

Special Report

CONCRETE PAVEMENT TECHNOLOGY & RESEARCH

INCLUDES:

Comparison between
Grinding and Milling

Uses and Applications of
Diamond Grinding

Concrete Pavement Surface Restoration: Diamond Grinding vs. Carbide Milling

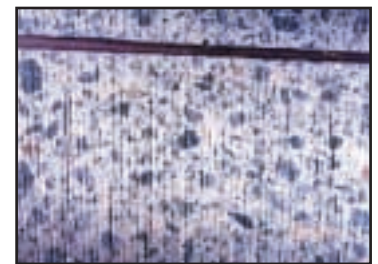
By design, most portland cement concrete (PCC) pavements last for 20 to 30 years with minimal structural damage. The most common pavement deterioration after this time is increased roughness due to faulting, settlement, and wheel-path rutting due to studded tires. In the past, agencies used asphalt overlays to smooth the pavement. However, these were only temporary fixes that covered up the problem and did not address the cause.

Diamond grinding has been used since 1965 and is an excellent procedure to repair PCC pavement roughness, increase friction, and reduce tire/pavement noise. Recently, some agencies have tried carbide milling to restore smoothness. **This is not recommended because it leaves the pavement rough and causes excessive damage to transverse and longitudinal joints.**

Comparison

The main difference between diamond grinding and carbide milling is in the way that the cutting head removes the concrete layer. Diamond grinding uses closely spaced, diamond saw blades that gently abrade away the top surface of the concrete. On average, the diamond cutting media will contact the pavement surface nearly 27,000,000 times per square yard. This accounts for the gentle removal action. The level surface is achieved by running the blade assembly at a predetermined level across the pavement surface. The uncut layer between each saw cut breaks off, leaving a level surface (at a macroscopic level) with longitudinal texture as shown below. The result is a pavement that is smooth, safe, quiet, and pleasing to ride on.

Diamond grinding of concrete pavement leaves a surface which is often as good as a new pavement. In reducing the bumps and dips in the pavement surface, the dynamic loading from heavy wheel loads is decreased, resulting in lower stresses in the pavement. Diamond grinding reduces road noise by providing a longitudinal texture, which is quieter than transverse textures. The longitudinal texture also enhances surface texture and skid resistance in polished pavements.



Carbide milling (also referred to as cold planing, rotomilling, and profiling) is a demolition technique, not a surface restoration technique. The carbide milling process is similar to a jackhammer, in that it chips away at the surface of the concrete with a milling head, which is an arbor equipped with carbide-tipped teeth. On average, these carbide teeth will contact the pavement nearly 5000 times per square yard (millions fewer when compared with diamond grinding). This breaks away the top layer of concrete from the pavement surface, leaving a roughened pavement and fractured



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joint faces (see left). Even with recent advancements, incorporating greater numbers of machined teeth and a smoother drum, the carbide milling process falls short of the diamond grinding process. According to a Caltrans report, "Unless an agency is willing to accept badly spalled joints, the cold planer (rotomill) is **NOT** considered a satisfactory substitute for diamond grinding."

Uses and Applications of Diamond Grinding

Diamond grinding is most often used as part of a comprehensive Concrete Pavement Restoration (CPR) program. The techniques employed in a CPR program usually include a combination of full-depth repair, partial-depth repair, dowel bar retrofit, joint and crack resealing, slab stabilization, cross-stitching of longitudinal cracks, grooving, and diamond grinding. If the application of each technique occurs at the right time, the maximum use and life of the pavement will be achieved.

Diamond grinding can also be used for spot situations, to fix smaller, local problems in newer and older concrete pavements. If there are "must grinds" or rough areas in a newly constructed concrete pavement, the easiest and most cost-effective way of achieving the desired smoothness is to diamond grind the pavement.

Diamond ground surfaces have been found to reduce accident rates. The Wisconsin DOT working with Marquette University found that the overall accident rate for diamond-ground surfaces was only 60% of the rate for non-ground surfaces. The diamond-ground pavements provided significantly reduced accident rates up to six years after grinding.

Additional Information

For more information on diamond grinding or carbide milling, contact your local concrete paving representative (1-87-PAVEMENT), the American Concrete Pavement Association, or the International Grooving and Grinding Association.

References

1. *The Concrete Pavement Restoration Guide*, TB020P, American Concrete Pavement Association, Skokie, IL, 1998.
2. *Diamond Grinding and Concrete Pavement Restoration*, TB008P, American Concrete Pavement Association, Skokie, IL, 2000.
3. Rao, S., Yu, H. T., and Darter, M. I., "The Longevity and Performance of Diamond-Ground Concrete Pavements," RD118P, Portland Cement Association, 1999.
4. Caltrans report number FHWA-CA-TL-78-15, "Evaluation of Cold Planers for Grinding PCC Pavements," Final Report, September 1978.

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