Holey Success

By Deodat Budhu, PE

About 10 years ago, Orange County, Fla., began to pave its dirt roads with porous asphalt, expecting them to last only a few years. Instead, most are still in use, saving the county money, eliminating equipment, and reducing maintenance.

Orange County is one of the fastest-growing urban areas in central Florida. More than 2500 lane miles—ranging from seldom-traveled rural byways to unpaved enclaves in urban areas—serve the county's 1 million citizens. Until 1997, more than 220 of these miles were high-maintenance dirt roads that literally bogged down traffic during rainy season and kept a fleet of seven motor graders constantly moving during dry season.

The challenge for the Orange County Roads and Drainage Division, which maintains the roads, was to find an affordable way to pave them.

Gravel roads require a lot of maintenance, which the division was trying to eliminate. Conventional paving was the ideal solution, but too expensive; it would cost $250,000 to $500,000 per lane mile, depending on right of way and drainage issues. In 1997, the county could afford to pave only 3 to 5 miles per year; and at that rate, it would take more than 45 years to complete the project. In addition, conventional paving would raise major stormwater permitting issues. Several roads didn't have enough right of way to construct conveyance systems, and the division couldn't afford designing and permitting the systems anyway.

Porous asphalt, however, circumvented all these issues. Porous pavement allows water to seep through the pavement and into the ground, eliminating the need for stormwater conveyances. And it was affordable: It would require less permitting and less raw material than conventional paving (to see a cost comparison between conventional paving and porous pavement, click here).

The division initiated infiltration and permeability tests to verify that the pervious pavement runoff coefficient was equal to or less than that of the existing dirt roads. The two local water management districts that required this information, St. Johns River Water Management District and South Florida Water Management District, would approve all permits as long as the pavement wouldn't be seal-coated and roads wouldn't be re-aligned.

In addition, the division had to:

- Minimize wetland impacts (separate dredge-and-fill permits are required when proposed roadwork will negatively affect wetlands).
- Leave existing drainage systems as-is. In addition, peak discharge rate for the affected areas could not be significantly increased.
- Excavate detention swales on both sides of the pavement (if possible) to provide temporary storage of water during rainy season.
- Connect the detention swales to the outfall system using pipe culverts or overflow weirs.
- Agree to not add lanes to existing roadways.

Once the division showed its porous-pavement proposal would meet all these requirements, the county's mayor and board of commissioners approved more than $11 million in funding over the course of eight years (see Short and Sweet for a breakdown of annual costs).

**Phase II: Construction**

Orange County's porous pavement consists of open-graded aggregate (#57 stone) bound by asphalt emulsion, placed on stabilized dirt roadways. The roads were prepared in two phases (to learn how Orange County decided on what roads to pave, click here).

First, they were graded to proper dimensions and to allow for adequate drainage. They were constructed to a minimum standard width of 18 feet with appurtenant drainage—usually roadside swales and ditches.

The second phase entailed ensuring that the road acted as a prepared base and subbase. Various materials were mixed into the road; in Florida, these include sand, shell, limestone, asphalt millings, and crushed concrete.

Since these roads were already compacted by ongoing vehicle traffic, only minimal compaction was required. The roads were then strengthened with an additional 3 to 6 inches of materials prior to cold-mix pavement.

A cationic emulsion system was used to construct the pavement mix design. The emulsion was kept at medium setting and latex modifiers were used to increase the aggregate's binding quality. The aggregate was mixed with the emulsion in mobile pugmill pavers and placed in a 3-inch lift by local pavement contractors.

In-house staff compacted the road to a finished depth of 2½ inches. They then rolled it so the aggregates weren't crushed and so that no creeping was left in the pavement. Blot sand was used to prevent the tracking of the emulsion. The roads were opened to traffic within an hour or two after compaction.

**Driving Forward**

Though Orange County learned from the planning, permitting, and construction of paving these roads, challenges popped up along the way, including the need to obtain the proper right of way to ensure permit requirements were met, and to establish a database of all roads, regardless of pavement type.

As the project neared completion, preparing the roads became more complicated. Some had been off the right of way for years and trees had grown into them. Since permits kept the county from realigning the road, some had to be paved outside the right of way—and property owners complained. As a result, the county is obtaining the proper rights of way for all new paving projects.

In addition, though the water management districts didn't allow large-scale development along the pervious roads, they permitted single-family homes. Rapid growth increased the number of permits issued along the
roads, making them similar to subdivision streets. Eventually, they'll have to be re-paved.

The paved roads also made it easier for commercial traffic to move in and out of the area, which in turn generated even more commercial development—and more traffic. Several roads have suffered severe damage due to high truck volumes.

In all, about 40% of the roads show some deterioration. The worst have been repaved with conventional resurfacing. The rest—approximately 130 miles—will be replaced with conventional pavement over the next two years, prioritized by the severity of their deterioration.

At its age, the porous pavement behaves like impervious pavement due to the buildup of sediment and small rocks. Luckily, both water districts have allowed the county to overlay the roads without additional permitting, as long as it doesn't add lanes or alter existing drainage conditions.

To resurface the roads, the division is using flex pave, which is similar to cold-mix asphalt and can be made by any paving company. Flex pave is a dense-graded cold-mix pavement surface course designed to be laid in thin lifts. This is achieved by using smaller aggregate than porous paving methods, emulsified asphalt, and a portable mix plant in conjunction with traditional lay-down and compaction equipment. Typically, flex pave is laid down with 1 to 1½ inch lift thickness. Flex pave varies from $6 per square yard for a 1-inch-thick layer to $10 per square yard for a 2-inch layer.

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Porous perks

Porous pavement has three major benefits:

- This mix allows water to infiltrate at a much greater rate than existing dirt roads
- It enables excess runoff to migrate to its edges and into existing drainage systems
- The percolation and clean surface (cleaner than the dirt surface) results in less turbid runoff, and does not require the purchase of additional parcels for stormwater runoff detention/retention.