T³S

Are We There Yet?

Winter 2007
Volume 18, Number 1

South Carolina Transportation Technology Transfer Service

In This Issue...

Safety First

by Sandy Woodward
Photo by Patrick Wright
Article Compliments of Clemson World Magazine

The statistics are sobering: traffic crashes are the leading cause of injury and death in the United States.

In its vision of becoming the premier automotive and motorsports research and educational facility in the world, the Clemson University International Center for Automotive Research (CU-ICAR) is making safety a focus.

"CU-ICAR is not just about vehicles; ultimately it's about improving vehicles to improve and save lives," says Chris Przirembel, Clemson's vice president for research and economic development.

Improving overall vehicle performance through the application of research and new knowledge generated by Clemson and its partners will undoubtedly save lives. CU-ICAR's strategy, however, is more direct. It has established the Automotive Safety Research Institute (ASRI) as a research-based interdisciplinary initiative focused on the critical human-vehicle-road interface. The institute—in the College of Engineering and Science's civil engineering department—provides synergy for interdisciplinary research, education and public service that enhances scholarship with increased opportunities for graduate and undergraduate students.

The University did not have to go far to

(cont. on page 2)

SCDOT

CLEMSON UNIVERSITY

"Whether it's communication about safety issues, psychological factors in driver impairment, vehicle design or marketing safety programs, we have many opportunities for collaborative research."
- Kim Alexander

find the right person to head the institute. Kim Alexander, ASRI executive director and faculty member, has a lifelong passion for automotive safety. She's earned a national reputation for the University's Cruisers Program, an evidence-based K-12 life skills curriculum, which focuses on the issue of youth traffic safety. "The Cruiser curriculum contains the most creative and innovative lesson plans for traffic safety that I've seen in this country," says Terecia Wilson, director of safety for the S.C. Department of Transportation (SCDOT).

Alexander says ASRI's goal is to bring together nationally and internationally recognized researchers, educators and practitioners in a variety of disciplines to improve the safety of the automotive transportation environment and leverage resource support through public and private funding.

"The interdisciplinary approach enables us to perform a comprehensive, systemic analysis of the human-vehicle-road system," she says. "This unique structure is addressing complex and interconnected challenges of the future of automotive transportation safety where it's no longer possible for these issues to be solved in a single discipline or profession." ASRI is already collaborating with Clemson faculty including civil engineering, sociology, public health, psychology, marketing, mechanical engineering and industrial engineering.

Current initiatives include safety and health issues such as vehicle-highway automation and human-machine interface; emerging technologies such as rapid tire deflation and advanced steering systems and in-vehicle information systems; and driver training and evaluation.

In addition to the on-campus collaborators, Alexander has built successful partnerships with state and federal agencies, and private corporations. The institute is currently working on a research project for the SCDOT to assess road users in South Carolina on current understanding, perceptions, attitudes and behaviors regarding key traffic control measures.

Alexander's longtime private partners are Michelin North America Inc. and Michelin Americas Research and Development Corp., and she's enthusiastic about the potential for expanding collaboration with the company as part of the CU-ICAR team.

"Michelin is an outstanding partner," says Alexander. "Their corporate culture is very supportive of mobility safety."

"Our support of the ASRI and Cruisers programs has saved lives, and we look forward to taking our work together to a new level through the synergy of the CU-ICAR research environment," says John Tully, director of community relations for Michelin.

Michelin's Laurens Proving Grounds, where vehicles can be tested for safety and other performance features, will be a key resource for ASRI. One creative project that has grown out of the partnership between Michelin and ASRI is "First Responders' Safety First." This bold new idea utilizes a team of Michelin safety experts and ASRI faculty to train and certify first responders in advanced emergency highway safety procedures.

The institute's comprehensive goals will require significant, long-term funding. In addition, Alexander plans an aggressive sponsored-research component for ASRI.

"Whether it's communication about safety issues, psychological factors in driver impairment, vehicle design or marketing safety programs, we have many opportunities for collaborative research," she says. "We are limited only by our imaginations."

And, for the moment, by space.

ASRI will have a permanent home on the CU-ICAR campus in Greenville, which will place the institute in the center of the research and collaboration neighborhood environment. Until construction is complete, Alexander and her team will work from the Clemson campus.

"We are breaking new ground in transportation safety. It's very exciting to anticipate what the institute will be able to accomplish in CU-ICAR's neighborhood environment."

Kim Alexander '88, M '92

When Kim Alexander was a senior in high school, an automobile crash changed the course of her life. The car in which she was a passenger ran off the road and crashed into a tree. The result was a spinal cord injury that left her paralyzed and confined to a wheelchair.

Where others may see limitations, Alexander found opportunity. While attending Clemson, Alexander used her personal experience as a springboard and created a program called "Keeping in Motion," an inspirational testimony that challenges students and adults to utilize their abilities and seize their opportunities. She speaks on the state, national and international stage, offering a look at the consequences of one's judgments and shares the importance of smart, healthy and informed decision making. Alexander believes that "in order to survive you have to keep your eyes open and your options alive, and realize that you may not always get a second chance!" South Carolina historically has had one of the highest traffic-based teen-fatality rates in the country, and, nationally, crashes are the No. 1 killer of teens. "We call these events 'accidents,'" says Alexander, "but crashes are preventable and most often occur due to human error."

To date, she has received over $2.3 million in sponsored research in the field of transportation safety. ASRI takes Alexander's work to a new level and makes safety a focal point for the international automotive research community. She holds Clemson degrees in marketing and counseling and guidance services and received a doctorate in education in August.

New Offerings Highlight the Planned 2007 T³S Workshop Schedule

The tentative list of T³S workshops that will be offered in 2007 has been established. We have several new courses that we will be presenting along with topics that have remained popular through the years.

In 2004 T³S became a co-sponsor, along with the Clemson Extension Service, the SC Department of Transportation, and the SC Department of Health and Environmental Control, offering the Certified Erosion Prevention and Sediment Control Inspector Course numerous times throughout the year. Back by popular demand, we will again offer these courses in the spring along with Certified Storm Water Plan Review, which will be a two-day course designed for technical staff who are not licensed professional engineers.

- Writing Skills for Transportation Professionals will be our first course offered in January 2007.
- Chainsaw Safety will return in early 2007 and we will also offer a new Tractor Mowing Safety workshop in early March.
- Ken Wood from FHWA will present Basics of the MUTCD.
- The South Carolina American Public Works Association will partner with T³S in 2007 to offer a series of Competent Person Trenching and Shoring Workshops throughout the state.
- General Construction Inspection is another new course planned for 2007 as well as Gaining Understanding & Support: Getting Your Message Across.
- And, we are currently planning the Fifth Annual Count on Concrete Conference.

We will continue to send out brochures announcing the workshops, and as dates are finalized, information will be posted on our web site at www.clemson.edu/t3s that will allow you to register early for the classes that have limited space.

If you have any questions regarding any workshops we have planned, please feel free to contact us at 888-414-3069. We look forward to seeing you soon.

2006 US Bridge Inventory

Nearly half—more than 250,000 of U.S. bridges according to the National Bridge Inventory are in the 25- to-50 year age range. This is a major concern for many state departments of transportation (DOTs) and the Federal Highway Administration (FHWA) because many bridges have a life expectancy of 50 years—making them near the ends of their anticipated life cycles. The combination of weather and vehicle traffic leads to deterioration, including corrosion, fatigue, seismic activity, foundation settlement, cracking, and bearing often damage bridges. About 26 percent of the bridges in the United States are deficient. Studies suggest that bridges deteriorate slowly during the first few decades of their 50-year design lives, followed by rapid decline in the last decade.

Bridge conditions inched upward in 2006, but engineers forecast a flat year ahead. FHWA, in consultation with the states, has assigned a sufficiency rating SR to each bridge (20 ft. or more) inventoried. Formula SR rating factors are as outlined in the current Recording and Coding Guide for Structures Inventory and Appraisal SI&A of the Nations Bridges. Per the FHWA: "A Structurally Deficient (SD) bridge is one that (1) has been restricted to light vehicles only, (2) is closed, or (3) requires immediate rehabilitation to remain open. A Functionally Obsolete (FO) bridge is one in which the deck geometry, load carrying capacity (comparison of the original design load to the State legal load), clearance, or approach roadway alignment no longer meets the usual criteria for the system of which it is an integral part."

In the most recent year of our bridge survey, the United States has 436 fewer bridges in its total inventory. Decreases came at the state/inventory level. Bridges owned by local government agencies increased by 819.

The decrease in bridges helped agencies show a slight drop in structurally deficient or functionally obsolete bridges. The number of SD/FO bridges decreased 0.5% between 2005 and 2006. Interstate and state bridges showed a decrease of 0.2%, dropping to 21.9% of the total of that category. City, county, and township bridges showed a decrease of 0.7%, standing at 27.0%—helped by the new bridges added to the inventory.

Our thanks to all the state highway engineers for their continuing cooperation and special effort to provide current data through October 2006.

Article courtesy of Better Roads Magazine.

State	Total interstate & state bridges	Total *SD/FO	%	Total city/ county bridges	Total *SD/FO	%	Total all Bridges	Combined Total *SD/FO %	%
Alabama	5,673	1,192	21%	10,039	2,727	27%	15,712	3,919	25%
Alaska	891	183	21%	138	52	38%	1,029	235	23%
Arizona	4,630	161	3%	2,354	223	9%	6,984	384	5%
Arkansas	7,132	1,170	16%	5,227	1,579	30%	12,359	2,749	22%
California	12,482	1,751	14%	12,201	2,590	21%	24,683	4,341	18%
Colorado	3,750	479	13%	4,754	623	13%	8,504	1,102	13%
Connecticut	2,919	1,015	35%	1,232	404	33%	4,151	1,419	34%
Delaware	839	136	16%	7	4	57%	846	140	17%
District of Columbia	214	88	41%	N/A	N/A	N/A	214	88	41%
Florida	6,324	835	13%	4,802	1,204	25%	11,126	2,039	18%
Georgia	5,931	890	15%	8,385	2,023	24%	14,316	2,913	20%
Hawaii	758	275	36%	398	151	38%	1,156	426	37%
Idaho	1,267	287	23%	2,286	385	17%	3,553	672	19%
Illinois	8,085	1,633	20%	18,018	2,950	16%	26,103	4,583	18%
Indiana	5,676	813	14%	12,732	3,206	25%	18,408	4,019	22%
Iowa	3,973	555	14%	20,614	6,099	30%	24,587	6,654	27%
Kansas	5,318	795	15%	20,509	4,641	23%	25,827	5,436	21%
Kentucky	8,814	2,576	29%	4,728	1,683	36%	13,542	4,259	31%

Louisiana	7,889	2,207	28%	5,292	1,835	35%	13,181	4,042	31%
Maine	2,068	566	27%	212	115	54%	2,280	681	30%
Maryland	2,775	614	22%	2,201	726	33%	4,976	1,340	27%
Massachusetts	3,401	1,213	36%	1,544	586	38%	4,945	1,799	36%
Michigan	4,447	1,297	29%	6,399	1,696	27%	10,846	2,993	28%
Minnesota	3,837	365	10%	9,821	1,433	15%	13,658	1,798	13%
Mississippi	5,564	1,159	21%	10,935	3,200	29%	16,499	4,359	26%
Missouri	10,224	2,892	28%	13,748	4,653	34%	23,972	7,545	31%
Montana	2,578	438	17%	1,785	487	27%	4,363	925	21%
Nebraska	3,493	213	6%	11,940	3,576	30%	15,433	3,789	25%
Nevada	1,075	31	3%	697	38	5%	1,772	69	4%
New Hampshire	1,494	321	21%	929	419	45%	2,423	740	31%
New Jersey	2,405	573	24%	4,006	1,216	30%	6,411	1,789	28%
New Mexico	2,994	451	15%	718	233	32%	3,712	684	18%
New York	8,116	3,157	39%	9,251	3,283	35%	17,367	6,440	37%
North Carolina	17,231	5,361	31%	743	194	26%	17,974	5,555	31%
North Dakota	1,118	72%	6%	3,313	1,002	30%	4,431	1,074	24%
Ohio	11,583	2,482	21%	18,940	4,723	25%	30,523	7,205	24%
Oklahoma	7,644	1,848	24%	15,927	5,939	37%	23,571	7,787	33%
Oregon	2,676	826	31%	3,950	853	22%	6,626	1,679	25%
Pennsylvania	16,576	6,122	37%	6,951	3,053	44%	23,527	9,175	39%
Rhode Island	611	327	54%	153	78	51%	764	405	53%
South Carolina	8,339	1,839	22%	860	335	39%	9,199	2,174	24%
South Dakota	1,803	203	11%	4,032	1,292	32%	5,835	1,495	26%
Tennessee	7,585	1,271	17%	12,177	2,535	21%	19,762	3,806	19%
Texas	32,421	4,490	14%	16,673	5,604	34%	49,094	10,094	21%
Utah**	1,802	291	16%	968	195	20%	2,770	486	18%
Vermont	1,077	374	35%	1,604	559	35%	2,681	933	35%
Virginia	11,540	2,581	22%	1,202	281	23%	12,742	2,862	22%
Washington	3,197	887	28%	4,187	926	22%	7,381	1,813	25%
West Virginia	6,771	2,472	37%	116	83	72%	6,887	2,555	37%
Wisconsin	5,004	649	13%	8,705	1,535	18%	13,709	2,184	16%
Wyoming	1,928	91	5%	844	252	30%	2,772	343	12%
TOTAL	**285,942**	**62,517**	**21.9%**	**309,247**	**83,479**	**27.0%**	**595,189**	**145,996**	**24.5%**

**SD/FO Structurally Deficient or Functionally Obsolete. **2005 figures*


WASHINGTON
OREGON
IDAHO
MONTANA
NORTH DAKOTA
SOUTH DAKOTA
WYOMING
NEBRASKA
NEVADA
UTAH
COLORADO
CALIFORNIA
KANSAS
ARIZONA
NEW MEXICO
OKLAHOMA
TEXAS
ALASKA
HAWAII


MINNESOTA
WISCONSIN
MICHIGAN
IOWA
ILLINOIS
INDIANA
OHIO
MISSOURI
KENTUCKY
WEST VIRGINA
VIRGINIA
TENNESSEE
NORTH CAROLINA
ARKANSAS
SOUTH CAROLINA
ALABAMA
GEORGIA
LOUISIANA
MISSISSIPPI
FLORIDA
NEW HAMPSHIRE
VERMONT
MAINE
MASSACHUSETTS
NEW YORK
RHODE ISLAND
CONNECTICUT
PENNSYLVANIA
NEW JERSEY
DELAWARE
MARYLAND
DISTRICT OF COLUMBIA
% Total Bridges Structurally Deficient or Functionally Obsolete
< 10%
10-14%
15-19%
20-24%
25-29%
30-34%
35-39%
> 40%

Safety Zone

Stopping Sight Distance

By Jim Mearkle, Safety Technical Assistance Engineer (at the time of publication. Jim Mearkle is currently a Traffic Engineer with Albany County, New York)

A simple road safety check YOU can do

Roads are safer when drivers can see as far as it takes to stop. The distance it takes to notice a problem, realize a stop is necessary, and come to a complete stop is called stopping sight distance. It is important all along the road, and special attention is needed when approaching crosswalks, intersections, work zones, and driveways.

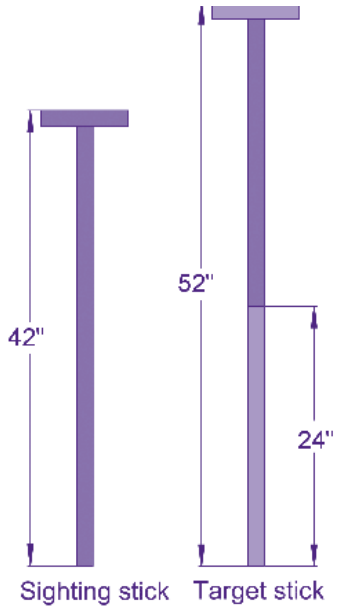
Stopping sight distance is measured using a driver's eye height of 42 inches looking at an object 24 inches high. These measurements correspond to the eye height of a small adult in a small car and the brake lights on passenger cars. Trucks need more distance to stop, but the driver's higher eye position allows for extra sight distance on hillcrests. However, it does not help seeing around an obstruction on the inside of a curve.

How to measure stopping sight distance

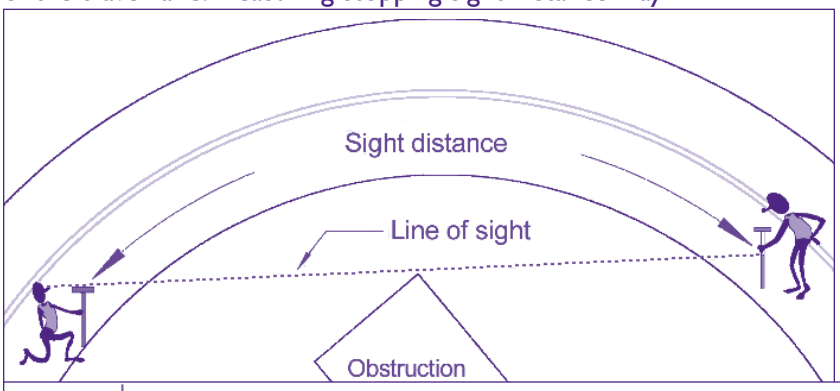
On crests, sight distance is measured along the center of the travel lane. Measuring stopping sight distance may require you to be in the travel lane with your back to traffic. Many times, measuring the sight distance along the shoulder is often close enough, but if you need to be accurate, use caution. If necessary, have extra persons watch or flag traffic.

You will need:

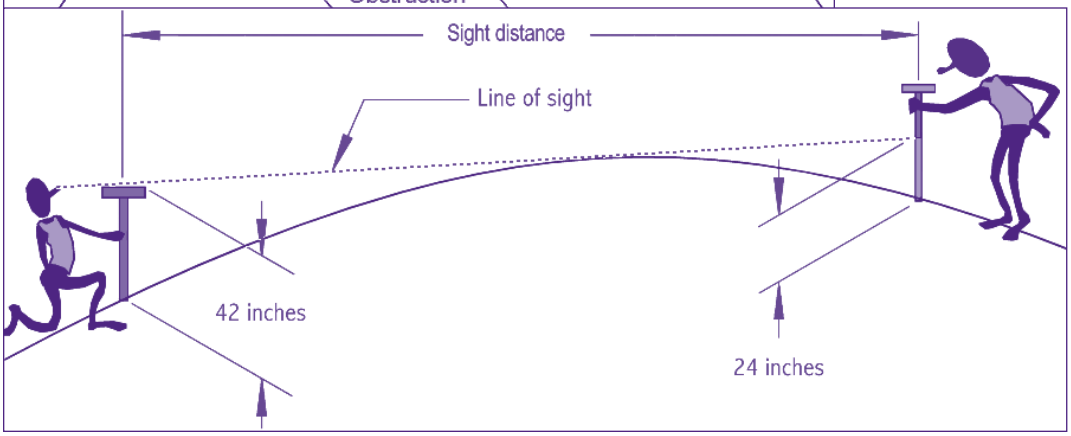
- An assistant
- High visibility clothing
- Sight distance measuring sticks
- A measuring wheel, long steel tape measure, or surveyor's chain
- Traffic spotters or flaggers, if needed.



To measure sight distance, kneel and use the 42inch sighting stick to get your eyes at the proper height. Have your assistant move the target stick until you cannot see the orange part on the bottom, or until the assistant reaches the distance shown in the table.



On curves, stopping sight distance should be measured along the travel path of the vehicle. Note in the figure that the line of sight is shorter than the sight distance. Keep in mind that brush and tall seasonal crops can cause problems that may not be obvious when you are taking your measurements.



If you can still see the orange part on the bottom of the target stick when your assistant reaches the stopping sight distance needed, then there is adequate stopping sight distance. If you lose sight of the orange part before your assistant reaches the stopping sight distance, according to the table, then you may want to make some changes.

How much is enough?

Stopping sight distance varies with speed and grade. On roads that carry less than 400 vehicles per day, less sight distance is acceptable because the chances of a conflict are lower. The chart below shows stopping sight distance for various speeds and traffic volumes. These distances are for level pavement. Less distance is needed going uphill, and more is needed going downhill. As much as 20 percent more is needed on steep downgrades.

It is always better if you can provide a sight distance that is longer than the minimum shown in the table.

If you don't have enough...

If poor sight distance hides a safety condition, warn drivers with the appropriate warning sign. For example, where an intersection is hidden by a hillcrest or curve, install an intersection warning sign.

Sight distance improvements are often costly. Improvements may be worthwhile at places where poor sight distance has played a role in crashes that have occurred there. Sight distance improvements are more likely to be worth the cost if you can add them to other work at that location. For example, you might eliminate a dip during culvert replacement or lower a crest during fulldepth pavement repair. On the other hand, they can be very effective if something simple is all that is needed, like brush clearing.

Sight distance problems can be easier to avoid than fix. Work with your planning and zoning boards so new driveways, intersections, or crosswalks are not built in locations with poor sight distance. Many municipalities have local laws prohibiting landowners from placing buildings or landscaping that will block sight distance at intersections.

Traffic speed/ mph[1]	Stopping Sight Distance, feet				
	0-100 veh/day	100-250 veh/day		250-400 veh/day	>400 veh/day
		Lower risk locations[2]	Higher risk locations[2]		
25	115	115	125	125	155
30	135	135	165	165	200
35	170	170	205	205	250
40	215	215	250	250	305
45	260	260	300	300	360
50	310	310	350	350	425
55	365	365	405	405	495
60	435	435	470	470	570

[1]Choose a speed that includes most traffic on the road. If you know it, use the 85th percentile speed. This is the speed that 85% of traffic is not exceeding, and 15% is exceeding.

[2]Higher risk locations include features like intersections, narrow bridges, railroad grade crossings, sharp curves or steep downgrades. Lower risk locations are areas without such features.

Based on AASHTO Geometric Design of Very Low-Volume Local Roads and "Green Book".

Paving a Half-Mile per Night in Georgia

Fast-tracked project opens concrete to traffic in a few hours.

From the August 2005 issue of Better Roads Magazine
The Staff of the American Concrete Pavement Association

A recent project in Georgia has proven that you can open a new concrete pavement to Interstate traffic in just four to six hours after it is paved. Even though the concrete mix had to meet a strength of 2,500 psi in 24 hours, limited maturity data obtained by the contractor showed that the concrete achieved about 1,500-psi compressive strength at opening time — and could carry truck traffic — with no detrimental effects. Working about eight hours every night, the Ballenger Paving Division, APAC-Southeast Inc., removed one lane of old concrete pavement, paved an average of 1,500 feet per night, and reopened the new pavement to traffic by 10:00 a.m. the following morning. The 14.7-mile project took place on Interstate 75 near Macon, Georgia. The highway is a major route through Georgia and carries an average daily traffic of 54,000 with 24% trucks.

Ballenger replaced a 10-mile stretch of the 39-year-old outside lane on each side of the Interstate for a total of 20.1 lane miles of pavement. The remainder of the project was routine concrete pavement rehabilitation work. Total project cost was $19.1 million and the concrete pavement cost was $7.24 million. Work was completed on October 7, 2004.

On some nights, Ballenger was able to replace more than half a mile of pavement per night, says Wouter Gulden, director of engineering and training, Southeast Chapter, American Concrete Pavement Association. In fact, the contractor removed and replaced the 20.1 lane miles of concrete pavement in just 16 weeks time. The actual paving took the equivalent of 11 weeks and was done during the months of January through April 2004.

Drama at night

Beginning at 8:00 p.m. every night, the contractor closed down the two outside lanes, while the inside lane remained open, says Ronnie Ashmore, a vice president with Ballenger Paving Division, APAC Southeast. Work zone barrels came first, followed by sawing and removal of the old concrete. A wheel loader with forks removed 6- by 10-foot blocks of pavement. Next was smoothing and compaction of the existing base. Then Ballenger placed dowel baskets, chairs, and reinforcing mats.

Paving began about 10:30 or 11:00 p.m. Concrete was hauled from a central mixing plant to the site in Maxon side-dumps on Autocar trucks. The side-dumps emptied the concrete into a Maxon spreader, and a Gomaco 2800 slipform paver did the rest. Finishers used 16-foot straightedges to correct any minor deficiencies.

The contractor would stop paving each morning at about 4:00 to 4:30 a.m. The middle lane — used during construction as a safety buffer and haul road — had to reopen to traffic at 6:00 a.m. By 10:00 a.m., Ballenger could open the new pavement to traffic. The Georgia Department of Transportation specifies a minimum cure requirement time of four hours.

"This all required close coordination between the sawing and removal crews, the concrete plant, and the paving crew," said Ashmore. "We at the Ballenger Paving Division had a work force of 75 people and the removal contractor had 25 people at the worksite. During a good portion of the night, all of the activities were taking place at once, from sawing the old slabs to paving the new concrete."

High early strength

"Most fast-tracked concrete pavements are done during weekends," says Gulden. "I don't know of one done each night in concrete. It's an equal production speed to deep milling of asphalt and repaving. The concept came out of the Georgia DOT's Maintenance Office.

"Conventional wisdom says you need the 400-psi flexural strength or 2,500-psi compressive to hold up to trucks," says Gulden. "But Georgia found in the late '70s that you can open it up sooner. And that was by trial and error. The Georgia DOT tried eight hours, and that worked, and then they tried six hours, and that worked okay. They get about 1,200 to 1,500 psi in five and a half to six hours."

To achieve that strength, the Georgia DOT designed a high-early-strength mix with 750 pounds of Type 1 Portland Cement per cubic yard. It's an eight-bag mix. "They added a non-chloride accelerator," says Gulden. "It's a standard paving mix except for the higher cement content and the non-chloride accelerator.

"The DOT's challenge was to design a pavement system that had to be 10 inches in thickness to replace the existing slab," says Gulden. "The existing slab was originally designed to carry 6 million Equivalent Single Axle Loadings, while future ESALs were estimated to be about 115 million over the next 20 years. High-strength concrete (800-psi flexural), dowels, short joint spacing of 15 feet, and reinforcing steel were used in the design. The reinforcing steel mats were added to enhance strength and provide for a margin of safety, even though design formulas do not account for this feature." Diamond grinding was specified as the final finish.

APAC-Southeast's Ballenger Paving Division received two Southeast Concrete Alliance Network awards for this project. SCAN is composed of state DOTs, the Federal Highway Administration, the Southeast Chapter of the American Concrete Pavement Association, concrete paving contractors, and equipment manufacturers and material suppliers. Awards are presented to all concrete paving and rehabilitation projects that meet the quality or innovation standards established by the SCAN Award Committee. Ballenger received the following awards for this project: the 2005 SCAN Quality Award in the Concrete Pavement Construction category; and the 2005 SCAN Innovation Award for advancing the knowledge and practice in concrete pavements.

For more information, you can contact the American Concrete Pavement Association headquarters at 847-966-2272. ACPA maintains chapter offices throughout the country that stand ready to help with your concrete pavement questions. See also www.pavement.com.

You're My Type

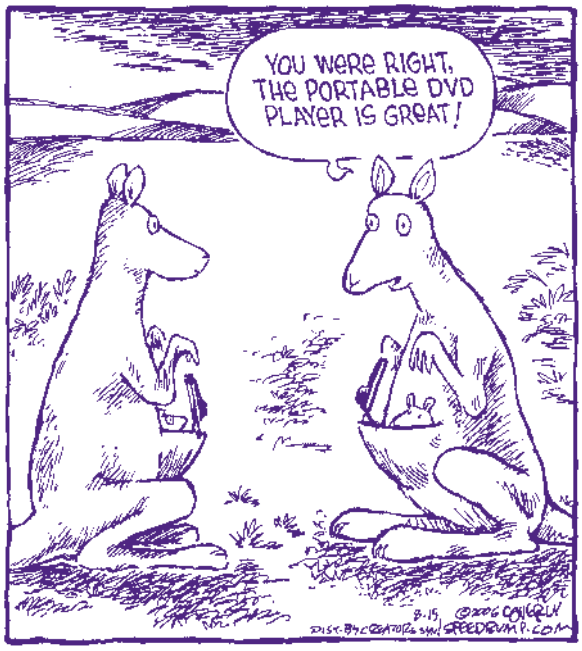
If you're over 17, you can be a blood donor. Do you know your blood type?

Here's how blood types are distributed among the population:

O+	1 person in 3
O-	1 person in 15
A+	1 person in 3
A-	1 person in 16
B+	1 person in 12
B-	1 person in 67
AB+	1 person in 29
AB-	1 person in 167

From the most common to the rarest, all types are needed, so give the gift of life this season.

SPEED BUMP Dave Coverly



Are We There Yet? is published by the South Carolina Transportation Technology Transfer Service (T^3S) for the benefit of county and municipal government agency personnel in South Carolina. T^3S, administered by the Clemson University Civil Engineering Department, is the Local Technical Assistance Program (LTAP) center for SC. T^3S is part of a nationwide network of LTAP centers established by the Federal Highway Administration (FHWA) in cooperation with state transportation agencies. T^3S is jointly funded by FHWA and the South Carolina Department of Transportation (SCDOT). The views, opinions, and recommendations contained in the newsletter do not necessarily reflect the views of the FHWA or the SCDOT.

How to Contact Us

SC Transportation Technology Transfer Service
Civil Engineering Department
Clemson University—Box 340911
Clemson, SC 29634–0911
Phone: 888-414-3069 Fax: 864-656-2670
E-mail: t3s@ces.clemson.edu
Web: www.clemson.edu/t3s

Director:	Jim Burati	864-656-3315
Program Manager:	Sandi Priddy	864-656-6141
Designer/Assistant Editor:	Ardyce Alspach	864-656-6141

Transportation Technology Transfer Service
Civil Engineering Department
Clemson University
Box 340911
Clemson, SC 29634-0911

Nonprofit Organization
U.S. POSTAGE PAID
Clemson, SC
Permit No. 10