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## ACPA Provides Update on Mechanistic-Empirical Design Guide



The 2002 Mechanistic-Empirical Design Guide for New and Rehabilitated Pavement Structures is the latest and most significant revision of the American Association of State Highway and Transportation Officials (AASHTO) Design Guide.

It is a radical departure from the AASHTO's 1972, 1986, and 1993 design procedures currently in use by the majority of states. The pavement design methodology includes both mechanistic (calculated stresses, strains, and deflections as a function of load) and empirical (predicted distresses arising from the mechanistic parameters) elements to improve the ability to predict specific distresses and pavement deterioration.

The guide was released in June by the National Cooperative Highway Research Program (NCHRP), the organization contracted to develop this resource. NCHRP posted the guide to its website so that federal and state agencies, industry, and academia could evaluate it. Some states have already begun applying the guide.

The guide is currently under review by a team of independent experts evaluating the overall approach; the validity of the assumptions used in development; the transfer functions or models; reliability; and many other factors. Additional tasks include the preparation of a comprehensive manual on regional calibration of the guide and software modification to improve run times.

ACPA is participating in the initial steps for the implementation of the 2002 Design Guide through NCHRP Project 1-40. ACPA is developing a two-day training course on the rigid pavement design and rehabilitation modules of the guide. (See related story, "ACPA to Assist in Design Guide Implementation.")

The concrete pavement industry has been involved with the development of the 2002 Design Guide from its inception and supports the full development and implementation of the guide.

The Federal Highway Administration's design guide implementation team is conducting a series of workshops. The workshops focus on the basics of the mechanistic-empirical process and introduce participants to the benefits of implementation and framework for localized calibration.

### ACPA to Assist in Design Guide Implementation

In response to strong interest and demand, ACPA is developing a two-day training course on the rigid pavement design and rehabilitation modules of the 2002 AASHTO Design Guide.

The course will provide training on the design software, as well as hands-on training in selecting appropriate input values, performing the analyses, and interpreting results.

The course will benefit FHWA and State DOT engineers, consultants, and other transportation professionals requiring in-depth knowledge of

The National Highway Institute's course number 131064, titled "Introduction to Mechanistic-Empirical Pavement Design," offers a highly detailed overview of the mechanistic-empirical design process for both rigid and flexible pavements.

The guide is still available at the NCHRP website for review. ACPA encourages peer review, as it is considered a critical step in the implementation process.

To view the guide, visit the Transportation Research Board's website at <http://www.trb.org/mepdg/home.htm>.

To post comments about the guide, visit the FHWA website: [http://knowledge.fhwa.dot.gov/cops/hcx.nsf/home?openform&Group=NCHRP%201-37A%20\(Mechanistic-Empirical\)%20Pavement%20Design%20Guide](http://knowledge.fhwa.dot.gov/cops/hcx.nsf/home?openform&Group=NCHRP%201-37A%20(Mechanistic-Empirical)%20Pavement%20Design%20Guide).

how to use the guide. The series of courses is set to begin next year.

Also next year, ACPA will continue its line-up of popular technical education courses, including "Concrete Pavements 101" and the "Professors' Seminar."

For more information, contact [Mike Ayers](#), PhD, at 217-548-2575.

Look for more information about the courses in future issues of **CONCRETE PAVEMENT PROGRESS**.

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## Get a Grip on Skid Resistance

*What is pavement surface friction?*

Pavement surface friction has always been an important issue because it influences roadway safety. It's especially important considering there are 1 million wet-weather traffic accidents, 40,000 work zone accidents, and some 42,000 fatalities occurring on U.S. highways every year, according to the Federal Highway Administration (FHWA).

These startling statistics raise serious questions about whether the nation's highways provide the necessary surface characteristics. For anyone who has ever skidded or slid on a roadway, the importance of a pavement's surface friction is undeniable.

Surface friction (or skid resistance) is the characteristic that allows tires to "grip" the pavement, thereby allowing vehicle steering and braking.

Surface friction depends upon a complex interaction involving the way a vehicle is driven; pavement surface characteristics; tire performance; and, of course, the presence of water, oil, etc., on the pavement.

Proper pavement surface characteristics during pavement construction or rehabilitation may mitigate-or even prevent-accidents and incidents related to hydroplaning, over-steering, and excessive skidding (which requires longer than average braking distances). Skid resistance is an increasingly important factor as agency/owners, contractors, and others endeavor to make our highways safer.



One million wet-weather traffic accidents, 40,000 work zone accidents, and more than 42,000 fatalities underscore the importance of proper surface texturing.

Concrete pavements have some inherent and well known friction characteristics, but skid resistance is not the only variable in quality pavement design and construction. Other issues, including sound at the tire/pavement interface; splash and spray; reflectivity; and heat absorption/reflectance, also must be considered.

### What's New/What's Next?

ACPA and its affiliated Chapter/States are getting a "firm grip" on the issue of surface friction. Working together, ACPA National staff and a number of Chapter/State executives and promoters are evaluating how friction is measured, as well as

what the reasonable "skid" values are from state to state.

ACPA is compiling a database of friction numbers and other variables from state agencies. The goal is to develop a range of reasonable surface friction (skid resistance) values, which factor in a host of variables, including mix designs, aggregate types, and other contributing surface characteristics.

ACPA also is conducting and supporting research initiatives on innovative texturing to satisfy requirements for friction, sound, and durability.

The Association is evaluating a range of surface types, including two-lift construction, porous pavements, and exposed aggregates. One early finding in this evaluation is that concrete is inherently more durable than rubberized asphalt pavements, which lose both their sound qualities and their friction resistance over time. This translates into more frequent repair and rehabilitation cycles, which, in turn, increases traffic congestion and the perils of work-zone accidents.

In addition, ACPA is directly involved with the National Cooperative Highway Research Program and its project 1-43, which is developing a guide to pavement friction. ACPA is also maintaining active dialogue with key stakeholders--including state and federal agencies--to gain insights and ideas, while also sharing information and promoting best practices.

[Feedback: Share your thoughts on this article](#)

### *Companies Move Forward to Increase Cement Supply*

A number of cement companies are moving forward to expand capacity by the construction of new plants or expansion of existing facilities in the United States. The following announcements are related to U.S. facility expansions and independent of other plant expansions or new facilities planned outside of the United States. The following descriptions do **not** represent an all-inclusive list; they are simply recent announcements available to **ACPA CONCRETE PAVEMENT PROGRESS** at press time.

- Ash Grove Cement Co. announced an agreement in principle with Alamo Cement Company to increase portland cement capacity in Houston and surrounding areas. The joint venture includes the construction of a new terminal on the Port of Houston. The terminal will have an annual throughput capacity of approximately 1.5 million tons of cement each year, thereby adding to the company's existing terminal capacity of approximately 1 million tons annually. Construction is scheduled to be complete in the spring of 2006. Ash Grove Cement, based in Overland Park, Kan., operates nine cement plants, 23 terminals, a lime plant, and other subsidiaries. Alamo Cement Company is based in San Antonio, Texas, and operates a cement plant, as well as ready mix, aggregate, and concrete products operations in South Texas. Alamo is wholly owned by the Buzzi Unicem Group, which operates 11 cement plants and 30 cement terminals in the U.S.
- CEMEX, Inc., announced it will increase capacity by more than 1 million metric tons per year at its portland cement import terminal in Richmond, Calif. The company reported the expansion will help meet the needs of the construction market in northern California, according to a report on Business Wire. Construction will occur in two phases, beginning with a 500 thousand metric ton per year rail terminal, expected to be operational by 2005. The second phase will be a 1 million metric ton import terminal. CEMEX, headquartered in Monterrey, Mexico, is a global cement producer and marketer of cement and ready mix products. The company operates 13 cement plants and 52 land- and marine-terminals serving 30 states. CEMEX also operates 86 ready mix plants and 23 aggregate facilities in the United States.
- Dragon Products Company announced completion of a \$50 million modernization project at its cement plant in Thomaston, Maine. The modernization converts the plant from wet to dry process, expanding capacity and reducing energy consumption. The change also reduces the process time of the kiln, and will increase production by more than 30 percent. The project included a \$10-million upgrade of Dragon's distribution system.
- Holcim (US) Inc. laid the requisite groundwork to build what is believed to be the largest cement plant in the United States, the company reported last week. Once completed, the plant in Ste. Genevieve, Mo., approximately 50 miles southeast of St. Louis, is expected to produce more than 4 million metric tons of cement per year. The new cement plant reflects a \$600 million investment by the company and will produce Type 1 and Type 2 low alkali portland cement. Construction is expected to begin next summer. Holcim (US) Inc. is one of the nation's leading manufacturers and suppliers of cement and mineral components. The company is a subsidiary of Holcim Ltd, of Switzerland. The parent company is a leading supplier of cement, as well as aggregates (gravel and sand), concrete, and construction-related services.

What is the cement industry doing to bolster supply? The short-term solution is to import more cement, according to PCA. Longer term, cement companies have announced plans to expand manufacturing capacity by 17 million tons by 2009 - roughly an 18 percent increase in domestic capacity, according to PCA.

ACPA will continue to monitor and report new capacity as it is announced by the cement manufacturing industry.

[Feedback: Share your thoughts on this article](#)

## Five Tips for Paving with Slag Cement

Slag cement can enhance a concrete pavement. It improves workability in the plastic state, and increases strengths and reduces permeability in the hardened state.



Slag cement is commonly referred to as ground granulated blast-furnace slag (GGBF).

The correct amount of slag to use on a particular project depends on the materials and admixtures used, as well as ambient conditions during paving.

With careful attention to detail during the concrete mixture design and construction portions of a project, a successful and durable pavement can be produced with slag cement. Because of differences between portland cement mixtures and slag cement mixtures, there are certain adjustments necessary when paving with slag cement.

Follow these five tips in order to maintain quality control and a superior product:

1. Reduce the vibration energy to minimize chance of segregation.
2. Avoid the addition of water to a slag cement mixture's "sticky" appearance.
3. Use accelerating admixtures, lower the percentage of slag cement, or use a pure portland cement mixture for low ambient temperatures.
4. Apply curing compound subsequent to finishing, because bleeding may not occur in low w/c ratio (i.e. slipform paving) mixtures.
5. Educate the saw crew and adjust sawing operations to the mixture's different setting properties.

For more information on slag cement, refer to ACPA's *Research & Technology Update* on slag cement at [www.pavement.com](http://www.pavement.com). The publication covers several aspects of placing and paving concrete with slag cement including workability, finishability, set time, bleed rates, curing, and sawing joints. It also explains where slag cement originates, as well as its purposes in concrete pavement. Click [here](#) to download the publication free of charge. For more information, contact [Steve Waalkes](#), P.E., At 847-966-2272.

[Feedback: Share your thoughts on this article](#)

## Study Says Traffic Congestion Getting Worse

Congestion in America is getting worse, according to 20-year trends announced recently. The 2004 Urban Mobility Report, published by the Texas Transportation Institute (TTI), shows traffic congestion growing across the nation in cities of all sizes, consuming more hours of the day, and affecting more travelers and shipments of goods than ever before.

The TTI study evaluated a number of variables and measured their effects in time, dollars, and gallons of fuel expended. The key findings were:



- \* Annual delay per peak period (rush hour) per traveler has grown from 16 hours to 46 hours since 1982;
- \* Annual financial cost of traffic congestion has grown from \$14 billion to more than \$63 billion since 1982, as expressed in 2002 dollars, and
- \* Wasted fuel attributable to engines idling in traffic jams totaled 5.6 billion gallons.

This year's installment increased the number of urban areas studied from 75 to 85, and included all urban areas exceeding a population of 500,000. The report also measured the mobility improving contributions of public transportation service and techniques to improve roadway operating efficiency. For additional information, visit TTI's [website](#).

## Take Advantage of Special Rate for ACPA Annual Convention

There is still time to take advantage of a special reduced registration rate exclusively for public officials and first-time attendees from industry.

The special rate is offered as a way of highlighting the wealth of information disseminated during the three-day event.

Among the highlights of the convention is the very popular Tech Day on Friday, December 3. This event begins with a general technical session and is followed by concurrent sessions throughout the day. Research findings, updates on research projects, technical tips, troubleshooting, technical casebook examples, and other technical and technology transfer ideas are also discussed throughout the day.

### Here are 30 more reasons to attend the ACPA Annual Convention

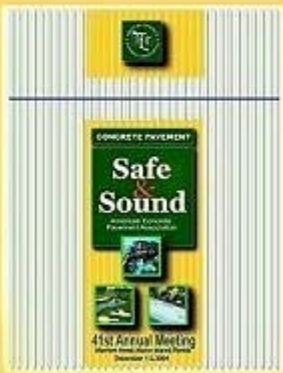
**Call today to  
save 30%**

**There's one place where people gather to talk about the latest developments in concrete paving -- the ACPA Annual Convention.**

**This year, we're presenting our popular Tech Day (on Friday, December 3). If you're an agency official, consultant, or in the business of highway, airport, and roadway construction, you won't want to miss it.**

**Register today for the ACPA Annual Convention. Use this coupon to save 30% off the registration price. For more information, call Maryann Beckman or Polina Demidova at 847-966-2272. Or, visit the ACPA website at [www.pavement.com](http://www.pavement.com).**

Offer valid only for federal, state, county, and municipal government employees, as well as industry officials whose companies have not registered for the convention previously. Not valid with other promotional offers.



ACPA's is also offering a special, reduced registration rate for its Tech Day program. The package, which is exclusively for public officials, includes a full day of technical presentations on Friday, December 3, as well as a free ticket to the ACPA dinner and awards gala that night. The cost of the package is discounted 30 percent for public officials.

For more information, visit ACPA's special website for the Association's 41st Annual Convention. The interactive website provides detailed information on everything attendees need to know about the event, from how to get there to a list of speakers and topics for the popular Tech Day. Click here or visit ACPA's website, [www.pavement.com](http://www.pavement.com), to view this user-friendly, comprehensive convention website.

### *Tips for Achieving Pavement Smoothness*

Trying to achieve a smooth surface? Doing so requires close attention to pre-construction activities. The set up and maintenance of the stringline, including stringline material, stakes, staking interval, splices, and repositioning frequency all may impact the resulting pavement surface. The stringline plays an important role as the primary guidance system for a slipform paver.

#### **Setting the Stringline**

The stringline may be wire, cable, woven nylon, polyethylene rope, or another similar material. It must be checked periodically. Aircraft cable has been found to be an outstanding material for stringline, primarily because it is extremely durable, flexible, and strong, allowing it to be placed under great tension without risk of breakage.

The paver's elevation sensing wand rides beneath the string, and the alignment-sensing wand rides against the inside of the string. Neither wand should deflect the line a measurable amount.

Air temperature and relative humidity variations during the day affect the length of the line, causing sags between the

stakes. The more tension that can be applied to the stringline, the less sag will occur, even with substantial changes in weather conditions.



The set up and maintenance of the stringline, including stringline material, stakes, staking interval, splices, and repositioning frequency all may impact the resulting pavement surface.

Splices in the stringline need to be clean and tight. Loose ends can cause the sensors to go astray, creating a defect in the pavement surface. Wherever two separate lines meet to form a continuous run, the end treatment of each line requires particular care to prevent the sensors on the slipform machine from following the wrong line.

Stakes that secure the stringline should be long enough to be firm when driven into the subgrade. There must be an adequate stake length exposed above grade to allow adjustment of the stringline to the desired height above the subgrade survey hub, typically 1.5 - 2.5 ft (450-750 mm). A maximum spacing between stakes of no more than 25 ft (7.5 m) on tangent sections will produce the best results. Decreasing this interval in horizontal and vertical curves may be necessary.

The staking system normally includes hand winches placed at intervals that are normally not more than about 1000 ft (300 m). The winches allow the line to be tightened to avoid stringline sagging between stakes. (Operators are cautioned to apply stringline tension carefully because a line break may cause injuries.)

### Maintaining the Stringline

Reducing the number of times a stringline must be set up during the project can lead to better smoothness control. Where possible, it is advantageous to set up one stringline on each side of the paving area to serve all operations, including subgrade preparation, subgrade stabilization, subbase construction and pavement placement.

For multi-operational usage, the stakes and strings must be offset farther from the pavement area to keep them clear of the equipment and operations. However, some equipment modifications, such as the attachment of a truss or cantilever arm to the paver, also may be necessary so the sensor wands can reach the stringlines, particularly for haul roads utilizing the pavement structure.

All personnel working near the stringline should avoid tripping over, nudging or otherwise touching the stringline. Some contractors increase the visibility of the stringline by tying on brightly colored ribbons. Despite these precautions, equipment or personnel may bump the line occasionally. When this occurs, the crew should check and reposition the line immediately to avoid bumps in the pavement.

In many instances, the haul road is next to the stringline. This arrangement necessitates regular visual inspection of the stringline to determine if any heaving or settling of the grade disturbed the hubs and/or line stakes. It takes considerable experience to properly "eyeball" corrections to a stringline because of deviations in the grade. When deviations are noticed, the survey or stringline crew should reposition misaligned stakes without delay.

The length of the transition into a superelevated curve impacts the surface smoothness. As a pavement changes from full crown to full superelevation there are a number of transition points. The stringline crew must be careful how the stringline is set.



To increase the visibility, some contractors tie brightly colored ribbons to the stringline. Personnel near the stringline should avoid touching the stringline.

For example, using a projection of the cross-slope, if the stringline offset is 1.3 m (4 ft) for a 2 percent cross-slope, then the string must be set 25 mm (1 in) below the pavement surface. After setting the string, the crew should eye the string to ensure "pleasing lines." However, in the transition zone, the cross slope changes and so does the relative location of the string. The stringline crew can create bumps and dips inadvertently. These bumps are less pronounced with longer superelevation transition lengths.

It is helpful to check a stringline at night using light from vehicle headlights. This technique reduces visibility of background objects and eases the ability to focus solely on the stringline.

The use of averaging skis or lock-to-grade methods of grade control are generally not recommended where constructing a pavement under a smoothness specification. Using two stringlines will usually result in a smoother surface than using an averaging ski or lock-to-grade methods, except for thin overlays on smooth existing pavements, or slabs on closely controlled stabilized subbases.

Two stringlines also are beneficial for wide sections. If only one stringline is used, then small deviations in the stringline can propagate into large variations in the surface elevation on the other side of the paving machine.

For more information about constructing smooth pavements, refer to ACPA's "Constructing Smooth Concrete Pavements" (TB006P), or see [ACPA's Product Showcase](#) section below.

[Feedback: Share your thoughts on this article](#)



### ***New R&T Update Addresses Early Cracking***



In its latest issue of *Research & Technology Update*, ACPA's technical staff addresses an unusual form of early cracking that has shown up on a few recent projects across the country.

This issue, "Cause, Prevention, and Repair of Longitudinal Shear Cracking," reports on the study of a project experiencing this new type of cracking, which takes the shape of a smile.

The technical report lists the factors that cause the cracking, as well as six tips and techniques for addressing the 'smile.'

Click [here](#) to download the publication free of charge. For more information, contact [Steve Waalkes](#), P.E., At 847-966-2272.

## Constructing Smooth Concrete Pavements

The 28-page technical bulletin (TB006P) covers all aspects of concrete pavement design and construction that affect pavement smoothness.

It is an excellent resource for training contractor crews before paving, as well as engineers. Featured topics include bases/subbases, horizontal and vertical curves, embedded items, concrete mixture, grade preparation, stringline setup, operation of the paving machine, and finishing crew activities. The publication also covers measuring devices for smoothness measurement in construction acceptance.

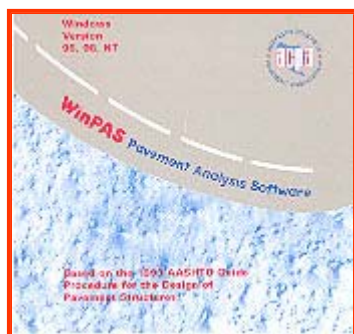
The cost of this publication is \$20.00.

To order TB006P, go to [www.pavement.com](http://www.pavement.com) or access <http://www.pavement.com/ecommerce/main.html>; call toll-free 1-800-868-6733; or fax requests to 847-966-9666.



TB006P

## WinPAS Software, Simplified Design Guide



MC016.01P

This popular, user-friendly software program (MC016.01P) allows roadway pavement thickness design and evaluation according to the 1993 American Association of State Highway & Transportation Officials (AASHTO) Design Guide for Pavement Structures, including traffic and overlay thickness methods.

A life-cycle cost module allows you to compare alternative designs, as well. The software is compatible with Windows 95, 98, NT, 2000, and XP.

A 94-page manual (MC016P) accompanies the software program.

It explains all factors in the 1993 AASHTO Design Guide for Pavement Structures, including reliability, traffic, soil support, serviceability, and concrete properties. It also includes chapters on overlay thickness design and life-cycle cost analysis.

The cost of this resource is \$495.00. To order MC016.01P, go to [www.pavement.com](http://www.pavement.com) or access <http://www.pavement.com/ecommerce/main.html>; call toll-free 1-800-868-6733; or fax requests to 847-966-9666.

## Concrete Pavement News Digest

### ACPA Announces International Whitetopping Conference

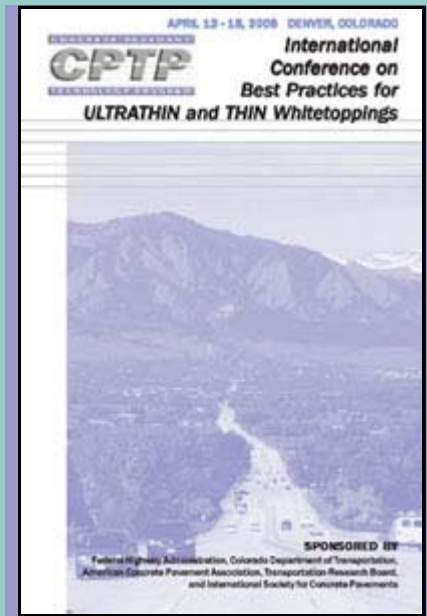
ACPA and other industry groups will co-sponsor the "International Conference on Best Practices for Ultrathin and Thin Whitetopping" to be held on April 13 - 15 in Denver.

The conference is geared toward federal, state, and municipal engineers; consulting engineers; contractors; materials suppliers; and academia. Click here for a brochure. Technical topics will cover the latest technologies in ultrathin whitetopping (UTW) and thin whitetopping. ACPA is calling for papers on those techniques.

Suggested topics include:

- > Selecting the right projects for UTW and thin whitetopping.
- > Pavement analysis and design.
- > Construction.
- > Concrete materials for UTW and thin whitetopping.
- > Pavement performance.
- > Jointing patterns.
- > Whitetopping repair and rehabilitation.

New and emerging topics are also acceptable. Papers will be selected based on near-term applicability to practice. The presentations should include the most comprehensive coverage of UTW and thin whitetopping. ACPA, the International Society for Concrete Pavements, the Transportation Research Board, the Federal Highway Administration, and the Colorado DOT are co-sponsoring the conference.



For more information, contact [Shiraz Tayabji](#) at 410-997-0400.

### Coal Ash Association Announces Workshops

The American Coal Ash Association (ACAA) will conduct two workshops next month covering the use of coal and fly ash in concrete pavement.

The workshops, themed Coal Combustion Products Partnership (C2P2), will provide contractors, engineers, state transportation officials, and other transportation professionals with information about the benefits of using coal ash in highway construction. Added sessions will cover structural fills, controlled low strength materials, and road base products.



Dates and locations for the workshops are:

- > November 16 - Atlanta
- > November 18 - Louisville

ACAA is co-sponsoring the workshop with the Federal Highway Administration, the Environmental Protection Administration, the Recycled Materials Resource Center, DOE and the Utility Solid Waste Activities Group.

For more information, visit <http://www.epa.gov/epaoswer/osw/consERVE/c2p2/>, or contact the ACAA at 720-870-7897.

### Research Board Announces Highway Design Symposium

The Transportation Research Board has slated the 3rd International Symposium on Highway Geometric Design on June 29 - July 2, in Chicago.



The purpose of the symposium is to improve geometric design worldwide. Presentations, demonstrations, and discussions will focus on the latest research, policies, and practices for street and highway geometric design, including safety and operational effects. Visit the [TRB](#) website for more information.

## Colorado DOT Evaluates Recessed Striping in Concrete Pavements



Recessed striping makes highways safer for drivers, according to a report by Research Branch of The Colorado DOT (CDOT). CDOT released the report recently on the study of recessed striping in concrete pavements. The study found that lane markings last longer when placed in shallow grooves in the pavement.

The study evaluated the condition of the thermoplastic and pavement marking tape stripes through several winters to see if the grooves provided significant protection for the stripes. In 1999 - 2000 on project NH 0342-034, the contractor modified the screed bar on a paver to form grooves for both shoulder stripes and the skip stripe on a 4-lane divided highway. To view the complete report, click [here](#) or visit CDOT's website, [www.dot.state.co.us](http://www.dot.state.co.us).

## U.S. Cement Industry is Largest User of Scrap Tires

Fifty-three million tires were consumed by the cement industry in 2003, making it the largest end user industry for scrap tires, according to Cement Americas magazine. In 2003, 80% of the 290 million scrap tires generated in the United States went to an end-use market. Visit [Cement Americas'](#) website for more information on the report.



**ACPA Concrete Pavement Progress** is published four times a year and covers current practices and case histories in the concrete pavement industry. **ACPA Concrete Pavement Progress** is distributed free of charge to public officials, ACPA members, executive committee, board of directors, and affiliated chapter/state paving associations.

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