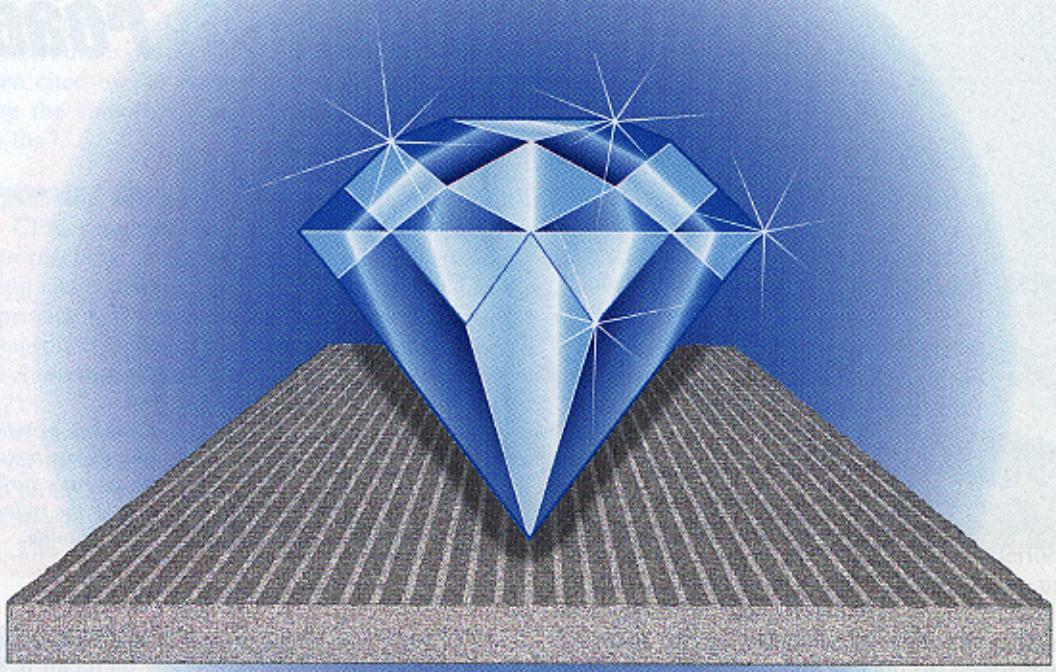
CONCRETE PAVEMENT RESTORATION

The Georgia Story



DIAMOND GRINDING

500 Lane Miles Smoothed For Olympics

Benefits That Follow Twenty Years Of CPR

Nine Design Lives Of Excellent Service Life

Entire Concrete Pavement System Is Smooth

Concrete Pavement Is Revived Three Times

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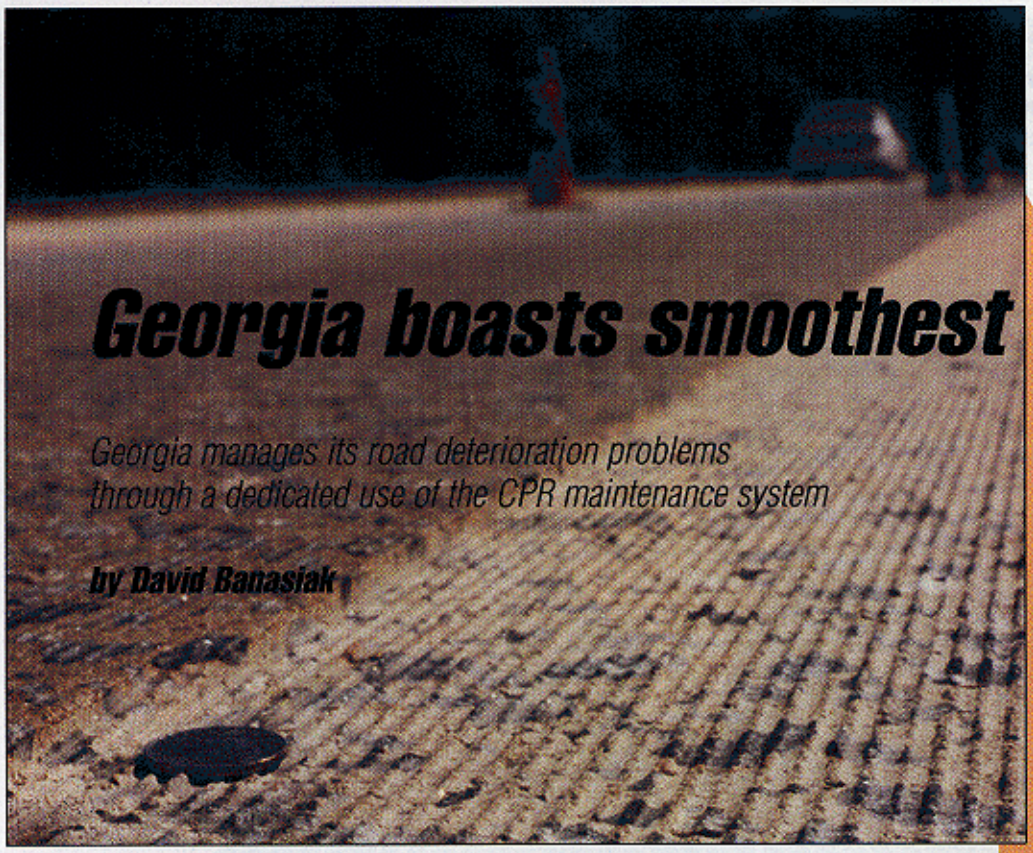


Georgia boasts smoothest roads

Georgia manages its road deterioration problems through a dedicated use of the CPR maintenance system

by David Banasiak

Diamond grinding leaves a corduroy texture to a pavement's surface, which aids in the reduction of hydroplaning

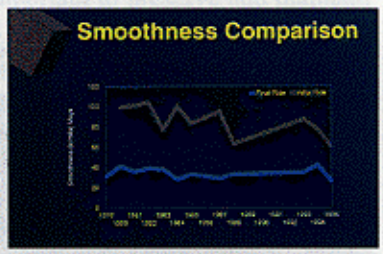
In the mid-70s, over 50% of Georgia's 1,260 miles of interstate was paved in concrete and much of it was 10 to 15 years old. Georgia had been monitoring the conditions of their roads since its first comprehensive interstate condition survey in 1971. These surveys led to a growing concern over the rate of deterioration of the roads.

A typical cross section of Georgia's concrete roads consisted of a 9-in., plain-jointed concrete pavement over a 6-in. aggregate base. The aggregate was of a high granite quality and the joints did not contain dowels. The deterioration being monitored by the Georgia DOT (GDOT) consisted of cracked slabs, faulting, shoulder degeneration, pumping, joint seal failure and spalling at the joints.

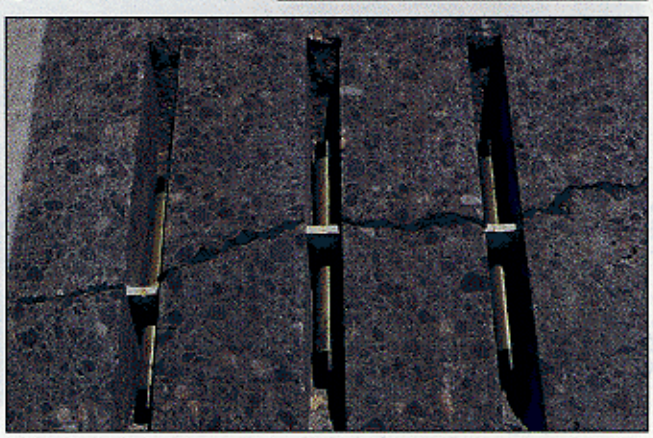
A solution to the deterioration problem had to be found if GDOT was to continue to build concrete paved highways. In 1974, GDOT began researching maintenance procedures for portland cement concrete pavements (PCC). In 1976 they asked the American Concrete Pavement Association (ACPA) for advice and help, and several member companies provided men, material and equipment to repair a section of I–20 near Augusta. These efforts resulted in a concrete restoration workshop co-sponsored by GDOT and ACPA held in Augusta that same year.

Among some of the techniques demonstrated were slab jacking, retrofit edge drains, slab replacement, undersealing and diamond grinding. Many of these repair methods were in use in other states across America. For example, in the 1960s California was using diamond grinding to smooth over bumps on old Route 66; Minnesota resealed its highway joints; and Virginia performed full depth slab replacements on its roads. However, Georgia was the first to pull together these techniques into a comprehensive system of repairs which came to be known as concrete pavement restoration (CPR). CPR involved the use of all the techniques or various combinations of them depending on repair needs.

After looking at what caused the problem and the treatments which could be used to correct it, GDOT decided to implement this new system of repairs. They began outfitting their maintenance force with the equipment necessary to perform CPR. In 1978 they contracted out CPR projects which did not involve grinding. The following year they awarded their first grinding project.



Right: *This graph illustrates the difference in smoothness on Georgia's roads before and after CPR.*
Below: *Dowel retrofit increases the load transfer and structural capabilities of a road.*



A philosophy toward concrete road maintenance began to take shape. It was based on the notion that road deterioration must be managed rather then waiting until it got out of hand. This included new PCC road designs which featured non-erodible bases, doweled joints, tied concrete shoulders and effective joint seals. In addition to addressing design issues they also continued to improve their use of CPR, incorporating annual condition surveys to record road distress, thus pinpointing damage in the early stages so that it could be repaired before the problem became too large.

GDOT's dedication to the CPR method of roadway maintenance has been successful for them. In the last two years they have been cited by the Federal Highway Administration as having the smoothest concrete roads, based upon rideability, in the U.S.

CPR incorporates the use of one or more procedures. A complete CPR program involves slab stabilization, replacement or patching of damaged slabs, repair of spalls, sawing cleaning and resealing joints and cracks, installation of dowels to provide load transfer support, shoulder restoration, retrofitting of edge drains and diamond grinding (see *CPR Methods Rejuvenate Aging Municipal Streets,* September 1993, p 32).

The number of procedures employed in any particular project depends on the deterioration of the road. In order to determine the procedures which would best suit its needs, GDOT began monitoring its efforts used on its first three CPR projects. The first exclusively GDOT CPR effort took place on I–75 north of Forsythe. The other two CPR projects occurred on I–75 south of Macon and I–85, northeast of Atlanta. These three restoration projects turned up some interesting results.

Full-slab replacement is one procedure of the CPR maintenance system

The edge drains worked so well, and the water flowed so fast, it washed away some of the base, causing faulting of the pavement. Adjacent control sections without edge drains did not experience the same rate of deterioration. Further research showed that 80% of the water under the slab entered at the edge joint.

It was decided that the best way to prevent water from gathering under the slab was through a properly maintained joint seal. The CPR procedure adopted for this was sawing and sealing the edge joint. It is important that the joint is well cleaned so the seal can function properly. Widening the joint slightly, aids in its cleaning.

Slab jacking also caused more harm than good. The grout being pumped into the voids caused too much stress, resulting in broken and cracked slabs. GDOT still uses this procedure sparingly, taking special care to identify voids before drilling and pumping.

Slab replacement has been a very successful procedure for Georgia. After using the lift out method to remove the slab, they remove some base in order to give themselves the option of increasing the concrete thickness. The new slab is joined to the existing roadway with dowels.

Partial depth repairs had a 50% failure rate within two years. This was due to point bearing and the problem was solved by using a compressible insert to form the joint that extended 1 in. below and 1 in. beyond each limit of the patch. Now the rate of success after two years exceeds 90%.

Diamond grinding has always been a successful CPR procedure for Georgia. Since 1976, Georgia has tightened up the riding quality specification for diamond grinding five times.

Knowledge gained in the early days of CPR continues to be used today. The system proved successful on the restoration and lane expansion of I–20. The interstate originally carried three lanes of traffic each way through downtown Atlanta, but it was expanded to five lanes to help carry additional traffic due to the growth of Atlanta and the upcoming Olympic games. After conducting pavement monitoring, it was decided that the existing 25-year-old highway could be

Contractors and Suppliers in CPR

Some contractors that are involved with CPR work:

- Burlington Pavers, Burlington, WI, (414) 539-2128;
- Central Atlantic Contractors, Aberdeen, MD, (410) 575-6930;
- Concrete Textures, Inc., Des Moines, IA, (515) 266-5173;
- Highway Services, Inc., Rogers, MN, (612) 428-2244;
- McLake Construction, McHenry, IL, (815) 385-7336;
- Pavement Specialists, DFW Airport, TX (817) 491-9665;
- Safety Grooving & Grinding, Inc., Wauseon, OH, (419) 335-1820;
- W&M Grooving, Inc., Lebanon, TN, (615) 444-2301.

Some suppliers that are involved with CPR equipment:

- Cushion Cut, Torrance, CA (800) 421-2222;
- Diamond Products, Elyria, OH (800) 321-5336;
- Diamond B, Inc., Cerritos, CA (800) 436-2523;
- Diamond Boart, Kansas City, MO (800) 288-5040;
- Magnum Diamond & Machinery Co., Grandview, MO (800) 527-5451;
- Penhall Diamond Products, Fullerton, CA (800) 854-3281;
- Sanders Saws, Honey Brook, PA (800) 486-0207;
- Specialty Sales, Osseo, MN (612) 425-3087;
- Wel-Co Metallurgical Corp., Oldsmar, FL (800) 343-4960.□

Diamonds are a road's best friend

Diamond grinding has been used to restore and improve roadway rideability since the 1960s. It is an effective, cost efficient method and an integral part of any CPR program. Generally diamond grinding is combined with at least one other CPR procedure; however, if there is no structural damage to the road and distress data indicates only skid or rideability problems, then diamond grinding can be used alone.

Diamond grinding involves the use of diamond blades gang-mounted on a horizontal grinding head. As the grinding machine moves over the pavement, the grinding head rotates and shaves off from 0.06 to 0.75 in. of the surface, leaving behind a corduroy texture. Diamond grinding is very effective in shaving down bumps, reprofiling rough lanes and smoothing pavements. The corduroy texture also helps reduce hydroplanning by providing displacement channels for water.

Before beginning a grinding project a contractor must make the proper blade selection. There are three factors in selecting a blade—bond hardness, diamond size and diamond concentration. Each of these factors impacts upon productivity, cost and quality of the ground surface.

Bond hardness determines the rate at which support, provided by a metal matrix responsible for holding the diamonds, is lost as the diamonds become worn. This is why bond hardness impacts on the cutting speed and life of a grinding head. It is important to match the proper bond hardness to the aggregate being ground in order to maintain maximum cutting efficiency.

Diamond size also effects the life and cutting speed of the grinding head. When grinding soft aggregates choose large diamond particles. For harder aggregates use smaller diamonds.

Diamond concentration is the most important factor because it can either disguise or overshadow the effects of bond hardness or diamond size. More diamonds make a harder grinding head and allows for more efficient cutting.

Diamond grinding offers advantages over bituminous overlays. In many cases grinding costs less than one-half the price of bituminous overlays. In addition, problems common with bituminous overlays, such as rutting, corrugation and poor skid resistance, are not experienced with grinding. Overlays fill gutters and reduce the curb high, adversely affecting a road's drainage abilities. Grinding does not raise the surface of the road, leaving drainage unaffected.

Diamond grinding does not require that every lane of a highway be ground. Trouble lanes can be spotlighted and ground, thus reducing the cost of a restoration project. With an overlay, all lanes most be resurfaced to meet the new elevation. □

retained through a restoration project involving diamond grinding and other CPR procedures. This provided a cost effective alternative to reconstruction and guaranteed against the delays caused by complete removal and replacement of the pavement. The additional two lanes were placed in the highway's right-of-way. Vertical earth walls replaced the slopes, allowing the extra lanes to be squeezed in. Bridges, culverts, signs and interchanges also were widened.

Other states also have enjoyed success with CPR techniques. Kansas used CPR on I–70 in Dickinson County. Badly damaged slabs were repaired, and over 1,200 patches and dowels were installed. The finishing touch to the 240,000 sq ft of concrete pavement was a diamond grinding of its surface.

In Florida, CPR was used to restore two million sq yd of I–10 between Tallahassee and Pensacola. The project involved partial depth repairs, complete slab replacement when required and diamond grinding (see *Largest-Ever Grinding Project Improves I–10*, September 1992, p 43).

In 50 days, Progressive Contractors Inc., Osseo, Minn. completed CPR work on westbound I–90 in Winona County, Minn. The work involved 1,500 partial depth and 240 full-depth slab repairs which were followed up by diamond grinding 283,000 sq yd of pavement.

Concrete roads built in America are designed to last about 20 years; however, many have provided between 20 and 35 years of service. This extended service has been crucial as traffic loads increase, and in many cases exceed designed load limits. Hit with the one-two punch of extended service and increased loads, these roads are deteriorating, while the availability of funds for road reconstruction is diminishing.

By following Georgia's example and aggressively attacking the deterioration problem through new road design methods and use of CPR procedures, road life can successfully be extended and the deterioration slowed. Some Georgia roads have exceeded nine times their design life through CPR maintenance. At a time when budgets are tight, it is important to preserve and maintain an existing road. A CPR program can help.□

A diamond grinding machine at work on Georgia's I–16.

RP345P