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RUNOFF CAP

How using Heavy Duty porous asphalt will help your roadway against the elements

By Thomas C. Baird, Contributing Author

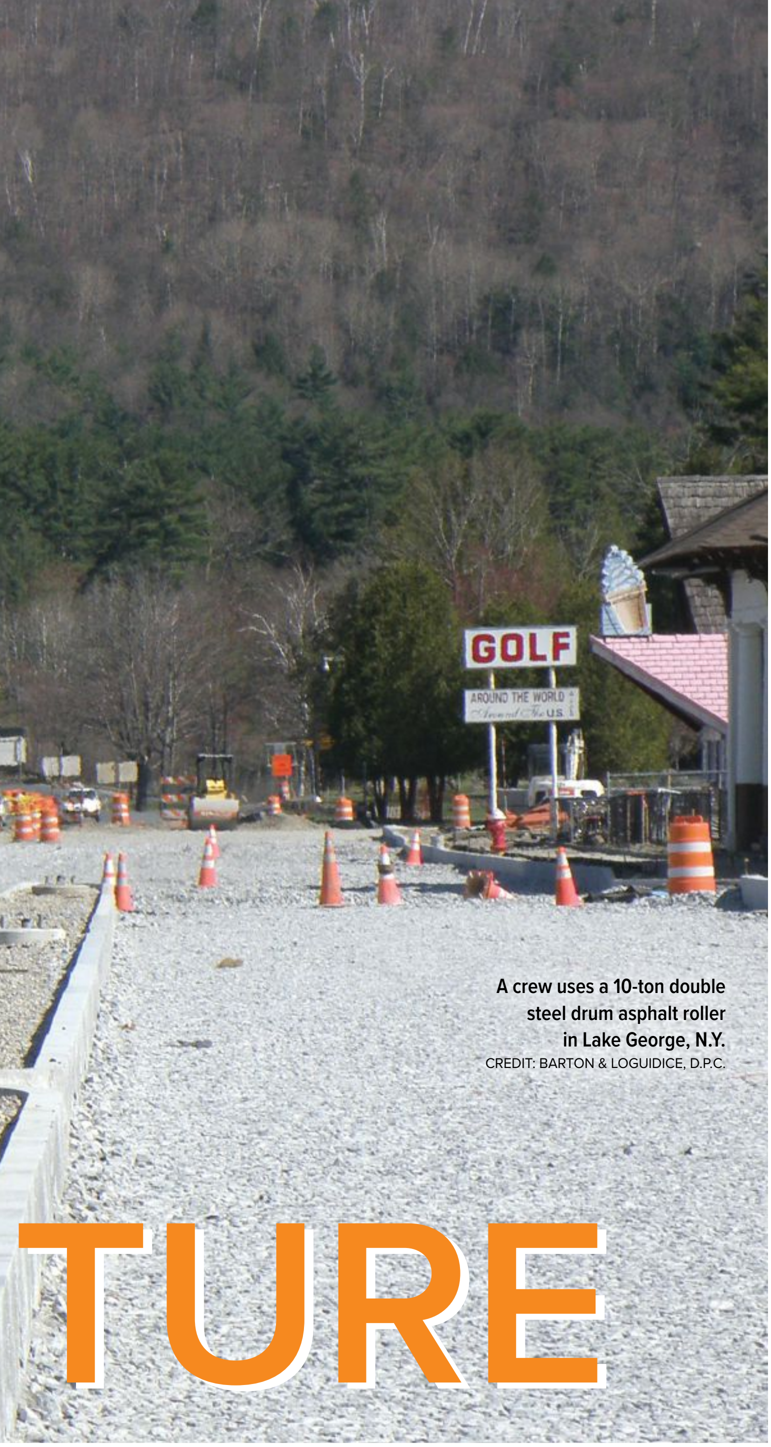
At 10 a.m. on March 27, the author will give a lecture, "Construction Methods and Design Elements for Porous Pavements," at the World of Asphalt Show and Conference in Nashville, Tenn.

POROUS OR PERMEABLE pavement use takes many forms such as asphalt, concrete, pavers, open graded stone, structural grass, and other open-graded products. With each of these, the primary goals are typically runoff reduction, water treatment, and ground water recharge.

While specific runoff capture requirements vary from state to state, permeable pavements are exceptionally suited to satisfying most project's objectives and regulatory requirements. Porous asphalt is primarily the selected material for roadways and parking lots.

In the spring of 2013, Beach Road, the four-lane, 1.1-mile urban collector, serving the south shore of Lake George in Warren County, New York, was reconstructed utilizing a Heavy Duty (HD) porous asphalt system design.

The project was sponsored by the Warren County Department of Public Works and designed by the engineering firm, Barton & Loguidice, D.P.C. (B&L). The project included



TURE

A crew uses a 10-ton double steel drum asphalt roller in Lake George, N.Y.

CREDIT: BARTON & LOGUIDICE, D.P.C.

significant support, funding, and backing from local Lake George watershed focused groups, the New York State Department of Transportation (NYSDOT), the Federal Highway Administration (FHWA), and the New York State Environmental Facilities Corporation (NYSEFC).

Since the construction of the project 10 years ago, much has been learned when it comes to effective production, transportation, handling, placement, and finishing of porous asphalt. Adherence to these proper techniques and understanding the importance of regular maintenance will directly impact performance and longevity.

Originally constructed in 1951, the roadway included a closed drainage system that collected runoff and contaminants and discharged it directly to the lake. Since the original construction, deterioration typical of an upstate New York roadway (potholes, frost heaves, cracking) were repaired, resurfaced, and reconstructed.

In 2007, utilizing county, state and federal funds, full depth reconstruction of the roadway was funded. The reconstruction included the replacement of the drainage system using conventional methods and materials.

However, with the desire for more environmentally friendly highway infrastructure and stormwater management continuing to grow, the project drew interest from the Warren County Soil and Water Conservation District (WCSWCD) and the Lake George Association (LGA) as an opportunity to make a positive impact on water quality for the lake.

The potential to utilize porous pavement for Beach Road was studied. Background data along the corridor such as historic photos and soil borings indicated the presence of a sandy, gravelly material, ideal to provide the base subgrade for infiltration.

The study showed that the pervious area could be increased from 0.1 acres to 2.8 acres by utilizing porous asphalt.

Annual rainfall records revealed that from 1995 until 2009, the region experienced an average of 39 inches of rainfall per year, which is equivalent to approximately 2.9 million gallons per year, or one American football field filled with 8 feet of water per year.

The roadway would require a unique design to resist frost and water inundation because of its proximity to the lake — as the water table fluctuated with lake elevation where high lake water events (often during spring snow melt) would temporarily back-flow into the reservoir course. Design goals were set to provide capacity to store 5 inches of rain in a 24-hour period while still accommodating the fluctuating water table. To accomplish this, excavating to within 12 inches of the water table was required to provide a design section thickness of 36 inches (9 inches of porous asphalt, 27 inches of stone).

To account for the influence of ground water, the 21-inch thick reservoir course is comprised of 100% fractured limestone sized between 1.5 inches and 3 inches placed on a 6-inch thick base layer of 100% fractured three-fourth inch limestone.

The larger reservoir stone, with interlocking acute edges, resists movement and settlement from the fluctuating water table and compressive loading while providing a 40% to 45% air void space.

Vibratory rolling with a double steel drum 10-ton asphalt roller provides the interlocking effect.

Limestone, typically used as aggregate in upstate New York, and the associated stone dust has the potential to clog the underlying geotextile fabric unless the stone is washed effectively.

Aggregate washing procedures can be effective; however, good practice is to utilize as large a reservoir stone as possible to reduce surface area and the potential for clogging stone dust accumulation at the bottom of the system over time.

The choker course layer is often the most misunderstood layer in porous pavement applications. The design for Beach Road used a 1 inch to 1.5 inch maximum application course of three-fourth inch of 100% crushed stone installed carefully on the vibratory rolled reservoir course.

The choker course is then vibratory rolled until the reservoir layer and choker course layers are locked in place. The result is a stable platform that does not rut or displace when the asphalt trucks are backed up to the paving hopper or when making turns.

This design contrasts with most guidance that calls for 4 inches or more of choker course.

Those in the industry of road building understand that this will rut easily and result in inconsistent asphalt thickness and density.

Optimum stability was found after two or three passes of vibratory rolling. This resulted in 70% to 80% of exposed stone consisting of the three-fourth inch stone choker course and 20% to 30% of the larger reservoir course stone is exposed.

With traffic volumes in the corridor reaching nearly 9,000 vehicles daily, a heavy-duty asphalt design was also required.

The open-graded base/binder course consisted of a single 7.5 inch loose lift utilizing a polymer modified (PG64-22 ER at 2.5% AC content) asphalt binder compacted to 6 inches with a target density of 128 pounds per cubic foot.

The top course asphalt mix consisted of 0.6% cellulose fibers, uniformly graded stone and a polymer modified (PG76-22ER at 5.9% AC content) asphalt binder.

Placed at a loose lift of 4 inches, the top course compacted to 3 inches with a density of approximately 133 lb./CF. In total, 2,100 tons of top and 3,800 tons of base/binder were placed.

While the numerous quality control procedures developed are important, temperature is the most influential metric in the installation of porous asphalt whether it is production, transporting, placement or finishing. Nowhere in the process should temperatures exceed 295 degrees Fahrenheit.

Adding fibers to the top course combined with a 290 degrees Fahrenheit mix temperature reduced asphalt draindown to less than 0.04%. Draindown is the undesirable process of the asphalt binder separating from the stone aggregate. This “draining down” results in less film thickness, reduced adhesion, and overall reduced integrity of the pavement.

Porous asphalt retains a unique characteristic when compared to conventional asphalt in that it holds heat well, but also disperses heat well. The asphalt layer, after placement, will tend to cool quickly on the surface due to the air voids and increased surface area exposed to the ambient air temperature on top and the aggregate from below.

On the contrary, in the center of the lift, these same air voids provide an insulating effect that helps hold the heat.

Thinner sections of porous pavement have the potential to cool too quickly and not achieve peak density. The recommended minimum lift thickness for asphalt top course is 4 inches when paved directly over aggregate courses and 3 inches when installed on a porous asphalt base/binder course.

Utilizing a double steel drum 10-ton asphalt roller on static mode, rolling temperatures generally are 250 degrees Fahrenheit (surface temperature) for the initial rolling with three additional passes between 250 degrees Fahrenheit and 150 degrees Fahrenheit.

The critical final rolling temperature range, where peak density has been consistently achieved, is between 110 degrees Fahrenheit and 140 degrees Fahrenheit. Density spikes of between 3 to 5 lbs/CF can be expected in this range. There are also special procedures for paving porous asphalt in cold weather and when unexpected rainfall occurs.

In reservoir course placement, the 100% fractured stone courses are crtical to stormwater storage, structural support, and in-place density of the porous asphalt.
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The specifications, process, and quality control procedures were further refined as part of the $7 million project where the New York State Department of Environmental Conservation (NYSDEC) reconstructed the Lake George Beach Day-Use Area facility, which was designed by B&L.

The project site, located adjacent to Beach Road, included more than 7,100 tons of HD porous asphalt encompassing approximately 4 acres of the 10-acre facility.

While concrete, stone, asphalt, and other materials were hauled along Beach Road to the NYSDEC site, the pavement system performed as expected and was monitored for deflections or pavement distress; none was found.

The performance in this situation, and the stability in the stone course design, provides a strong indication of the structural stability that can be obtained with a design that utilizes 20% to 40% air as a component.

Additional scientific testing of porous asphalt systems is underway at Rowan University in New Jersey, with the construction of two full-scale porous asphalt systems that were constructed in the fall of 2023 and will be highway traffic load tested in the accelerated loading facility in 2024.

Stormwater runoff is the number one source of pollutants entering Lake George. By implementing porous asphalt, the runoff is collected, and contaminants are trapped and treated.

Traffic operational upgrades include improved wet-weather roadway traction, elimination of hydroplaning, reduction in the build-up of ice, reduction in road salt usage, elimination of drainage grates, and the elimination of frost heave and subbase saturation that leads to pothole formation and pavement deterioration. **R&B**

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