

by the Staff of the American Concrete Pavement Association

Concrete Overlays: A Proven Option

Despite a successful track record of projects extending back several decades, some public agencies and contractors have been hesitant to use concrete overlays.

This lack of confidence in concrete overlays has been based on a number of factors, including the misperception that concrete overlays are expensive or difficult to build.

The fact is that concrete overlays can serve as a cost-effective maintenance and rehabilitation solution for almost any combination of pavement type and condition, desired service life, and anticipated traffic loading, says Dale Harrington, P.E., one of the authors of the collaborative publication, *Guide to Concrete Overlay Solutions*, produced by the National Center for Concrete Pavement

Technology, seated at Iowa State University.

Experience has shown that well-designed and constructed concrete overlays can extend the life of existing pavements for an additional 30 years or more. Among the many states using concrete overlays are Colorado, Illinois, Iowa, Kansas, Minnesota, North Carolina, Michigan, and Oklahoma, to name a few.

Reasons to consider a concrete overlay solution include:

- Concrete overlays are not only a durable rehabilitation tool; they can also be a cost-effective maintenance tool. A wide range of overlay

thicknesses can be used.

- The existing pavement does not need to be removed for a concrete overlay to be placed. This reduces the cost of a concrete overlay, compared to reconstruction. The existing pavement can provide additional structural and load-carrying capacity.

- With normal concrete paving practices and careful attention to detail, concrete overlay projects can be completed as quickly and efficiently as any other paving method.

- Inch for inch, concrete overlays are one of the most cost-effective pavement alternatives; typically,



Gratiot Avenue in the Detroit metro area received a 4-inch-thick concrete overlay that was cut into 6- by 6-foot panels.

Concrete's Life-Cycle Cost Wins

Usually, when a county performs full-depth asphalt reclamation on a road, the prime contractor will place an asphalt overlay on the reclaimed base material. But in Freeborn County, Minnesota, the county decided to use a concrete overlay on the reclaimed base.

"We've done similar projects with bituminous overlays, so we figured it would work just as well — if not better — with concrete," says Susan Miller, P.E., Freeborn county engineer. "Concrete was very competitive on a lifecycle cost basis. It turned out to be to the county's advantage to select concrete for this project."

The existing 5.9-mile stretch of County State Aid Highway 46 was paved with 9.5 to 10 inches of full-depth asphalt on 2 inches of classified gravel.

When the county cored the road, inspectors found that the asphalt had stripped from its aggregate in the bottom. And teepee shaped cracks, 3-inches wide at the bottom, had opened up in the asphalt.

So contractors first milled off 6 inches of asphalt and hauled it away. Full-depth reclamation followed, by Progressive Contractors Inc. Three inches of virgin aggregate was added to strengthen the base. The reclaiming cutter passed through the existing asphalt, mixed it with the new aggregate, and cut into the old subbase.

When the base had been compacted and trimmed, PCI paved the road with 7.5 inches of



This concrete overlay was placed over a reclaimed asphalt base in Freeborn County, Minnesota.

concrete. Dowel bar baskets were placed in the wheel paths only. Joints were spaced at 15 feet on the 27-foot-wide pavement.

"With the concrete pavement, we could get our strength in the concrete and we didn't need to add as much aggregate base in the section," says Miller. "If we had used asphalt pavement, we would have had to add 7 or 8 inches more of aggregate, and that would have raised our profile — which would have been unacceptable because of right-of-way restrictions."

The actual cost of the new concrete road, as bid, was \$91,963 per year based on a 50-year design; the estimated cost of the road with a 12-inch aggregate base and an 8-inch asphalt overlay was \$100,007 per year.

they last longer than asphalt of the same thickness.

■ Concrete overlays are recyclable. Today's equipment permits overlays to be removed and reused as high-quality drainable base material for a future pavement.

There are a number of additional benefits of concrete overlays that are often not considered, says Leif Wathne, P.E., director of highways for the American Concrete Pavement Association. For example, since concrete pavements reflect more light than asphalt, nighttime visibility is improved and safety can be significantly enhanced.

Energy savings can also be realized along urban roadways and illuminated interchanges, since fewer/lower-power light standards are required to sufficiently illuminate the roadway. Finally, because of concrete's high reflectivity, concrete overlays can also be an effective strategy to mitigate urban heat-island effects, helping to lower the temperatures in our cities, lowering energy demand and improving air

quality in the process.

Bonded and unbonded

All concrete overlays are divided into two families: the bonded resurfacing family and the unbonded resurfacing family. The key difference is that with bonded resurfacing projects, the overlay depends on the underlying pavement — asphalt or concrete — to act in unison with the new pavement. The new pavement is designed to count heavily on the strength of the underlying structure. Bonded resurfacing projects require that the existing pavement be in fair to good structural condition.

But unbonded resurfacing projects treat the old pavement as stable base for the new overlay. So, in fact, unbonded overlays are often used to rehabilitate asphalt or concrete pavements that are in poor condition. Unbonded resurfacing projects do not require a bond between the resurfacing and the underlying pavement. Both bonded resurfacing and unbonded concrete

resurfacing can be placed on existing concrete pavements or on composite pavements where asphalt has been placed over concrete.

Care in design

Harrington says that when placing a bonded concrete resurfacing on concrete, it's very important to understand the characteristics of the existing pavement. "In temperature expansion and contraction, the new overlay needs to move with the underlying concrete," he says. "When the joints in the old pavement open up, you want the joints in the new pavement to open up. If not, it could debond and separate."

For bonded concrete resurfacing of asphalt pavements (previously called ultra-thin whitetopping), if the concrete moves more than the asphalt, the two may debond, Harrington says. "So we cut the concrete resurfacing into small panels, and if the concrete wants to move, it won't move very much, because the panels are so small."

“We have some concrete overlays on the freeway system that have served well for almost 25 years,” says Dan DeGraaf, P.E.

For an unbonded concrete overlay on concrete, engineers usually design a thin separation layer of debonding material — typically a 1-inch layer of asphalt — to be placed over the existing concrete. “We don’t have to worry about the two layers moving together,” says Harrington. “In Europe, they use a fabric as a bond breaker.”

Should you mill old asphalt before placing the concrete overlay? “You can mill it or not, depending on how bad the surface distortions are,” says Harrington. “You don’t want a lot of soft spots. Concrete doesn’t need a lot of underlying strength but needs uniformity. Milling is probably more important in bonded overlays, because it provides a more uniform cross section and it helps roughen up the surface, which improves the bond.”

Pioneering projects

Since the early 1970s, Iowa counties have been placing concrete overlays on both concrete and asphalt pavements, says Todd Hanson, P.E., concrete engineer in the Materials Department at the Iowa DOT. In 1979 and again in 1981, the state built 10-inch concrete overlays over full-depth asphalt on Interstate 80 in Adair County. “Both of those are still performing very well,” says Hanson.

Hanson cites a list of 17 bonded concrete resurfacing projects — most of them done by county agencies — between 1973 and 1990. Thicknesses ranged up to 6 inches on the interstate highway. In 1994, Iowa State University researcher James Cable, P.E., Ph.D., built a



Photo courtesy of Randy Riley, Illinois Concrete Paving Association.

The state of Illinois paved this concrete overlay on Interstate 70.

7.1-mile-long research project on Iowa 21 for what was called ultra-thin whitetopping, now bonded concrete resurfacing over asphalt. Featuring 65 test sections, the project featured concrete thicknesses ranging from 2 to 6 inches and panels cut in sizes ranging from 2-foot to 6-foot squares.

All 4-inch or thicker sections were in excellent condition after seven years. The practical minimum thickness of concrete turned out to be 4 inches placed in 4-foot- or 6-foot-square panels.

Now, the state of Iowa has some 8-inch-thick continuously reinforced concrete pavements that could be candidates for unbonded overlays, Hanson says. “Almost all the interstates we did from 1967 to 1976 were 8-inch CRC,” he notes.

The Michigan experience

“We have some overlays on the freeway system that have been

down for almost 25 years,” says Dan DeGraaf, P.E., executive director of the Michigan Concrete Paving Association. He lists a 1983 project on Interstate 96 between Grand Rapids and Lansing, one on U.S. 23 near Ann Arbor, and a demonstration section placed in the early 1990s on U.S. 10 between Bay City and Midland.

In 1998, the state of Michigan ruled that its engineers must run a lifecycle cost analysis between concrete and asphalt for all new repair projects. “Since then, the concrete overlay has been the dominant winner when there is any appreciable traffic involved,” says DeGraaf. “Since that law passed, Michigan has built at least a dozen concrete overlay projects. On the freeway, the dominant fix is an unbonded concrete resurfacing, typically 6.5- to 7.5-inches thick with an asphalt interlayer.”

DeGraaf says the Detroit metro area has hundreds of miles of deteriorated 40-year-old concrete pavements and other concrete roads that have been overlaid with asphalt and need work. “So we’ve taken the concept of thinner sections and shorter joint spacings and applied them as unbonded overlays,” says DeGraaf. “We’ve done many miles of those since 2000. Typically, they’re 4-inches thick and cut in 6-foot squares. We’ve combined the two designs and it’s working very well.”

Frequently, in Michigan, the agency has placed a 4-inch asphalt overlay over the concrete. “If you



A crew from Manatt’s places a concrete overlay on U.S. 71 in Montgomery County, Iowa.

“Over more than 20 years, we have more than 20 projects that are performing well,” says Doug Schwartz, P.E., Minnesota DOT.

try to mill off 3 inches, the whole thing comes up, so usually, we just mill off the asphalt, put down the new asphalt interlayer, and apply the concrete overlay,” says DeGraaf. “Usually, these are curb-and-gutter sections where you want to go back to the same elevation for the final surface.”

Wayne County, Michigan, gets the credit for pioneering the thin unbonded resurfacing projects, DeGraaf says. After Wayne County did three or four of them, the state of Michigan observed their success and decided to follow suit with an overlay on Gratiot Avenue in the summer of 2005. It was a 3-mile by 9-lane-wide project with almost 200,000 square yards of concrete, 350 manholes, and approximately 45 intersecting streets.

Lower cost

Local agencies in Michigan have done eight thin unbonded resurfacing projects like Gratiot Avenue. “It’s a combination of the thin bonded overlay with the thicker unbonded technology,” says DeGraaf. “We combined them and made it a thin unbonded section.” He says the shorter joint spacing of



This project in Delaware County, Iowa, is called a “reverse Oreo cookie” because asphalt is sandwiched between two layers of concrete.



Photo courtesy of Randy Riley, Illinois Concrete Paving Association.

Placing a concrete overlay on Interstate 70 in Illinois.

6-foot squares makes the 4-inch-thick sections work.

“This pavement does handle heavy truck traffic fairly well,” says DeGraaf. “But the best thing is the cost. It’s always been close to asphalt, and this year, our 4-inch concrete overlay is less expensive than asphalt when they use Superpave. We used to say we last twice as long but cost 10 to 15% more than asphalt; now we say we cost 10 to 15% less and still last twice as long!”

What’s more, cities and counties in Michigan have built 32 bonded resurfacing projects on asphalt since 1996. “The city of Grand Rapids has done 17 of the 32,” says DeGraaf. “Wherever they have a problem with rutted asphalt at intersections, they use whitetopping. They have really embraced

that technology.”

Proven in Minnesota

“We’ve been doing unbonded concrete resurfacing projects for slightly more than 20 years, and I would say we have more than 20 projects that are performing well,” says Doug Schwartz, P.E., concrete engineer with the Minnesota DOT. “Concrete overlays are our standard way of doing things.”

Schwartz points out that overlay construction never exposes the underlying subbase soil to rainstorms that can delay construction when doing remove-and-replace projects. Most of Minnesota’s concrete overlays are placed over concrete with a 1-inch interlayer of open-graded asphalt to act as a bond breaker.

And Minnesota now expects to get the same life from a concrete overlay as from a new concrete pavement. “Our first thought was that we’ll get 20 years out of these overlays, and that will be doing well,” says Schwartz. “But now, we think we’ll get the same number of years as new construction. We want to use methods that are most cost-effective. That’s why concrete overlays have been a Godsend.” BR

