

Roller-Compacted Concrete Pavements for Highways and Streets

A History of Superior Performance for Heavy-Duty Pavements

Roller-Compacted Concrete (RCC) consists of an engineered mixture of dense-graded aggregates, cement and water. This zero-slump concrete mixture, when placed with an asphalt paver and compacted to high density, provides a high-strength, durable pavement structure. RCC uses no forms, requires no conventional finishing, and needs no dowels or reinforcing steel, making it an economical choice.

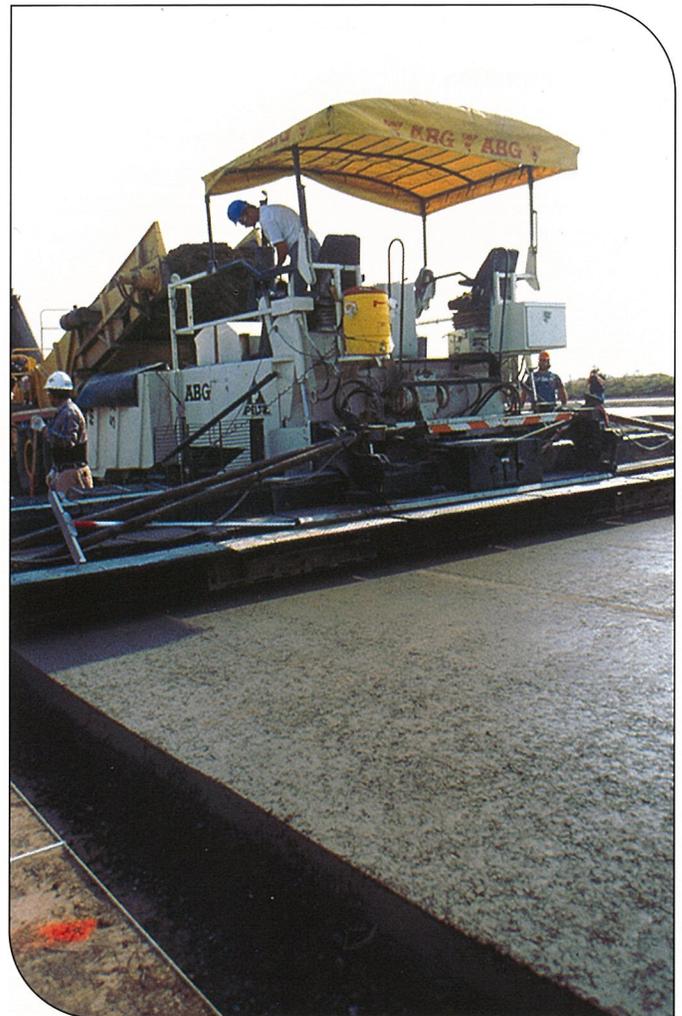
Since its first use in Canada in the 1970s, RCC has been used on pavement projects throughout North America. RCC provides superior performance under conditions of heavy wheel loads, extreme climates and difficult operating conditions. Typically, the construction of heavy-duty pavements with RCC has been focused in log handling yards, intermodal terminals, freight depots and other heavy duty applications. But the past 10 years has seen an increase in using RCC to create cost-effective pavements for many conventional highway and street applications.

RCC Solves Problems Associated with Flexible Pavements

Innovative engineers and contractors have found new ways to put RCC to use to combat the problems often encountered with flexible asphalt pavements. RCC provides a rigid pavement structure that does not rut and can stand up to the abuse of heavy vehicle traffic. Excellent smoothness can be achieved with RCC pavements through the use of high-density paving equipment, surface grinding, and/or the application of thin concrete or asphalt overlays. RCC construction is fast and is competitive on an initial cost basis with asphalt pavements. Over its lifetime, RCC will exhibit significantly lower maintenance costs.

Here are some examples of how engineers are using RCC to solve their flexible pavement problems:

www.cement.org/pavements



RCC normally is placed with asphalt paving machines; most contractors who specialize in the construction of RCC pavements use high-density pavers with vibrating screeds and oscillating tamping bars.

Low-Maintenance Road System

The General Motors Saturn automobile manufacturing facility in Spring Hill, Tenn., contains a significant road network and parking areas. In 1988, the Saturn Corporation was looking for a durable pavement that would require very little maintenance. The solution: the equivalent of 18 miles (29 km) of 24-foot (7.3 m)-wide pavement was constructed with RCC, varying in thickness between six inches (150 mm) (parking areas) and 10 inches (250 mm) (loading docks). Most areas of the road network and parking lots employ RCC as the finished surface. Pavement performance has been exceptional, with virtually no maintenance performed during the first 15 years of service, and no apparent need for maintenance in the near future.

Inlay Rehabilitation

The City of Fort McMurray, Alberta, Canada, selected RCC as a pavement structure for several problem areas on one of its heaviest-traveled thoroughfares. Trucks had caused severe rutting, creating continuous maintenance problems with the existing flexible pavement. Instead of replacing the rutted sections with new asphalt, RCC was used as a more durable option. The inlays, typically using 10 inches (250 mm) of RCC overlaid with a two-inch (50 mm) asphalt traveling surface, have performed well in the several years since they were constructed: the asphalt adheres to the RCC and the pavement surface remains smooth. Most importantly, the rutting problem is solved and no maintenance has been necessary.

Road Widening

In most areas of the U.S., pavement engineers are widening and upgrading roads. In many instances, the road is widened into ditches or other areas where soil and road foundation conditions are poor. The strength and speed of construction of RCC is particularly suited to road-widening applications. The material provides a stable foundation that can be surfaced with asphalt or concrete for highway traffic and provides a long, low-maintenance life. In urban areas, traffic usually can be placed on the RCC within hours after construction, providing an excellent benefit to traffic control plans.



Road widening made easy with roller-compacted concrete.



RCC was used to reconstruct shoulders along I-285 in Atlanta.

Shoulder Reconstruction

Georgia Department of Transportation used RCC to reconstruct shoulders on I-285 (Atlanta Beltway). The existing asphalt shoulders were badly distressed and required reconstruction. The existing shoulder was milled out, and replaced with a 10-ft (3 m) wide and eight inch (200 mm) deep section of RCC. Rumble strips were ground into the surface to conform with interstate highway safety requirements. The project included 34-shoulder miles (55 km) of RCC (Northbound and southbound outside shoulders were replaced for 17 centerline miles (27.5 km)). No surfacing was placed on the RCC because the smoothness was adequate for shoulder speeds.

Fast-Track Intersections

Intersections experience particularly tough punishment from traffic because of the stresses caused by turning movements and vehicle acceleration/deceleration. Rehabilitating busy intersections while causing only minimal interference with traffic operations is a common challenge for transportation engineers. RCC can help speed the process.

In 1994 the City of Calgary, Alberta, Canada, constructed a fast-track intersection with RCC. The asphalt had rutted and shoved, and maintenance was a continual headache. After rush hour on a Friday evening, the existing asphalt was milled out, and workers replaced the failed pavement with six-inch (150 mm) RCC inlays. (Traffic was maintained through the intersection with construction work zones.) A two-inch (50 mm) asphalt overlay, placed shortly after the RCC, sealed in the moisture, and by early Monday morning, the entire intersection was open to traffic. The superior stability of the RCC mix, as well as the protection provided by an asphalt surface during the RCC's strength gain, allowed traffic to return to some pavement areas only eight hours old.

Industrial Access Roads

The Tennessee Department of Transportation (TDOT) regularly makes effective use of RCC for industrial access roads. TDOT maintenance personnel are called on to build roads for new industrial parks

constructed in cooperation with local governments; these roads must offer economical construction and provide strength to withstand the heavy equipment and truck loads found in industrial areas. TDOT tried using asphalt roads, but local authorities soon faced high maintenance costs from asphalt failure. Pavement engineers have since found that RCC pavements, both surfaced and unsurfaced, cost less to install than asphalt pavements and offer far greater strength and durability.

Residential and City Streets

Many new residential developments use thin asphalt surfaces with aggregate base courses for their pavements, a construction method that doesn't offer optimal support for high traffic loads generated during construction. Developers are faced with two poor choices: build the entire road prior to constructing homes, or build only the road base, saving the asphalt surface until construction is finished.

The first choice provides good construction access, but often leaves a worn-out, high maintenance road for the new residents. The second choice eventually provides residents with a new surface, but during construction, the aggregate base course must be continually graded and watered to allow proper vehicle access and dust reduction. Inclement weather often causes work slowdowns or stoppages due to wet, rutted base course material.

A third option—using RCC to construct new residential roadways—solves these problems. RCC is placed during initial site-work to serve as a working pavement and surface. Once construction is complete, a thin (one-and-a-half- to two-inch) (40-50 mm) asphalt overlay is applied, and the residents have a new, low maintenance road.

When constructing residential streets, city officials often are concerned about possible inconvenience to local residents. Pavement



Constructing city streets in Columbus, OH using RCC is quick and convenient. Residents can drive on the RCC base soon after final rolling.

engineers can allay those concerns by using RCC, which allows traffic to be restored quickly. In Columbus, Ohio, several reconstruction projects in residential areas have taken advantage of RCC's speed of construction. For these projects, the old pavement was removed, new curb and gutter installed, and an RCC base was constructed—with residents driving on the surface as soon as it was rolled to the proper density.

The City of Columbus also selected RCC pavement for reconstruction of Lane Avenue, a major arterial near the Ohio State University campus which handles over 30,000 ADT. The existing pavement was seriously distressed, and RCC was chosen because of the city's excellent experience with RCC streets in residential areas.

The reconstructed Lane Avenue pavement consists of eight inches (200 mm) of RCC, surfaced with three inches (75 mm) of asphalt to provide smoothness for the higher speed traffic. The RCC construction was done under traffic for this four to six-lane arterial street. In some cases, traffic was placed on the RCC pavement within 24 hours after construction in order to accommodate nearby businesses.



RCC placed during site work serves as a working surface. With a thin overlay, it becomes a residential street once construction is complete.



RCC can be constructed with minimum disruption of traffic.



Unsurfaced RCC street in Alliance, NB shows little sign of wear 11 years after construction.



A smooth, durable RCC pavement can be achieved that will provide excellent performance for many years.

Roller-compacted concrete has been used successfully unsurfaced. The City of Alliance, Neb., used RCC for the construction of collector streets in a residential subdivision. The RCC pavement was built to smoothness specifications that eliminated the need for an asphalt surface, and saw cuts were constructed every 27 feet (8.2 m) to enhance pavement aesthetics. This pavement has performed well for 11 years with no faulting or surface distress.

Long-Term Performance

A study by the Portland Cement Association of RCC pavements built over the past 25 years found that the material's long-term durability and performance is exceptional.¹ In particular, cracks that formed shortly after construction were not found to deteriorate significantly over time, and faulting (vertical displacement along cracks or joints) was virtually nonexistent. Also, even though RCC is not air-entrained, the pavements surveyed did not show signs of deterioration due to freezing and thawing.

With excellent long-term performance, an initial construction price comparable to that of asphalt, and versatility for use in many applications, RCC pavements offer unmatched value.

1. "Roller Compacted Concrete Pavements - A Study of Long Term Performance," PCA Publication RP366, 1999.

More Information

PCA offers a broad range of resources on roller-compacted concrete and soil-cement applications for pavements. Visit our Web site at www.cement.org/pavements for design and construction guidelines, technical support, and research on RCC and soil-cement including cement-modified soils, cement-treated base, and full-depth reclamation.

www.cement.org/pavements



A key to long term performance is adequate curing. Water or concrete curing compounds are typically used.

For local support, tap into the cement industry's network of regional groups covering the United States. Contact information is available at www.cement.org/local.



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An organization of cement companies to improve and extend the uses of portland cement and concrete through market development, engineering, research, education, and public affairs work.