

# PERPETUAL PAVEMENT:

## Structured for the Future



Just imagine it: Total pavement reconstruction, the remove-and-replace option, is rendered virtually obsolete. The only pavement rehabilitation needed would be surface replacement at about 20-year intervals.

With Hot Mix Asphalt (HMA), we have the technology to achieve just that. We call it Perpetual Pavement. The concept is not a new one. In fact, full-depth and deep-strength asphalt pavement structures have been built since the 1960s. Today, recent efforts in materials selection, mixture design, performance testing, and pavement design offer a methodology to obtain performances exceeding 50 years from asphalt pavement structures, while periodically replacing the pavement surface and recycling the old pavement material.

Perpetual Pavements have three distinct features: a rut-resistant and wear-resistant surface layer; a rut-resistant, durable intermediate layer; and a combination of adequate asphalt thickness and flexibility to resist deep fatigue cracking.

“Perpetual Pavement is engineered so that any distress that occurs is confined to the upper pavement layer,” explains David Newcomb, vice president for research and technology at the National Asphalt Pavement Association. “At some point in time, say, at about 20-plus years, you go back and mill out the surface and replace it with a new surface.”

Maintaining a Perpetual Pavement can be compared to maintaining a house or any other structure. The owner may choose to paint it, put a new roof on it, or add to it. With Perpetual Pavement, contractors can maintain and even enhance an aging pavement, rather than breaking it up and hauling it away to a landfill, because the original structure is still sound and has great value.

In addition, the process is environmentally friendly because the pavement material that is milled off is 100 percent recyclable. Recent research has shown that the asphalt pavement industry is the nation's number one recycler.

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## Building on a good foundation

The design begins with a good foundation upon which to construct the thick asphalt layers. The asphalt is thick enough to resist bending so that cracks do not form at the bottom of the asphalt section. This layer can be made even more resistant to cracking either through the use of a little more asphalt cement in the mix, creating lower voids, or through the use of engineered binders in that layer, to preclude the cracks from starting.

The intermediate layer of the structure has the quality of rut resistance. This layer can be designed to resist rutting, again through the use of high-quality aggregate and engineered binders.

The top surface layer is a renewable surface that can be designed for specific applications. In some instances, the use of a conventional dense-graded Superpave mixture is adequate. In very high-traffic areas, the use of Stone Matrix Asphalt (SMA) may be attractive, provided that the materials are available to construct it. And in some places, engineers may want to use an Open Graded Friction Course (OGFC) on the surface, to reduce splash and spray and to provide better skid resistance during rainstorms. Both OGFC and SMA also have the advantage of absorbing road noise.



## Research supports the concept

An excellent example of an existing Perpetual Pavement design procedure is the Transport Research Laboratory Report No. 250 by Nunn, Brown, Weston & Nicholls. (TRL is the leading transportation research institution in the U.K.) Nunn and his colleagues found that high rates of rutting were associated with thin asphalt pavements. Sections of more than 200 mm, or eight inches, tended to show a relatively slow rate of rutting. And in pavements thicker than eight inches, the rutting was confined to the top layer of the pavement. As a result, only surface work was required to correct the problem.

In thicker asphalt pavements, Nunn and his colleagues found that cracking did not start at the bottom and work its way upward. Instead, it occurred mostly in the surface course and went down. The result: a superficial, much less expensive repair is required. In short, the British team found that well-built, thick HMA pavements performed well.

“The most significant finding in this report is that there was no distress in the base – none – zero – zip,” commented Jim Huddleston, executive director, Asphalt Pavement Association of Oregon.

## Concept already proven over time

Researchers have discovered that in some locations, certain pavements have been functioning as Perpetual Pavements – and are performing very well. It’s useful to consider a study conducted by the University of Washington on a 300-mile stretch of Interstate 90 from Spokane to Seattle.

Over a range in age from six to 35 years, none of the pavements on I-90 have been rebuilt due to structural problems. In eastern Washington, which has a cold, dry climate, the asphalt layers in the pavements ranged from six to 14 inches in thickness. The time to resurfacing has averaged 12 years, using technology that predated the development of Superpave and the introduction of SMA to this country.

In western Washington, HMA pavements are thicker, because Seattle-area traffic is much heavier. Pavements are 14 to 19 inches thick and range in age from 23 to 29 years old. The average time to resurfacing was 18.5 years – again, using pre-Superpave technology. The second resurfacing has not occurred for these pavements.

The Baltimore Beltway in Maryland provides another good example. The average daily traffic (ADT) is 175,000 vehicles per day with 19 percent trucks. The pavement section comprises 11.5 inches of a strong base layer with large aggregate under 2.5 inches of a dense-graded mix topped by two inches of SMA with 3/4-inch top-size stone.

The total HMA pavement thickness of 16 inches will preclude any bottom-up fatigue cracking – and the choice of an SMA surface mix has effectively prevented any significant rutting. Observation after four years of performance shows that the pavement rutting was on the order of 1/8-inch.



Research funded by Flexible Pavements of Ohio examined pavement performance on four Interstate routes in the state. Proving that Perpetual Pavements have been in use for some time, the researchers found that the HMA pavements provided up to 34 years of service without the need for expensive rehabilitation or reconstruction. And an examination of life cycle costs for these roads showed that HMA pavements produced only small incremental increases in present worth as overlays were added.

### Advantages of Perpetual Pavement

“One obvious advantage of Perpetual Pavement is its lower life cycle cost,” says Newcomb. “It has a lower life cycle cost than conventional asphalt or concrete pavements.”

Mark Buncher, director of field engineering at the Asphalt Institute, puts it this way: “Building a Perpetual Pavement may have a slightly higher initial cost versus a conventional flexible pavement, but it still will have a significantly lower initial cost than a comparably designed Portland Cement Concrete (PCC) pavement section. By never having to reconstruct the pavement system and only having to replace the surface periodically, a Perpetual Pavement will have a lower net present value in any life cycle cost analysis when compared to a Portland Cement Concrete pavement.”

Moreover, HMA surface repairs are faster than any alternative. “You can mill and replace asphalt in an overnight process,” says Huddleston. “By contrast, base reconstruction can take years. The idea that people design pavement for 20 years and then have to rebuild it completely is a concept that has outlived its useful life. We have the technology to do better than that.”

State DOTs like the concept of Perpetual Pavements and they want to build them, says Huddleston. “The concept makes a lot of sense to them and it’s being well received,” he says. “Some DOT personnel are not yet comfortable with their level of knowledge of the Perpetual Pavement. The model we’re recommending, therefore, is that the DOTs team up with a uni-

versity, representatives of industry, or a recognized pavement expert to come up with a design, a set of specifications that will work.”

At the Illinois Asphalt Pavement Association (IAPA), Marvin Traylor, director of engineering and research, is very enthusiastic about Perpetual Pavements. “The advantage of a Perpetual Pavement is that you can take care of it from the top,” says Traylor. “You don’t have full-depth patches, and you don’t have barricades that are left up for weeks at a time.”

“You never have to shut down your lanes during rush hour,” says Traylor. “You can mill off the surface at night, put a new surface down, and open it up. And we wouldn’t have these terrible bottlenecks that we have in urban areas because the concrete is being reconstructed. You’re not interrupting traffic and your costs are much reduced because you’re simply taking off two inches and putting back two inches of HMA.”

In Illinois, Traylor says a joint task force of the state DOT and IAPA worked together to develop a long-life asphalt pavement design procedure. “The committee developed a specification and cross-section for extended-life Hot Mix Asphalt pavement,” says Traylor. “And the industry in Illinois looks forward to having a contract to demonstrate its ability.”



Traylor says what he's really excited about is the potential to use the Perpetual Pavement concept to rehabilitate old Portland Cement Concrete pavements. He says most of the Illinois DOT's money is being spent for reconstruction and rehabilitation, not for new pavements. "The Perpetual Pavement concept works not only for new construction, but it also eliminates the need for reconstruction, because you take the concrete pavement, rubblize it, and put the same full-depth asphalt concept on top of that," says Traylor. "You start with a rich bottom mix, select aggregate properties to prevent striping, and top it off with an SMA. And we have a mechanistic design for rubblizing and overlay work."

Putting a Perpetual Pavement over cracked-and-sealed concrete is exactly what they're doing in southern California, where a Perpetual Pavement is being built on the Long Beach Freeway, Interstate 710, in 2001 and 2002. The existing concrete pavement will be cracked and sealed and then overlaid everywhere, except at overpasses. To maintain clearance under bridges, the concrete and base at those locations will be removed and replaced with full-depth asphalt.

The full-depth sections under bridges on the I-710 project will consist of a total thickness of 13 inches of HMA. The top layer will be an open-graded surface course over three inches of a rut-resistant mixture containing an engineered binder. The next-down HMA layer will be a 6-inch-thick dense-graded mix made with a relatively stiff binder. And the bottom fatigue layer will consist of a 3-inch binder-rich mixture.

The cracked concrete will be overlaid with five inches of dense-graded mixture, followed by a 3-inch rut-resistant layer, and the overlaid PCC sections will have an open-graded surface mixture.

Although Perpetual Pavements are a concept mainly aimed at high-volume roadways, the justification may be made for medium- and low-volume roads as well. "The concept is one that is applicable at all levels of traffic," says Newcomb. "You have to be cognizant of what a reasonable thickness is in order to get a Perpetual Pavement out of it. It's pretty evident that the thickness has to be greater than eight inches for the asphalt portion of the section."

#### Other advantages of Perpetual Pavement:

- They provide a consistently smooth and safe driving surface;
- Because they incorporate recycling techniques, they are environmentally friendly;
- The technology and knowledge to build them is proven.

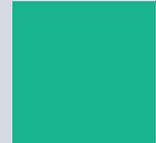
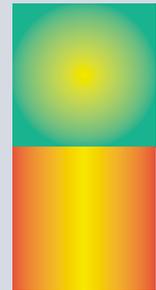
In summary, a Perpetual Pavement is designed to provide 50-plus years of life in the pavement structure with periodic surface renewal at about 20-year intervals. There is no reconstruction involved with a Perpetual Pavement.

#### Asphalt Pavement Alliance

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The **Asphalt Pavement Alliance** is a coalition of the Asphalt Institute, the National Asphalt Pavement Association, and the State Asphalt Pavement Associations.

The Asphalt Pavement Alliance's mission is to implement a unified, industry-wide plan that furthers the use and quality of asphalt pavements. The Alliance will accomplish this through engineering, research, technology transfer, education and innovation.