



# CENTERLINE

## EDUCATION

# Perpetual Pavement Concept Could Prove Economical for Low-Volume Roads



Adapted from "Perpetual Pavements for the Rest of Us," which appeared in *HMAT Magazine*, January/February 2005, with permission of the National Asphalt Pavement Association.

This is the first article in a 2-part series on long-lasting pavements for low-volume roads.

MUCH ATTENTION AND RESEARCH has been focused in recent years on the concept of "Perpetual Pavements" – those described by the Asphalt Pavement Alliance (APA) as built for long life without requiring major structural rehabilitation or reconstruction, and needing only periodic surface renewal in response to distresses confined to the top of the pavement.

In high-volume traffic applications, the Perpetual Pavement concept has proven successful not only for its ability to meet endurance expectations, but for its dramatically reduced maintenance and rehabilitation costs over the life of the pavement. That's great news, though a relatively low percentage of paved centerline miles in the U.S. (and elsewhere) qualify as "high-volume" roads. The majority (perhaps as much as 70%) could be classified as "low-volume" pavements, withstanding 25,000 equivalent single axle loads per year or less.

In an article appearing in the January/February 2005 issue of *HMAT Magazine*, **Dr. Stephen Muench**, Assistant Professor of Civil and Environmental Engineering at the University of Washington, points out that low-volume pavements are typically

rural roads or urban residential roads managed by agencies with very limited funds. At first glance, this group seems least able to afford the perceived costs associated with long-lasting pavement concepts. In reality, they can't afford *not* to consider them as an option.

**Lower maintenance and rehabilitation costs can result in significant savings over the life of the pavement structure**

Initial investment in long-lasting pavement construction for low-volume roads may exceed that of more "disposable pavement" structures – those which are thinner and more cheaply built. The lower maintenance and rehabilitation costs over the life of the long-lasting pavement structure, however, can actually result in significant savings compared to the disposable option, as well as much lower probability of failure.

In a technical paper on the subject, Muench and his research associates reported, "At worst,

the life-cycle cost of a long-lasting low-volume hot-mix asphalt (HMA) pavement can be about equal to that of a typical disposable HMA pavement. At best, the cost savings can possibly be as high as \$160,000 per mile of two-lane rural road over 50 years."

"For agencies with the least money to spend, the option of long-lasting pavements for low-volume applications warrants serious consideration," Muench said.

But how can it be accomplished? Current design methods for high-volume Perpetual Pavements are too complex and costly, and are generally unwarranted for low-volume applications, which have an entirely different set of demands to meet. In designing Perpetual Pavements for high-volume applications, for example, the focus is on limiting strains, constructing adequate thickness, and applying the proper surface course. For low-volume long-lasting pavement applications, success lies in careful subgrade preparation, more substantial structures, quality construction, and perhaps most important – a routine maintenance and rehabilitation plan. Muench notes that while proper construction is critical, mainte-

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# Perpetual Pavement – Continued

nance and rehabilitation issues may actually be the most likely culprits for failure of a long-lasting low-volume pavement, since budgets that fund these efforts are subject to changing political and economic climates over the life of the structure.

What we need is a new set of standards tailored specifically to low-volume, long-lasting pavement applications – standards that result in a structure substantial enough to meet the criteria of a long-lasting or “Perpetual Pavement,” while remaining economically attractive over the long term.

In attempting to identify characteristics of successful long-lasting low-volume pavements, Muench and his colleagues conducted a study of low-volume roads in Washington State, known for its effective pavement management system. They found that 78% of the paved centerline miles classified as low-volume under the care of the Washington State Department of Transportation were more than 35 years old, and judged to be in good condi-

**“We are in the early stages of gaining support, and need help from industry to continue with further development.”**

Dr. Stephen Muench

tion, with an average International Roughness Index of about 150 inches/mile.

“Many jurisdictions have been applying this (long-life/low-volume) concept for years,” said Muench, “they just didn’t have a name for it.”

While there are yet to be any official standards for construction of long-lasting pavements for low-volume roads, Muench and his colleagues offer the following as possible guidelines:

- 1) Pavement thickness must be deep enough to prevent at-depth initiation, or bottom-up fatigue cracking.

- 2) Pavement thickness must be adequate to allow periodic surface renewal using milling machines without damaging underlying layers.
- 3) Future traffic must be somewhat predictable, as these pavements are not designed for infinite traffic loading.
- 4) Adequate subgrade strength and preparation are essential.
- 5) Timely maintenance and rehabilitation are essential.
- 6) Quality construction is essential.

“We have a concept that needs development,” said **David Newcomb, P.E., Ph.D.**, and vice-president of research and technology for the National Asphalt Pavement Association. “We need education at the local level on how to construct roads that last, and to foster realization that this is the responsible thing to do,” he added. Newcomb noted that training courses have begun in order to educate departments of transportation, city engineers and consultants on Perpetual

Pavements for low-volume roads. But it is difficult, he said, to reach people in 3000 counties across the nation.

“Ideas for this concept are currently flowing from the bottom-up,” added Muench. “We are in the early stages of gaining support, and need help from industry to continue with further development.”

To learn more on this topic, request the technical paper written by **Joe Mahoney**, Steve Muench, **Linda Pierce**, **Nadarajah Sivanewaran**, and **George White**. It is available from the National Center for Asphalt Technology via e-mail request: [tapplecp@eng.auburn.edu](mailto:tapplecp@eng.auburn.edu).



*NEXT ISSUE: Learn more on the specifics of designing long-lasting, low-volume roads.*



## BITS & PIECES



### New Site Promotes Quiet Pavement

The Asphalt Pavement Alliance recently announced the launch of [quietpavement.com](http://quietpavement.com) – a website designed to provide an interactive learning experience on the impact of road noise in our lives, and promote the use of hot mix asphalt as a method for reducing road noise.

In “Sound Town,” visitors can construct a virtual neighborhood, and by positioning various ele-

ments on the landscape, discover how paving material, trees, buildings, noise walls and proximity affect the road noise we hear in our homes. Other areas of the site teach visitors about how the human ear works, how noise is measured, and the relationship between noise levels and distance from the source.

The site even includes a “History of Road Noise” timeline dating to 44 B.C., when **Julius Caesar**

declared the first documented noise regulation, banning wheeled vehicles from the city “between sunrise and the hour before dusk.” A learning center area provides case studies, research and other resources. Learn more at [www.quietpavement.com](http://www.quietpavement.com). ▲

## MISSION STATEMENT

The Asphalt Pavement Association of Oregon, Inc., (APAO) is dedicated to promoting the use of asphalt concrete by developing customer driven programs to enhance quality and excellence in all aspects of asphalt technology. We believe that the key to growth and prosperity in the industry is continuous quality improvement obtained through active association membership, positive customer relationships, education, and training.

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## APAO NEWS

# Annual Meeting Provides Industry Insight, Recognizes Current and Future Leaders

OREGON'S ASPHALT INDUSTRY convened in downtown Portland for the Asphalt Pavement Association of Oregon's (APAO) 35th Annual Meeting December 2-3, 2004. The program featured, among others, **Bruce Warner**, director of the Oregon Department of Transportation (ODOT); **Jessica Harris Adamson**, legislative affairs manager for Associated General Contractors; and **Tom Potiowsky**, Oregon's State Economist.

An evening dinner and awards program marked the close of the two-day event. Highlights included introduction of APAO's new board of directors, presentation of scholarships, and recognition of companies for environmental stewardship by the Department of Environmental Quality (DEQ).

The DEQ recognized five APAO members for exceeding local DEQ requirements to earn the National Asphalt Pavement Association's (NAPA) Diamond Achievement Commendation. Recipients included Baker Rock Resources, Lakeside Industries, Morse Bros., Inc., Salem Blacktop and Asphalt Paving, and Road and Driveway Co.



Scholarship recipients **Kevin Linderman** (l) and **Corey Westermann** (r) with **Gary Baker** of Baker Rock Resources

When asked what it takes to earn a Diamond Achievement Commendation, **Mike Walling**, operations manager at Salem Blacktop and Asphalt Paving, described it not only as an opportunity to do the right thing, but as a chance to improve relations between industry and the public.

"When we constructed our new plant in downtown Salem, we wanted to do it right," Mike explained. "We recognized it as an opportunity to be a good neighbor, and it has paid off. We set high standards for ourselves, and the compliments we receive for those efforts are a real morale booster for our employees."

The evening's program recognized future industry leaders as well, in the way of scholarships awarded to Oregon college students studying civil engineering or construction-related fields. **Gary Baker**, of Baker Rock Resources, presented two \$1200 scholarships – one to **Corey Westermann**, a 5th year civil engineering student at Oregon State University (OSU), and another to **Kevin Linderman**, a senior studying construction engineering management at



Scholarship recipients **Jason Wuertz** (l) and **Christopher Goins** (r) with **Jim Huddleston** of APAO



The Salem Blacktop and Asphalt Paving plant earns compliments for being a good neighbor with high standards

OSU. **Gary A. and Dal L. Baker** scholarships are made possible by NAPA and an endowment from the Baker family.

APAO executive director **Jim Huddleston** also made two \$1200 scholarship presentations on behalf of the organization, which established its own program in 1999. Recipients were **Christopher Goins** and **Jason Wuertz**, both seniors in the civil engineering program at Oregon State University. ▲

## 2005 Board Members

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## PAVEMENT DESIGN

# Test Track Charged with Validating New Design Process



*Trucks loaded with steel plates make the rounds at the NCAT Test Track. Total vehicle weight is approximately 152,000 lbs., or about double the legal load limit for highways.*

AFTER TWO YEARS AND 10 MILLION equivalent single axle loads (ESALs), the test track at the National Center for Asphalt Technology (NCAT) was divided into three areas for a second cycle of testing. The first area consists of 14 test sections, each milled and inlaid with different HMA mixes for rutting evaluation. The second area includes eight structural sections, milled deep and reconstructed to facilitate instrumented experimentation. The

third area contains 24 test sections that were untouched after the first testing period, and will endure another 10 million ESALs over the next two years, potentially leading to identification of high-traffic pavement candidates and evaluation of durability issues.

The eight structural sections are of particular interest for their potential to further the shift from empirical to mechanistic-empirical (ME) design and analysis.

“Current design methods are based on AASHTO equations,” said **Dr. David Timm**, assistant professor of Civil Engineering at Auburn University. Those equations were developed based on field testing that was performed more than 40 years ago with a very limited set of variables, and may no longer be valid.

“The (mechanistic-empirical) method is a change in analysis

and design relying more on mechanics rather than solely statistics, and allows more conditional variables to be introduced (while achieving predictable results). It is a lot more adaptable to changing conditions,” Timm added, noting the difficulties state DOTs are having incorporating Superpaves, stone matrix asphalts, and open graded friction courses using existing equations.

It is anticipated that performance data gathered from these eight test sections can establish the empirical relationships – or transfer functions – between pavement response and pavement performance, providing the link between empirical and mechanistic aspects of modern pavement design.

“A new mechanistic design procedure has been developed, but little roadwork has been done to validate it,” said **Dr. Ray Brown**,

NCAT director. “We are hoping to provide some initial validation of this new procedure, resulting in a much more rigorous analysis during the design process.”

The eight test sections involved in the structural experiment have instrumentation arrays consisting of strain gauges, pressure plates and compression sensors to measure pavement response under moving loads. “We’re measuring stress and strains,” said Brown. “We can see what the strain levels are and determine performance over time.”

Brown emphasized the importance of understanding that this is a new pavement design procedure. “The research is almost complete, and within the next few years the process will be implemented by states. The process must be fully validated before that time.” ▲