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Grants Help State Agencies
Improve Highways with
New Construction Techniques

By Sheryl S. Jackson

SOME AGENCY OFFICIALS may wonder if they should invest in new paving techniques that provide safer, faster and more economical construction – but how, then, to justify funds for new techniques that are not yet fully tested?
The “Highways for L.I.F.E.” (HFL) program provides grant money to help states build highways and bridges faster using new technology. While some of the techniques used in projects awarded grants have been researched and may have been tested in small, local projects, the HFL grant monies provide an additional source of funding that encourages innovation.

“The HFL program focuses on making highways safer and longer lasting, using construction techniques that build them faster while minimizing work zone congestion,” says J. Richard Capka, FHWA administrator. He says the key to improving roadway construction is getting designers and builders of the nation’s highways to use new products, methods and technologies in general that are proven but not yet universally embraced by the highway community.

While HFL is not a research program, there are a number of research projects related to concrete construction for which HFL grants will serve as a practical way to advance pavement construction technology, according to Tom Cackler, P.E., director of the National Concrete Pavement Technology Center (CP Tech Center). It can be risky for states to use their funds to try new technology as a demonstration project, he points out.

Shrinking budgets and increasing demands for new roads or improvements to existing roads don’t leave much room to test new construction techniques. “HFL grants that fund or match existing state funds for projects that use innovative techniques give state DOTs an opportunity to take advantage of new technology,” he says. The added benefit is the information gathered during and after the project to improve upon the technique and promote it to other states.

HFL grants announced in October cover a range of projects including bridge replacements and roadway rehabilitation. Concrete overlays and pre-cast concrete slabs are two technologies that meet HFL’s goal of improving roadways at a fast pace while maintaining safety and reducing traffic interruptions.

North Dakota will receive $1 million to help rehabilitate a section of US 2. The project will use a concrete overlay placed over the existing asphalt surface. Construction time for this section of the road will be reduced by 40 percent compared to traditional methods.

**Modular Construction Keeps Delays to a Minimum**

While pre-cast concrete has been used inbridge construction for many years, modular concrete pavement construction, which uses pre-cast concrete slabs, is less common, and existing projects using modular construction are only used on straight sections, says Charlie Goodspeed, Ph.D., P.E., director of the New Hampshire Local Technical Assistance Project Center for the New Hampshire DOT and an associate professor of civil engineering at the University of New Hampshire. Because pre-cast concrete slabs are produced in a factory in a controlled environment, the slabs meet a consistent, high standard that is hard to replicate on-site. “I am not saying that cast-in-place projects are designed to lower standards, but it is harder to control the environment on site,” he explains.

The greatest advantage to prefabricated slabs (like the ones that will be used in an HFL project in New York for approach slabs to bridges) is that work can be done in less time, with less disruption to traffic. The project in New York will be placed at night to limit traffic flow interruptions and lane closures.

“There are still a number of questions to answer,” says Goodspeed. How to best demolish existing pavement, how to stabilize the base to handle the weight of the slab and expected traffic, what types of joints are best to use and how to finish the surface to provide the highest level of safety are just a few of the questions Goodspeed cites. Current research suggests a variety of answers, but the best way to determine the effectiveness of each approach is to test them in real-world situations.

Pre-cast concrete slabs don’t have to be flat, straight modular units. “We have the capability to do super-elevated curves and double curvatures,” Goodspeed points out. “You can also connect modular concrete units to existing concrete or asphalt roadways.”

Obtaining pre-cast concrete will not be an issue for any DOT or contractor, Goodspeed continues. “Because pre-cast concrete has been used in bridges and other forms of construction, there are concrete casting plants all around the country. This is also not a technology that will require a significant change for most contractors.”

**Two-Lift Technique is Economical**

Using pre-cast concrete in a new way is one innovation for concrete pavement construction; returning to a technique used in the early days of interstate construction is another.

When a team of engineers and other pavement experts visited Europe in 2006 to conduct a Long-Life Concrete Pavement Scan of European highways to learn more about design philosophies, materials requirements and construction practices used to build long-lasting roads, team members discovered that two-lift concrete pavement construction has been attracting some interest.

Two-lift concrete construction relies on the use of two different levels and types of concrete. Recycled or other relatively economical aggregate is used in most of the lower portion of the concrete slab, while the highest quality aggregate is used in the upper lift.

The CP Tech Center’s Cackler describes that this approach not only represents a significant cost-savings, but...
also allows agencies to improve surface quality. Such improvements will reduce noise, reduce maintenance requirements and yield a better ride quality.

Engineers and contractors heretofore avoided two-lift concrete construction for several reasons, notes Cackler. “There was no emphasis on recycling materials, and it was much easier to use one plant and one paver to place the material. Two-lift construction does require the use of two plants, or one plant that can switch back and forth between materials. It also can require minor re-tooling of equipment.

“As projects are announced and begin construction, open houses will be held for state DOT representatives and members of the concrete industry,” Cackler concludes.

**HfL, ACPA Share Same Goals**

The American Concrete Pavement Association (ACPA) supports Highways for L.I.F.E. for a variety of reasons, according to Leif Wathne, P.E., director of highways for ACPA. “HfL goals are to build and rehabilitate highways in a safer, faster, better way that presents as little imposition on the driving public as possible,” he says. “These goals are in line with ACPA’s goals, especially the emphasis on long-lasting pavements.

“Highways for L.I.F.E. presents an opportunity for our industry to spotlight the importance of concrete in projects that do qualify for HfL grants,” Wathne says. “As an organization, we can support research of innovative techniques, and we can help state agencies learn more about HfL and the funding opportunities that may exist for some of their upcoming projects.”

Publicizing innovations and providing funding to encourage use of these innovations is a key focus of Highways for L.I.F.E. “Success of HfL will dramatically improve the driving experience for Americans,” says FHWA Administrator J. Richard Capka. “To do this, we must shorten the time it takes to get innovation from the lab to practical application.”

**Log On**

For more information about Highways for L.I.F.E., visit www.fhwa.dot.gov/hfl/. The Web site includes a toolbox of innovations and technologies, information on grant applications and descriptions of more than 40 success stories that illustrate the use of innovative techniques.

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Getting Creative with Concrete Paving

Colors and Stamped Designs Improve

By Sheryl S. Jackson

AN INTERESTING PHENOMENON is sweeping the nation as a growing number of cities, towns and other jurisdictions are discovering the advantages of colored and stamped concrete pavements.

Driving the trend is the replacement or revitalization of areas, which typically involves reconstruction or rehabilitation of the infrastructure, including streets, roads, crosswalks, sidewalks and more.

With the ability to color, stamp and etch concrete to match architectural features of old buildings, designers can now use concrete in more ways than possible in the past. But the trend extends far beyond just matching features, as planners and other stakeholders are discovering that decorative concrete adds charm, personality and vibrancy to virtually any area.

“Colors and designs stamped into concrete make roads and other structures more aesthetically pleasing,” points out Scott Haislip, director of streets and roads for the American Concrete Pavement Association (ACPA). “We are seeing the techniques used more often because they soften the hardscape and enable designers and engineers to match roadway design to the surrounding architecture, especially in a downtown setting.”

Decorative concrete techniques such as coloring, etching, staining and stamping have been around for many years, but popularity is growing for this and a number of other reasons.

“We have an old infrastructure that is reaching the point that revitalization is a priority, and concrete roadways are part of that revitalization,” Haislip notes. “The capability to make concrete a design element as well as a functional part of a renovation gives engineers and designers more options than previously existed.”

University of Wisconsin – Madison
The city of New Castle, Penn., was an inaugural winner of ACPA’s Main Street USA award for innovative use of concrete as a key component of a downtown redevelopment project. The city used colored concrete in downtown streets to complement and tie together architectural components of the redevelopment project.

Colored concrete also was used in a project in Minnesota to soften the appearance of a bridge connecting a residential and a shopping area. The colored concrete used in the bridge, as well as in retaining walls and walkways, made the project a part of the landscape rather than an intrusion.

Coloring concrete does not require an increase in labor, but attention to detail is still necessary, says Haislip. “There are a number of ways to color concrete.”

The most important requirement is consistency, especially if you use different batches of concrete. “More water in one batch will make the color lighter,” he explains.

According to Haislip, there are two basic methods of adding colorants to concrete. Concrete that is integrally colored has the color actually mixed throughout the concrete, but it also can be colored by broadcasting a darker color on top of the concrete surface. The type of coloring process used is determined by the parameters of the project, with size of area, type of traffic, cost and performance expectations all taken into account.

Stamped concrete can look like stone, brick or cobblestone, depending on the

Award-winning project in Overland Park, Kan.
appearance needed for the renovation, says Haislip. “In Las Vegas, acid etching techniques result in clouds appearing on sidewalks.”

Haislip notes that stamping concrete requires special equipment and is relatively labor-intensive, but he is quick to add that it offers many intrinsic benefits. He adds it’s important to ensure contractors mix the concrete well and that employees are well-trained in the process.

Decorative Concrete Perfect for Roundabouts

“Roundabouts are also becoming increasingly popular as one way to keep traffic moving through downtown areas,” says Haislip. Known as traffic-calming devices, roundabouts are popular sites for colored concrete. Often, stamped concrete that simulates stone or brick not only softens the appearance of the roundabout intersection, but also helps keep traffic moving in the right direction.

Roundabouts differ from traditional traffic circles because they require a circumference of no more than 180 feet, while traditional traffic circles are larger, allowing vehicles to travel at greater speeds. Because roundabouts are smaller, speeds are lower, which improves safety at these intersections without impeding traffic flow. Roundabouts also can be built at intersections that require upgrades but don’t have extra space for multiple new lanes.¹

A roundabout in Muskegon, Mich., was part of another project recognized with a Main Street USA award in 2006. Haislip notes that colored concrete in a star pattern not only makes the roundabout attractive, but also clearly marks the roadway, increasing safety on the road.

The greatest benefit of using decorative concrete in a project is that the stamping, etching or coloring techniques do not diminish the durability of concrete. As Haislip says, “It is still concrete, and it will last just as long as concrete that is not colored or stamped.”

Quiet Zone

Tire/Pavement Noise Battle Goes High-Tech

By Sheryl S. Jackson

WITH 1,735.4 BILLION vehicle miles of travel predicted by the Federal Highway Administration for 2007\(^1\), it is no surprise that noise reduction is a factor in pavement selection on urban highways and roadways.

\(^1\)Source: FHWA July 2007 Traffic Volume Trends report
“Europeans began addressing noise issues in the early 1990s, but today, noise is a major issue for them,” points out Gerald F. Voigt, P.E., president and chief executive officer of the American Concrete Pavement Association (ACPA). “Road noise becomes a more important issue as urban populations grow.”

“The population density in Europe, for example, is higher than in the United States, so they have reached the critical stage,” he explains. Although our country may have more land mass with fewer people, Voigt suggests that the European experience serve as a forecast for the United States. “We can’t ignore the fact that noise will become a greater issue in our own urban areas, so we are taking steps to address the issue now.”

Although various groups have tested pavement noise throughout the years, it is only recently that standardized testing methods have been developed that enable comparison of data between different groups, according to Larry Scofield, P.E., director of environmental engineering for ACPA.

So-called on-board sound intensity (OBSI) equipment measures the level of noise where the tire meets the pavement provides data that can be used to evaluate the effect of surface texture as well as surface condition on noise. The standard OBSI technology uses a pair of microphones attached to a fixture that is mounted on the vehicle’s lug nuts. The microphones record noise levels as the vehicle is driven 60 mph over the surface.

Scofield explains that because equipment calibration can change over time, there are regional equipment “rodeos” used to compare the devices. “This ensures everyone gets the same answer as they test with their equipment.” He adds, “Everyone [also] tests with the same tire now,” which is another way to ensure that data is comparable between testing groups. This is done with the ASTM Standard Reference Test Tire.

Now that there is a standard method to test pavement tire noise, there are OBSI standards in development for both ASTM International and the American Association of State Highway and Transportation Officials (AASHTO) to ensure data collection is standardized.

Texture is One Way to Reduce Noise

Because texture affects noise as well as road surface safety, two different methods of testing surface texture are providing valuable information. Developed by The Transtec Group, RoboTex is a line-laser-based three-dimensional system that measures surface texture. “By combining RoboTex data with OBSI data, we can relate texture to noise and predict noise levels,” notes Scofield. ACPA field tests of 18 different surfaces garnered valuable information that can be used to develop new textures or modify existing textures to reduce noise. The five-year project also is evaluating how noise levels change as road

“Although an important component of noise, passenger tires are not the complete picture in the noise issue.”

– Larry Scofield, P.E.
OBSI uses microphones attached to the wheel of the car to measure passenger car tire noise.

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Surfaces age. “One interesting fact that we’ve discovered is that concrete becomes quieter with age as compared to asphalt, which becomes noisier,” Scofield continues.

“Historically, any new texture research involved the construction of field test section,” Scofield says. “This limited the types of textures to be studied to those that could be produced by the existing equipment and those that would be allowed on an active highway by the owner,” he explains. “These limitations resulted in almost no innovation in the past 50 years. The field test sections are expensive to construct, create significant liability issues and generally require traffic control to conduct evaluations.”

To overcome these limitations, ACPA contracted with Purdue University to use its Tire Pavement Test Apparatus (TPTA) to develop new textures for existing pavements and for new construction.

“From both an environmental and quality-of-life perspectives, reduction of road noise will continue to increase in importance for all departments of transportation.”

– Gerald F. Voigt, P.E.,
ACPA president and CEO

“ACPA, the International Grooving and Grinding Association (IGGA), and Purdue University teamed together to use the university’s diamond grinding facility for the TPTA so that diamond ground textures could be tested,” Scofield says. This created the first industry capability to evaluate diamond grind surfaces and has led to the development of a new texture. Scofield noted that ACPA and IGGA member Diamond Surfaces, Inc., developed the custom-built grinding head used on the TPTA to evaluate a range of concrete pavement textures.

The TPTA is a 12-foot diameter drum that is covered by six curved test pavement sections. Two tires are rolled over the test sections at different speeds as microphones and sensors collect test data.

“Not only does this testing apparatus give us the opportunity to test existing textures economically, but it gives us the opportunity to test textures that we cannot produce on a road surface with existing equipment,” notes Scofield. In addition to development of a new diamond ground texture, the Purdue study is being used to evaluate noise generated by joint slap.

Joint slap noise, as Scofield describes, is affected by a variety of factors. The amount of faulting, the width of the joint opening, and the amount of sealant in the joint all affect the noise generated when a tire passes over it. The greater the step-off fault levels, the wider the joint and the more the sealant is recessed will all increase joint slap noise, according to initial
Although various groups have tested pavement noise throughout the years, it is only recently that standardized testing methods have been developed that enable comparison of data between different groups.

“In addition to evaluating the effect of pavement on noise, another issue that a great deal of research is focused on is passenger-car tires,” says Scofield. “Although an important component of noise, passenger tires are not the complete picture in the noise issue. Truck traffic has a profound impact on neighborhood noise.” He explains that, because truck traffic noise travels further than passenger automobile traffic noise, the effect of surface type on noise diminishes in neighborhoods, and so, at relatively short distances, the effect of quiet pavements becomes insignificant.

“To address these issues, the ACPA has been developing Reference Energy Mean Emission Level (REMEL) data for longitudinally tined pavements, the new Purdue textures, Astro Turf textures and diamond-ground surfaces,” says Scofield. These data should assist agencies in developing pavement specific modeling for concrete surfaces.

“For Federal-aid projects, you need to use the FHWA Traffic Noise Model (TNM) software to conduct your noise mitigation analysis,” points out Scofield. “Currently that process only allows the use of an average pavement and does not reflect different surfaces or constructions. However, considerable pressure is occurring to use specific pavement types in the software, and so, the ACPA REMEL data will be useful in updating the program.

“From both an environmental and quality-of-life perspectives, reduction of road noise will continue to increase in importance for all departments of transportation,” Voigt says. “Noise reduction will become a standard requirement for all contractors, and further to the point, we anticipate the general public will demand that we continue to look for innovative ways to address this problem.”
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**Smoother by Design**

**Pavement Surface Characteristics Affect More than Noise**

**FRICTION, SMOOTHNESS, noise level, durability and splash/spray characteristics are key aspects of a concrete pavement’s surface. While all of these characteristics can be modified to improve performance in one area, it is critical to remember that modifying one can affect others.**
Researchers are utilizing technology to measure noise levels of different pavements, and the project is evaluating the performance of porous concrete and exposed aggregate concrete, which results from two-lift construction.

Advances in technology now enable more accurate monitoring of friction, texture, noise and other surface characteristics, notes Larry Scofield, P.E., director of environmental engineering for the American Concrete Pavement Association (ACPA). These improvements for monitoring and measuring characteristics provide data that is helpful in the development of new construction techniques.

The Transtec Group’s RoboTex is a six-wheeled, remote-controlled robot that uses lasers to obtain three-dimensional measurements of pavements. Combined with on-board sound intensity (OBSI) equipment that relies upon microphones attached to a car’s wheel, the data from RoboTex can be used to better understand the relationship between pavement texture and noise, says Scofield. These are technological tools that have not been available until recent years.

Although simply making a pavement smoother would reduce noise, Scofield points out that you can’t forget the safety issues associated with texture and friction. Of the 14 percent of automobile crashes that occur in wet weather in the United States, research indicates that 70 percent are preventable. Skidding on wet pavement and reduced visibility due to splash and spray from the road are listed as two primary causes of accidents in wet weather.¹

In addition to evaluating textures, a research project being conducted by the National Concrete Pavement Technology Center (CP Tech Center) is looking at a variety of construction methods and materials as they relate to noise, friction and splash/spray.

Researchers are utilizing technology to measure noise levels of different pavements, and the project is evaluating the performance of porous concrete and exposed aggregate concrete, which results from two-lift construction. The effect of having two different quality levels of concrete in the pavement will be evaluated in terms of noise, safety and durability.

In Europe, porous concrete has been used for road construction. Researchers point out that while porous concrete has excellent splash/spray and noise characteristics, it does not hold up well on high-speed, high-load highways. “As we review surface characteristics, we need to keep durability in mind,” explains Scofield. “We need pavements that are economical to maintain.”¹

Government Spotlight

Highway Officials Present Vision, Recommendations for Future Transportation

(Editor’s note: This story details findings from the final four reports prepared by the American Association of State Highway and Transportation Officials (AASHTO) for the National Transportation Policy and Revenue Commission. Surface Transportation reported on the first three reports in the Second Quarter 2007 issue).

Report #5

Transportation planners must take into account new dynamics to create an infrastructure for the 21st century, according to the fifth report prepared by AASHTO, based on key findings from a vision summit of transportation leaders.

These considerations that require new thinking include global economic competition, metropolitan congestion and global climate change.

Recommendations include:
• Increase core program funding for highways and transit outside the Highway Trust Fund, making the transition from fuel taxes to a more reliable funding base when necessary.
• Sustain federal commitments to the federal/state partnership.
• Improve and modernize the current transportation system through management and applied technology.
• Address global warming by cutting oil consumption by 20 percent in the next decade and double fuel efficiency of new passenger cars and light trucks by 2020 and the entire fleet by 2030.

Report #6

In the sixth report, AASHTO provides provided state-specific strategies as examples for optimizing highway programs, based on a report by the organization’s Performance Based Highway Program Task Force. The purpose of the document is to reach those unfamiliar with performance measures and systems of their various applications and how they benefit decision-making in the transportation arena.

The document provides a look at how states use these measures to support decision-making; provide a solid foundation for statewide planning; ensure accountability and responsiveness to stakeholders; support quantification of program benefits; and meet federal and state legislative mandates.

Report #7

In the final report, “Accelerating Project Delivery,” AASHTO recommends the federal government set a goal of cutting the current project delivery time in half – achieving in five to seven years what now takes 10 to 15 years.

More in Store for Long-Life Pavements, Despite Program Deadline

The Federal Highway Administration’s (FHWA) Long-Term Pavement Performance Program (LTPP) will continue to focus on concrete pavement design features, as well as some additional key elements.

This is good news to many stakeholders who have relied on the program since 1987 to better understand why some pavements perform better than others, a key to building and maintaining a cost-effective highway system, according to the FHWA. The LTPP program is a series of rigorous long-term field experiments monitoring concrete and asphalt pavement test sections across the United States and Canada, according to the FHWA’s Web site.

FHWA will continue to compile data on pavement performance, specifically focusing on concrete pavement design features. At present, the LTPP includes a massive database of information compiled from more than 2,400 concrete and asphalt pavement test sections.

Recognizing its present and potential value for road construction, some 15 highway stakeholders from the public- and private-sectors met last week to review a number of important items identified by FHWA for future progress, including making the database more comprehensive and easier to use.

One important action item specifically recommended by FHWA, in response to an April 18 letter request by ACPA, is the continued monitoring of new concrete pavement design features. It’s likely the activities will be conducted under a different name, though the original spirit of the LTPP will continue unabated.

There are a number of concrete pavement features and innovations that hold potential for future construction projects. The group anticipates monitoring them over the next 15 years, said Mike Ayers, Ph.D., ACPA’s director of pavement technology.

The current LTPP stakeholders anticipate holding another meeting in approximately six months, when they will work on identifying funding sources for future activities. For more information, contact Mike Ayers at mayers@pavement.com or (217) 621-3438.
The report contains a number of recommendations and case studies to assist transportation agencies to achieve this goal.

These include a detailed overview of why transportation projects take so long, as well as:
- A background of accelerating planning and environmental reviews;
- Accelerating project delivery during detailed design and construction; and
- How to get in, get out and stay out.

The report delivers an urgent message that it is the primary responsibility of the Federal Highway Administration and the U.S. DOT to improve mobility for motorists in the most expeditious way possible.

Research Board to Conduct Pavement-Related Workshops

A number of specialized workshops will have a pavement focus at the Transportation Research Board (TRB) Annual Meeting. Visit www.trb.org/meeting/Workshops.htm for a full lineup of workshops, and visit www.trb.org/Meeting/Announcement.pdf for more information on TRB’s Annual Meeting, scheduled for January 13 through 17, in Washington, D.C.

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