Volume VIII No 2 Summer 2002

Research Development Technology Transfer

SCDOT

# The R D & T Newsletter

A Publication of the South Carolina Department of Transportation Research and Materials Laboratory

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## SPR 593, "Investigation of SCDOT Asphalt Mixtures Using the Pavement Analyzer—Phase I" Recently Completed

Research Project No. SPR 593 was conducted in–house by Mr. Chad Hawkins with assistance from personnel in the Department's Asphalt Mix Design Unit. The objective of the research was to use the Asphalt Pavement Analyzer (APA) to evaluate the rutting characteristics of SCDOT high performance asphalt mixtures. These mixtures included Superpave 19.0 mm, Superpave 12.5 mm, and Asphalt Surface Course Type 1C. The standard mixes were tested to determine their resistance to rutting. Then, dust to asphalt ratios, compaction levels, and polymer usage were varied in each of the mixtures to evaluate the effect on rut resistance.

In general for the standard mixtures, the surface courses tested, Superpave 12.5 mm and Surface Type 1C, rutted less than the binder course, Superpave 19.0 mm. Testing the mixtures with dust/asphalt ratios of 0.60, 1.20, and 1.60 indicated that lower dust/asphalt ratios provided more rut resistant mixes. Increasing the compaction level of the mixes from 91% to 93% substantially improved rut resistance. Also, using a polymer-modified binder, PG 76-22, in lieu of unmodified PG 64-22 binder greatly improved the rut resistance of all the mixtures. Finally, it was concluded that proper use of the APA could aid in designing more rut resistant mixtures. Several recommendations were made including increasing the compaction level from the current 91% to 93% of Maximum Specific Gravity and using a 76-22 binder in high volume riding courses.

**Asphalt Pavement Analyzer**

**Asphalt specimens being tested in the Asphalt Pavement Analyzer**

*If you would like to obtain a copy of the final report, contact Mr. Terry Swygert by telephone at (803) 737-6652 or e-mail swygerttl@dot.state.sc.us.*

**Volume VIII Number 2**

***In This Issue…***

# Richard Stewart to Retire from SCDOT

After thirty-five (35) years of service with the South Carolina Department of Transportation (SCDOT), Mr. Richard L. Stewart has announced his retirement at the end of June 2002. Though currently serving as Deputy Director for Executive Support, most remember Mr. Stewart for his work in the areas of materials and research. He began his tenure with the Department in the Research and Materials Laboratory and was the Research and Materials Engineer from 1976 till he moved to his current position in the Executive Director's office in May 2000.

Mr. Stewart was very active with committees related to materials and research on both regional and national levels. In the area of materials, he served on AASHTO's Subcommittee on Materials for twenty-four (24) years, and was vice-chairman of AASHTO Region II from 1987 to 1992. He was also a member of the Executive Council from 1987 to 1992 and from 1997 to 2000. He was very involved with the AMRL Administrative Task Group and AASHTO's Accreditation Program. In June 1999, Mr. Stewart was invited by the Peoples' Republic of China to a seminar in Beijing to give a series of lectures on AASHTO's Accreditation Program.

***Stewart completed 24 years with SCDOT Research and Materials.***

An enthusiastic proponent of research, Mr. Stewart served as chairman of the National Research Advisory Committee from 1995 to 1997 and in several regional capacities from the inception of the Committee until his departure from the Laboratory in 2000. He also served on numerous TRB and NCHRP committees and project panels during his career with the Department.

Throughout his thirty-five (35) years, Mr. Stewart served the SCDOT in a very professional manner. He was an asset to the Department and will certainly be missed. We all wish him the best of luck in his retirement.

# Highway Work Zone Accidents Increasing

Most work zone accident victims are motorists, a fact that the public may not realize, says E. Dean Carlson, Kansas Secretary of Transportation. He was testifying before the U.S. House Subcommittee on Highways and Transit.

"This is a point that should be driven home in every campaign for work zone safety," Carlson said, "because most drivers think it's not their problem."

***More danger for drivers than for workers***

A Georgia Department of Transportation survey found that 70 percent of the drivers in its focus groups believed work zones were more dangerous for the workers standing outside on the project than for vehicle occupants.

While the government and the highway contractors are doing what they can to make navigating work zones easier and safer, drivers should have a high degree of self–interest.

Slow down, read the signs, and follow the directions. Save your own life and your own vehicle from damage.

# Phase III of Pooled–Fund Study on "Hydraulic Computer Models" Complete

The third phase of the pooled–fund study entitled "Development of Hydraulic Computer Models to Analyze Tidal and Coastal Stream Hydraulic Conditions at Highway Structures" was recently completed by Ayres Associates, Inc. The SCDOT has served as lead state for this study during all three phases. Other states that participated in this phase of the study were: Georgia, North Carolina, Virginia, Connecticut, Maine, New York and New Jersey.

The main objective of the study has been to advance the field of hydraulic and scour analyses of bridges over tidal waterways. Highway structures in tidal waterways are subjected to foundation scour and stream instability resulting from dynamic flow conditions caused by tides, currents, storm surges and upland runoff. The phases of the study have focused on (1) evaluating computer models to determine which models were well suited for simulating unsteady tidal flow conditions at bridges, (2) developing recommendations on selecting boundary conditions for computer simulations, (3) developing manuals for tidal bridge hydraulics, and (4) providing training and technical support to pooled–fund member states. In the third phase of this study additional research was conducted, the manuals were updated, and additional training was conducted. The research included (1) relating hurricane category to frequency of occurrence along the east coast, (2) developing a method for predicting the rate of contraction scour at a bridge, (3) developing recommendations on including upland runoff in hurricane storm surge analyses, (4) developing an alternative storm surge stage hydrograph, (5) providing guidance on computing wave heights at bridge openings, and (6) providing guidance on incorporating wind into tidal simulations.

*If you would like to obtain a copy of the final report, contact Mr. Terry Swygert by telephone at (803) 737-6652 or e-mail swygerttl@dot.state.sc.us.*

***The not–too–distant future…***

## Hydrogen Fuel Cells may Power the Future

Has the reign of the combustion engine come to an end?

Ford Chairman William Clay Ford Jr. thinks hydrogen fuel cells will take the place occupied by the combustion engine for the last 100 years.

Hydrogen which, unlike electricity, is easy to store, has been the subject of investment and research for the last decade. If Ford is right, within two years we'll see products using hydrogen fuel cells capable of powering cars, buses, and even commercial buildings and houses.

At first, cells will be expensive and only niche products will use them. The infrastructure to deliver hydrogen on a massive scale could take decades.

Still, major oil companies such as Royal Dutch/Shell have begun to bet on a hydrogen future. Manufacturers have too, including United Technologies, General Electric, DuPont, and every major car company.

Worldwide, the seeds of oil displacement are becoming visible. Next year, three major energy companies in Scandinavia plan to build a pilot plant to make hydrogen from wind power, according to Fortune. The Scandinavians plan to use it in fuel-cell-equipped buildings and vehicles such as DaimlerChrysler's hydrogen-powered buses that are due out next year.

The auto industry has made bold investments in the new technology. Four years ago Ford and Daimler-Benz (now DaimlerChrysler) committed $750 million to producing fuel-cells cars by 2004. GM and Toyota teamed up to pursue the same goal.

# Roller Compacted Concrete Project, Aiken County, SC

With the assistance of the Portland Cement Association (PCA), a 1000–foot demonstration section of Roller Compacted Concrete (RCC) was placed on Powell Pond Road in Aiken County in March 2002. The material was produced by LaFarge Concrete and placed by C. Ray Miles Construction Co. to a depth of six inches. The Research and Materials Laboratory will monitor this section over the next several years to observe its performance.

According to the PCA, the first use of RCC was to pave logging facilities in Canada during the mid–1970s when dry land log sorting was made mandatory in British Columbia. RCC has also been used extensively by the US Army Corps of Engineers to pave hardstands for tanks due to its ability to withstand the turning and scuffing motions of tracked vehicles. The largest RCC paving project was the Saturn automobile manufacturing facility in Spring Hill, Tennessee, where 135 acres of roads, parking, and staging areas were paved in the late 1980's and early 1990's.

RCC is a stiff, zero-slump concrete mixture with the consistency of damp gravel and is comprised of aggregates,

**Before placement, The RCC appears damp and has no liquid paste.**

Portland cement, and water. It is similar in concept to the SCDOT's Cement Modified Aggregate Base, but with a different gradation and approximately twice the cement content. The mixture is placed using a modified asphalt paver and roller compacted with the same commonly available equipment used for asphalt pavement construction to 98 percent of maximum theoretical density as measured by AASHTO T 180. The process requires no forms, finishing, or surface texturing. Although many RCC paving projects do not have sawed contraction joints, single saw cut joints were placed at 30-foot intervals on the demonstration project to avoid unaesthetic cracking.

Once cured, the specifications require that the RCC develop a compressive strength of at least 5000 psi in 28 days.


However, on the demonstration project, strengths of over 3000 psi were developed in three days and strengths over 5000 psi were developed in seven days. Tests performed on other RCC projects indicate that the flexural strength of RCC is equivalent to traditional paving concrete.

It is hoped that RCC can provide an economical paving alternative in lower volume applications where substantial heavy truck traffic is expected. It also may have applications as a heavy-duty base course when placed under approximately 400 psy of asphalt surface and intermediate courses. Eight inches of RCC is expected to have the structural capacity of 1000 to 1200 psy of Asphalt Aggregate Base, can be placed in one lift, and can be temporarily used by automotive traffic within a few hours of placement.

**RCC being placed and compacted at a width of 24 feet using a modified asphalt paver and vibratory roller. Note the nuclear density gauge being moved into position at left for quality control measurements.**

**The finished product has a surface texture similar to asphalt. The valley gutters on this project were poured using conventional ready–mix concrete.**

## Research Projects Started Between January 1, 2002 and June 30, 2002

**SPR No. 630**, "Investigation of Graded Aggregate Base (GAB) Courses"
*Principal Investigator: Dr. Ronald L. Baus, University of South Carolina*

**SPR No. 634**, "Safety Considerations for Night-Time/Weekend Construction Activities"
*Principal Investigator: Dr. W. Edward Back, Clemson University*

**SPR No. 635,** "Assisting SCDOT in Analyzing, Verifying and Utilizing Transit"
*Principal Investigator: Wilber Smith Associates*

**SPR No. 636,** "Evaluation of South Carolina Aggregate Durability Properties"
*Principal Investigator: Dr. Prasada R. Rangaraju, Clemson University*

**SPR No. 637,** "Evaluation of the Use of Gyratory Compactor Asphalt Specimens for Tensile Strength Ration (TSR) Determination"
*Principal Investigator: Chad W. Hawkins, SCDOT*

**SPR No. 638,** "The South Carolina Department of Transportation and Its Economic Impact on the State of South Carolina"
*Principal Investigator: Dr. Donald L. Schunk, University of South Carolina*

**SPR No. 639**, "Establishment of Resident Construction Engineer Academy"
*Principal Investigator: Dr. M. Hanif Chaudhry, University of South Carolina*

**SPR No. 640,** "Meeting Air Quality Standards through Alternative Scenarios in Transportation Modeling"
*Principal Investigator: Emily J. Terrell, Clemson University*

## Research Projects Completed Between January 1, 2002 and June 30, 2002

**SPR No. 581**, "Development of Pavement Marking Materials On I-20, Lexington County"
*Principal Investigator: Terry L. Swygert, SCDOT*

**SPR No. 591**, "Development of Hydraulic Computer Models to Analyze Tidal and Coastal Stream Hydraulic Conditions at Highway Structures – Phase III"
*Principal Investigator: Ayres Associates, Inc.*

**SPR No. 595**, "Evaluation of Retroreflectivity of Interstate Markings"
*Principal Investigator: Dr. Wayne A. Sarasua, Clemson University*

**SPR No. 611**, "Impact Assessment of the New Cooper River Bridge, Charleston, SC"
*Principal Investigator: Dr. Arthur A. Felts, College of Charleston*

**SPR No. 613**, "Technology Transfer Programs for Concrete QC/QA Certification of Contractors & SCDOT Personnel"
*Principal Investigator: Dr. M. Hanif Chaudhry, University of South Carolina*

**SPR No. 624,** "Establishment of Foundations Inspector's and Earthwork and Base Course Inspector's Certification Courses"
*Principal Investigator: Dr. Serji N. Amirkhanian, Clemson University*

*If you would like a copy of the final report for any of these projects, please contact:*

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## Comments and Suggestions

The *RD&T Newsletter* is published on behalf of the SCDOT by the SC Transportation Technology Transfer Service at Clemson University ($T^3S$).

If you have suggestions, comments, or article submissions for the newsletter, please contact Mike Sanders at 803-737-6691, or mail them to:

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### *Engineering Humor 101*

To the optimist, the glass is half full. To the pessimist, the glass is half empty. To the engineer, the glass is twice as big as it needs to be.

## Coming Soon—New RD&T Web Site

The Research and Materials Lab has begun work on a new web-site. The site will include:

- Research contacts with names and contact information
- List of active SCDOT research studies along with a brief description
- List of completed SCDOT research studies with a summary of the findings
- Announcements for meetings related to research projects
- Latest RD&T Newsletters
- Links to other applicable research entities
- TRB Annual Meeting Schedule

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