slap pronounced at wide joints; typical otherwise.
							Hot-pour	3/16 to 5/16 in.	1/4 in.	None	None	Hinge joints effectively filled to surface.
Illinois 83	Between IL 45 and Gilmer Road; Vernon Hills, IL	5/26/04	Sunny & cool; 55°F	Uniform Transverse Tining (~1 in. spacing)	Hinge Joint Design; good condition	0.0 in.	Preformed compression seal	1/2 to 5/8 in.	9/16 in.	Barely noticeable at 40 mph; Noticeable at 45 mph	Noticeable at compression seals	Wheel slap pronounced (more than typical) at joints with significant recess.
							Hot-pour	3/16 to 3/8 in.	5/16 in.	None	None	Hinge joints effectively filled to surface.
Lake-Cook Rd.	West of IL 21 / US-45 (Milwaukee Ave.); Buffalo Grove, IL	4/1/04	Sunny & cool; 47°F	Turf Drag	Excellent condition	0.0 in.	Preformed compression seal	1/2 to 5/8 in.	5/8 in.	Barely noticeable at 35 mph; Noticeable at 40 mph; Clearly noticeable at 45 mph	Clearly noticeable	Some of compression seals recessed further down (1/2 to 3/4 in.) than others (1/4 in.).
Overlook Dr. (Narragansett Ave.)	South of Golf Road; Morton Grove, IL	4/1/04	Sunny & cool; 47°F	Uniform Transverse Tining (3/4 in. spacing)	Hinge Joint Design; minor spalling at compression seals; a few surface spalls evident.	0.0 in.	Preformed compression seal	5/8 to 3/4 in.	5/8 in.	Barely noticeable (only at 45 mph and above)	Clearly noticeable, even at low speeds	Aggregate pit gone. Road name changed from Narragansett Ave. to Overlook Dr.
							Hot-pour	1/4 in.	1/4 in.	None	None	No wheel slap at hot-pour hinge joints.
Old Orchard Rd.	Interstate 94 to Harms Road; Skokie, IL	4/1/04	Sunny & cool; 47°F	Turf Drag	JRCP design; cracks starting to spall/fault.	0.0 in.	Preformed compression seal with hot-pour on top	1/2 to 3/4 in.	5/8 in.	Noticeable above 40 mph	None at joints; Noticeable at cracks	Joints with recessed, preformed seals produced wheel slap. Joints with hot-pour sealant (flush with surface) produced no slap. Wheel slap coming mostly from faulted/spalled cracks.
Wisconsin 50	West of Interstate 94; Pleasant Prairie, WI	4/2/04	Sunny & cool; 50°F	Uniform Transverse Tining	Variable joint spacing - mid-panel cracks evident in long slabs. Faulted; skewed undoweled joints on an unstabilized permeable base.	1/4 in. (1/16 to 5/8 in.)	None	1/8 to 1/4 in.	3/16 in.	None	None	No wheel slap evident; can only hear transverse joint faulting. Longitudinal joint faulting ranges from 0 to 1 in. (some areas have settled).
Lakeview Pky. (Wisconsin 165 / County Rd. Q)	1/4 mile east and west of Interstate 94; Pleasant Prairie, WI	4/2/04	Sunny & cool; 53°F	Uniform Transverse Tining	Very minor faulting evident.	1/16 in. (0 to 1/8 in.)	None	3/16-1/4 in.	7/32 in.	None	None	No slap noticed at any speed.
US 41	SB ramp from I-94 (south of Wisconsin state line); Gurnee, IL	4/2/04	Sunny & cool; 52°F	Transverse Tining	JRCP design; some mid-slab cracks starting to fault. Some full-depth repairs evident.	1/16 in. (0 to 1/4 in.)	Hot-pour flush with surface	1/2 to 9/16 in. at original joints; 1 to 1-1/8 in. at cracks and around full-depth repairs.	1/2 in.; 1 in.	Noticeable only at wide joints	Clearly noticeable at wide joints; noticeable at narrower joints	Original joints in JRCP produce no wheel slap inside vehicle, but noticeable outside. Mid-panel cracks and full-depth repair joints in JRCP do produce wheel slap.
Illinois 131 (Green Bay Rd.)	Sunset Ave. south to IL 132; Gurnee, IL	4/2/04	Sunny & cool; 52°F	Transverse Tining	JRCP design; some mid-slab cracks starting to fault.	1/32 in.	Preformed compression seal	1/2 to 3/4 in.	9/16 in.	None at 40 mph; Barely noticeable at 45 mph	Noticeable @ 1/2 in.; Clearly noticeable (5/8-3/4 in.)	Variable recess on compression seals (seals may have moved since initial construction). Wheel slap depends not only on joint width, but also joint recess (sealant depth).
Lake-Cook Rd.	East of IL 43 to to Revere Dr.; Northbrook, IL	4/1/04	Sunny & cool; 47°F	Diamond Ground	Good condition; Patched, diamond ground, and resealed in 2003.	0.0 in.	Hot-pour	7/8 in.	7/8 in.	Barely noticeable at 30 mph; Noticeable at 35 mph; Clearly noticeable at 40	Clearly noticeable	Joint seals are recessed 1/8 to 1/4 in.
Illinois 21	South of Washington St. to IL-120; Gurnee, IL	4/2/04	Sunny & cool; 54°F	Transverse Tining with Longitudinal Turf Drag	New pavement; paved in summer & fall of 2003.	0.0 in.	Hot-pour (in single sawcut)	1/8 in.	1/8 in.	None	Barely noticeable at overfilled joints	Overfilled joints produce a noise which is similar to wheel slap noise, but produced from a different mechanism.

We recently revisited those same 10 pavements, and surveyed two additional ones. The pavements surveyed six years ago have not changed much, nor have our observations changed.



Typical overfilled joint, which can also cause an annoying sound similar to wheel slap when tires cross the joint.

New Observations

- Wheel-slap noise increases as both joint width and sealant recess increase.
- Wheel-slap is also related to the speed of the vehicles using the pavement. On all of the

pavements, regardless of joint width or sealant recess, wheel-slap noise was not noticeable inside the vehicle at speeds less than 30 mph. Most of the pavements showed evidence of wheel-slap noise only around 45 mph.

- Overfilled joints at one project also caused a noise similar to wheel slap. It was exactly the same noise that you would hear on an asphalt pavement that has had crack sealing, which uses “banding” to spread the sealant around the surface of the crack.

Conclusion

The application of this information is simple: keep the sealant reservoirs as narrow as possible initially to get these benefits:

- Keep the reservoir from being noticeable to the user as road noise.
- Optimize the necessary quantity of sealant material and the associated cost.
- Provide for an ample number of widening and resealing projects before the reservoir becomes too wide for cost or noise.

Wheel-slap is not as critical an issue today in some states as it was five years ago, because many agencies have changed their details for joint sealing to use a narrow 1/8-inch wide reservoir (i.e. single sawcut), filled with sealant. The agencies taking this approach are getting all of the associated benefits from their decision, including the opportunity for multiple resealing projects before joint reservoirs become wide enough to start causing wheel slap.



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