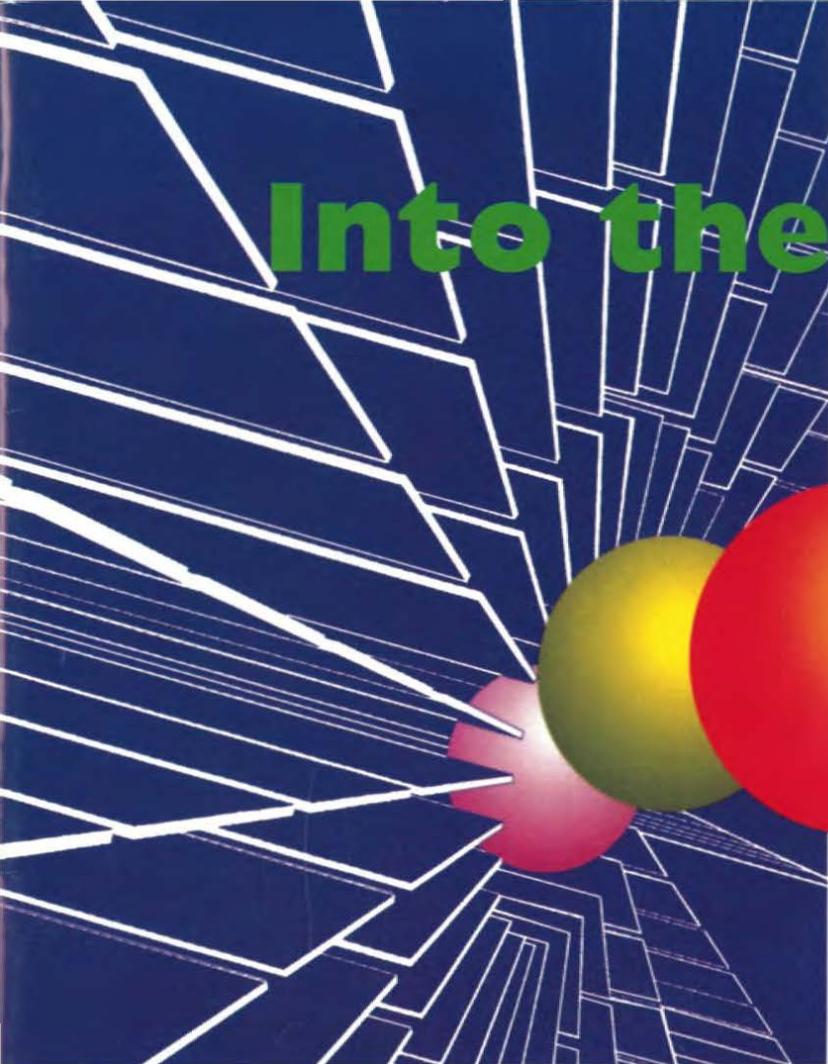


Into the Future



*MoDOT's Research
Development and
Technology Division's
Year In Review*



The mission of the Missouri Department of Transportation is to preserve, enhance and support Missouri's transportation systems.

The mission of the Research Development and Technology Division is to enhance a quality transportation system through research, development and technology transfer to ensure the implementation of innovative ideas and technology.

MoDOT's Research Development and Technology Division's Year In Review is compiled and produced by the Missouri Department of Transportation Research Development and Technology Division and the Public Affairs Division. Additional copies of this publication are available upon request. For more information or to request more copies of this brochure, send inquiries to: RDT's Year In Review, Research Development and Technology Division, Missouri Department of Transportation, P.O. Box 270, Jefferson City, MO 65102, or call Technology Transfer at (573) 751-0852 or 1 (888) ASK-MODOT.

Into the Future

This booklet reviews the accomplishments and technological advances MoDOT's new Research Development and Technology Division made during its first year.

Research -- Providing Answers for the Future	5
In the Beginning	6
Strategic Need for Research	9
Building a Solid Foundation	11
Program Administration	11
<i>Ground Penetrating Radar</i>	13
Research	15
<i>Lead States - HPC, Reinforced Concrete Structures</i>	15
<i>Fiber-Reinforced Concrete</i>	19
<i>Specific Pavement Studies</i>	21
Development	22
<i>Pothole Patchers</i>	23
<i>Truck- or Tractor-Mounted Pavement Sensors</i>	25
<i>Zero-Velocity Spreaders</i>	27
<i>Scrub Seal</i>	29
<i>Plastic Ditch Block</i>	31
Technology Transfer	33
<i>Salt Brine</i>	35
<i>School Transportation Program</i>	36
Future Plans	37

Inside...

“In a changing and progressive world, we can’t be satisfied doing things the same old way,” says Jim Murray, RDT Division Engineer. “People ask how we can afford to spend our money on research when really they should be asking how can we afford not to.”

Research — Providing Answers for the Future

Research is the process by which we solve problems and answer questions so our world is able to move forward instead of backward. Throughout history, research has provided the transportation industry with significant new developments as well as effective economical solutions to problems. Through research we discovered a box with two wings and an engine can fly. We discovered bicycles work better with two wheels instead of one. And, we discovered which type of pavement material works best under certain weather and traffic conditions.

The future of research at the Missouri Department of Transportation (MoDOT) holds exciting new developments and opportunities. MoDOT increased its emphasis on research recently in order to preserve, enhance and support Missouri's overall transportation system. To ensure this emphasis, MoDOT developed the new Research, Development and Technology (RDT) Division on April 1, 1996.

"Research must be a priority because it is essential in equipping the department to preserve and enhance Missouri's transportation system," says Joe Mickes, MoDOT chief engineer. "The transportation system has a vital role in people's daily lives."

The RDT Division is implementing strategies to ensure innovative ideas and technology equip the state's transportation systems for the future. By concentrating on research, development and transfer of technology, MoDOT will continue to expand its knowledge to provide a total transportation system for Missourians. For the average Missourian, this will mean safer, faster and more economical travel.

"The RDT Division provides a focal point for research activities within MoDOT and is committed to working with other divisions to see to it that the department's research and development needs are addressed and implemented," says RDT Division Engineer Jim Murray.

In the Beginning...

1923 The first Central Laboratory was located in the basement of the Missouri Capitol. The laboratory operated under the Bureau of Materials and was equipped to take care of the routine chemical analysis of cement, steel, water, paint, oil, asphalt, tars, creosote and many other materials entering into or connected with highway construction.

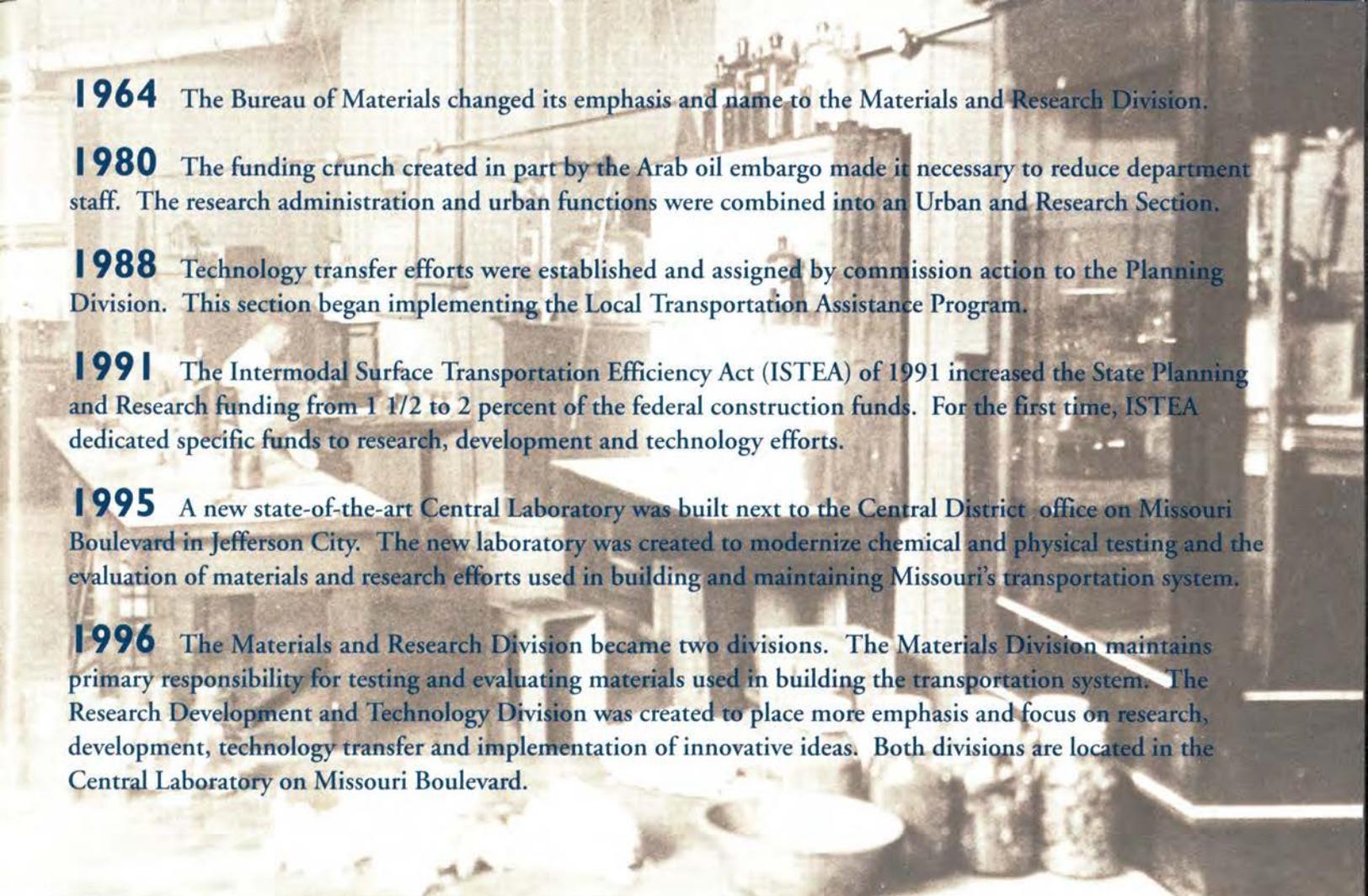
1928 After operating in the Capitol for five years, the Central Laboratory moved to the basement of the highway building at the corner of Capitol and Jefferson streets. Their operations were increased to include geology, core drilling and research.

F. V. Reagel was the first engineer of Materials and Tests. Reagel was the department contact with the National Research Council and Highway Research Board, which was the predecessor of the Transportation Research Board (TRB).

1938 The Central Laboratory moved to a new two-story building on Missouri Boulevard in Jefferson City where it shared the space with MoDOT's Central District office.

1953 A research section was created within the Bureau of Materials.

1962 The Federal Aid Highway Act of 1962 included a funding category for Highway Planning and Research. The Missouri Highway Department established a Research and Development Section within the Division of Planning. This section's responsibilities included the administration of contract research studies.



1964 The Bureau of Materials changed its emphasis and name to the Materials and Research Division.

1980 The funding crunch created in part by the Arab oil embargo made it necessary to reduce department staff. The research administration and urban functions were combined into an Urban and Research Section.

1988 Technology transfer efforts were established and assigned by commission action to the Planning Division. This section began implementing the Local Transportation Assistance Program.

1991 The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 increased the State Planning and Research funding from 1 1/2 to 2 percent of the federal construction funds. For the first time, ISTEA dedicated specific funds to research, development and technology efforts.

1995 A new state-of-the-art Central Laboratory was built next to the Central District office on Missouri Boulevard in Jefferson City. The new laboratory was created to modernize chemical and physical testing and the evaluation of materials and research efforts used in building and maintaining Missouri's transportation system.

1996 The Materials and Research Division became two divisions. The Materials Division maintains primary responsibility for testing and evaluating materials used in building the transportation system. The Research Development and Technology Division was created to place more emphasis and focus on research, development, technology transfer and implementation of innovative ideas. Both divisions are located in the Central Laboratory on Missouri Boulevard.

RDT's Vision: *To be an active and effective, nationally recognized Research Development and Technology Division that responds to the technology needs of Missouri's transportation system while ensuring and maintaining a quality research emphasis.*

RDT's Mission: *To enhance a quality transportation system through research, development and technology transfer to ensure the implementation of innovative ideas and technology.*

Strategic Plan Identifies Need for Research Division



In the fall of 1994, the department initiated the Research Administrative Team, a task force charged with reviewing federal regulations and existing department research, development and technology transfer administrative procedures. This was one of the first steps taken by the department to place more emphasis on research. The team concluded its work in the spring of 1995 and made several recommendations to senior management regarding department research activities. In response to the recommendations, senior management formed the Research Administrative Unit in the summer of 1995. The Research Administrative Unit was established to develop a strategic plan for department research, development and technology transfer.

The research strategic plan provides a focus and direction for the department's research, development and technology transfer by establishing goals and objectives for the division. The result of implementing the strategic plan will be enhanced departmental performance of all research, development and technology transfer activities. After the strategic plan was reviewed by MoDOT management, it was decided that the best way to accomplish this was to dedicate an entire division to these activities. In April 1996, this vision became a reality and MoDOT's research program took off.

The development of the RDT Division is another example of the department's ongoing effort to provide outstanding customer service to meet the ever-changing needs of Missouri citizens. An RDT Division with an established vision and mission is instrumental as the department works to provide the safest, most effective and efficient transportation system for Missouri.

“All of our products are a team effort,” says Jim Murray, RDT Division Engineer. “We don’t consider anything a product of just one of our emphasis areas. This first year, we have had positive accomplishments through the cooperative work of all emphasis areas.”

Building a Solid Foundation



The best way to ensure the Research Development and Technology Division is a reliable structure that serves its purpose is to begin with a solid foundation. This foundation consists of four different emphasis areas: program administration, research, development, and technology transfer. Each area is as important as the other and serves a different purpose; but, because these areas work together as a division, Missouri is ensured progress for its transportation future.

“All of our products are a team effort,” says Jim Murray, RDT Division Engineer. “We don’t consider anything a product of just one of our emphasis areas. This first year, we have had positive accomplishments through the cooperative work of all emphasis areas.”

Program Administration

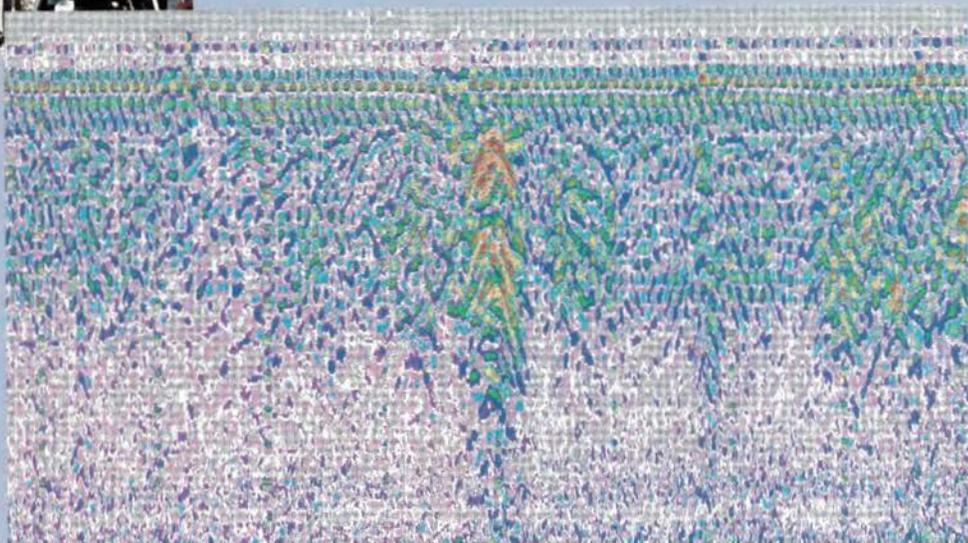
Before you can perform research, development or technology transfer, you must have direction and funds. The program administration emphasis of the division is responsible for developing the State Planning and Research Work Program, which identifies annual research priorities and the federal or state funds needed to perform all the projects. This program includes accomplishments of the current and previous year and proposed goals for the next year.

The program administration emphasis area is also responsible for coordinating National Highway Institute training and contracting research the division performs with universities and private companies. One of the RDT Division’s examples of contract research with a university involved the University of Missouri-Rolla using Ground Penetrating Radar.



University of Missouri-Rolla graduate students set up the Ground Penetrating Radar (GPR) system in the Springfield Area District during summer 1997. GPR works by sending short, precisely-timed pulses of radio frequency energy from the radar antennas into a bridge deck, pavement or subsurface. The radar provides a 10-foot view of the subsurface. Each pass of the radar shows oddities in ground-structure density, including any holes. The results of the GPR showed a few void areas that could form holes. These subsurface areas, called grikes, were irregularly shaped and ranged in approximate diameter from 2 to 5 feet.

This sample of a Ground Penetrating Radar readout shows subsurface conditions in the Springfield Area District. The lighter-colored areas indicate loose material with air voids. The darker and more purplish areas are the higher-density material.



MoDOT and UMR Use New Technology to Study Sinkhole Problem

One example of MoDOT research contracted out to a university is the Ground Penetrating Radar (GPR) project MoDOT and the University of Missouri-Rolla (UMR) worked on together. After several small holes opened up in the median, shoulder and right of way of Interstate 44 in Springfield, MoDOT contacted UMR experts to help analyze the situation. RDT staff contracted this research project where UMR graduate students and professors worked with Springfield District Operations personnel on a geophysical study of the area, which determined the soundness of underlying soil.

“We wanted a state-of-the art look at what was going on underground,” says Harry Price, Springfield District Engineer. “We weren’t anticipating any problems with the highway, but we needed to understand why these holes were appearing, and what was going on underground.”

In order to get a full picture of the geology, GPR was used to scan below the ground’s surface for problems. This is a significant improvement over former methods of determining conditions below the surface of a bridge deck or pavement. Whereas past methods were time-consuming and labor-intensive, GPR operates at high speeds and requires a crew of only two people. Software developed by the Strategic Highway Research Program makes GPR a powerful and easy-to-use tool for sub-surface studies or bridge and pavement management.

MoDOT’s RDT Division continues to look at other ways GPR technology can assist in everyday operations. GPR technology can also determine pavement thickness, which is useful in assessing the pavement’s load capacity and deciding how much material to remove when rehabilitating a pavement. This technology can also be used to survey a concrete bridge deck. The software determines the location and quantity of concrete deterioration, calculates the depth of the reinforcing steel, and can measure the thickness of the bridge deck and asphalt overlay with further development. Further refinement of GPR technology may lead to a better tool for bridge and pavement management.

Lead States in SHRP Technology

SHRP Technology Groups

Assessment, Protection & Rehabilitation of Reinforced Concrete Structures

Innovative Pavement Maintenance Materials

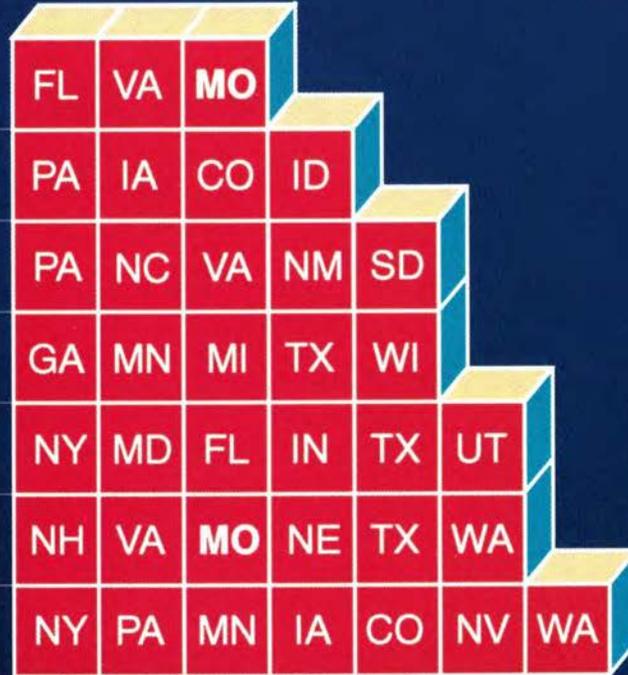
Alkali Silica Reactivity

Preventive Maintenance

Superpave

High-Performance Concrete

Anti-Icing/
Roadway Weather
Information Systems



Lead States

An American Association of State Highway and Transportation Officials (AASHTO) task force selected seven Strategic Highway Research Program (SHRP) high-payoff technologies for lead states to concentrate on and then asked for volunteers. Twenty-one states chose to serve as lead states because they were committed to leading and assisting in the implementation of specific SHRP technologies in which they had interest and practical experience. Missouri chose to emphasize high-performance concrete and the assessment, protection and rehabilitation of reinforced concrete structures.

Research

The research emphasis area is the next step in putting a new product on the road. Research is a word used for a broad range of tasks, but at MoDOT research essentially means physically investigating products or concepts to see what the possibilities are. Through research, state transportation departments across the country are able to improve materials and operations and provide a more cost-effective transportation system.

There are two types of research: hard and soft. Hard research involves physically evaluating materials and methods used in the infrastructure. This is the type of research the RDT Division performs for the most part. But soft research, which involves planning, safety, traffic operations and policy issue analysis, can prove to be just as valuable. The department expects to expand its soft research in the future.

The RDT Division has expanded their research role in the past year. One example of research from the RDT Division is its work with the two Strategic Highway Research Program (SHRP) lead state teams on high-performance concrete and the assessment, protection and rehabilitation of reinforced concrete structures.

Missouri Participates as Lead State in SHRP Implementation

An American Association of State Highway and Transportation Officials (AASHTO) task force created lead states to implement technology uncovered through the Strategic Highway Research Program (SHRP). Missouri volunteered in September 1996 to serve as one of 21 lead states. SHRP, a five-year \$150 million research program, was established by Congress in 1987 to improve the performance, durability and safety of our nation's roads.

The AASHTO task force created the concept of having certain states take the lead in SHRP technology implementation in order to share results and information with other states. By having state, Federal Highway Administration (FHWA) and industry representatives work together, states capitalize on their own and each others' strengths to implement the technology.

High-Performance Concrete (HPC)

"Concrete with enhanced strength and durability characteristics."

Advantages of HPC:

▼ Higher strengths

*longer spans/fewer bents
fewer beams*

▼ Increased durability

*less maintenance
longer life*

Example components of HPC:

- *lower W/CM ratios*
- *optimize cementitious materials*
- *use chemical admixtures*
- *higher contents of coarse aggregate*
- *use local materials*
- *tighter quality control*

High-Performance Concrete

Missouri has made significant progress in the high-performance concrete (HPC) technology area. HPC is concrete with enhanced strength and durability characteristics that contribute to stronger and more durable structures. HPC's improved durability translates into bridges that hold up better to traffic, climate and other conditions. The material's increased strength allows bridge designers to use more efficient girder cross sections and to eliminate some girder lines or piers, which can cut overall costs. The result is longer-lasting and potentially less expensive bridges.

"The team's real progress will actually be demonstrated in the advancements and implementation of HPC in the non-lead or current non-user states of HPC," says Patty Brake, senior research and development engineer. "That is the whole objective of the Lead State Program — nationwide and cost-effective implementation of technology for better performance."

Missouri developed its own HPC focus team with MoDOT and industry representatives to develop HPC for use in pre-stressed bridge members and other uses. Missouri's first HPC bridge project is scheduled to be contracted in fall 1997.

Assessment, Protection and Rehabilitation of Reinforced Concrete Structures



A MoDOT employee works on rehabilitating a state bridge.

Missouri sponsored a SHRP Showcase Feb. 3-5, 1997, to begin disseminating information on assessment, protection and rehabilitation of reinforced concrete structures. This emphasis area examines new equipment and information to repair and protect bridges and other concrete structures, as quickly and cost-effectively as possible. Representatives from Kansas, Nebraska, Iowa and Missouri attended the showcase, which included hands-on training on computer programs and physical assessment equipment.

“As a lead state, Missouri has a key role in this SHRP technology,” says Chief Engineer Joe Mickes. “Missouri looks forward to continued progress and prosperity with SHRP technology and implementation. The results of working together with other lead states means stronger transportation systems in Missouri and across the country.”

On Feb. 24, 1997, Missouri attended a team leader meeting, sponsored by the AASHTO Task Force on SHRP Implementation, where representatives from all seven high-payoff technologies reported to the task force on the progress of their emphasis areas. Senior Research and Development Engineer J.D. Wenzlick attended the meeting to report on the assessment, protection and rehabilitation of reinforced concrete structures. “Together Virginia, Florida and Missouri will evaluate 24 SHRP technologies and make recommendations for implementation,” Wenzlick says. “The teams recommendations will be a guideline to the rest of the 50 states.”



This concrete block broken in two shows the steel fibers incorporated into the concrete. These fibers improve material performance properties of concrete, including toughness, bending strength, impact resistance and fatigue strength. The RDT Division is currently researching the performance of fiber-reinforced concrete for designing and constructing thinner and more durable Missouri pavements that would have longer service lives and less maintenance.

Fiber-Reinforced Concrete May Mean More Durable Pavements

The RDT Division is currently researching the performance of fiber-reinforced concrete for designing and constructing thinner and more durable Missouri pavements, that would have longer service lives and less maintenance. This would result in saving department time, money and resources.

Fibers incorporated into concrete have been shown to improve material performance properties of concrete, including toughness, bending strength, impact resistance and fatigue strength. Taking advantage of these enhanced performance capabilities by utilizing fibers in pavement applications may offer a desirable alternative to conventional concrete pavement.

The department's study, the *Laboratory Evaluation of Fiber-Reinforced Concrete*, involves evaluating concrete mix designs using steel and polyolefin fibers at various dosage rates. In addition to gathering data on the effects fibers have on concrete's compressive and bending strength, the project includes a contract with the University of Missouri - Columbia to test specimens for toughness and fatigue endurance.

"The cost of the fiber-reinforced concrete pavement is higher initially," says Patty Brake, senior research and development engineer. "However, if we're able to use thinner pavements, then that's less material, which will cut costs. And if the pavements are more durable and last longer, then that's less maintenance over a longer life. In the long run, these pavements should be more cost-effective."

In January 1998, the department will test the effects of fiber-reinforced concrete on a highway project on Interstate 29 in the Northwest District. Results from this field test will help the RDT Division determine the extent to which fiber-reinforced concrete will be used in the future.

Missouri's Specific Pavement Studies Test Sites



This map of Missouri shows the seven existing Specific Pavement Studies (SPS) test sites and the four sites to be constructed in 1998. The Research Development and Technology Division, along with several MoDOT districts and divisions, nominates, constructs and monitors pavement test sections for the Long-Term Pavement Performance Program (LTPP) in hopes of producing more durable, longer-lasting and cost-effective roads.

Long-Term Pavement Performance Program Produces Better Roads

The Research Development and Technology Division, along with several MoDOT districts and divisions, nominates, constructs and monitors pavement test sections for the Long-Term Pavement Performance Program (LTPP) in hopes of producing more durable, longer-lasting and cost-effective roads. The pavement test sections are called Specific Pavement Studies (SPS). Missouri currently has seven SPS test sites and will construct four additional test sites in 1998.

The LTPP is a 20-year study of pavements across North America. Established as part of the Strategic Highway Research Program (SHRP) in 1987 and now managed by the Federal Highway Administration (FHWA), its goal is to develop improved pavement technologies.

By participating in the Long-Term Pavement Performance Program, Missouri is able to capitalize on several opportunities. For example, the availability of other state's data to compare with our own enables MoDOT to determine if our designs and methods are acceptable and comparable with other states. MoDOT is also able to look for LTPP data that will be beneficial to our design experts when producing new roads. Knowledge of proper sampling and testing methods for paving projects and the insight into tests necessary for performance specification helps MoDOT to further reach its goals of improved roads. Finally, the LTPP provides MoDOT with the opportunity to compare test results and ensure accuracy of equipment and test methods with other states.

Development

Developing something that has been researched involves putting all the tests together and designing a product that can be used on Missouri's transportation system.

"Development is the area the department needed the most when the RDT Division was created," says Jim Murray, RDT Division Engineer. "There are so many opportunities in development for MoDOT to take advantage of — and we've capitalized on them in this past year."

"Development is the area the department needed the most when the RDT Division was created," says Jim Murray, RDT Division Engineer. "There are so many opportunities in development for MoDOT to take advantage of — and we've capitalized on them in this past year."

The development emphasis area works with new product development as well as products we already use. In many instances, the RDT Division develops products that have already been researched by other states, companies or universities and refines them for MoDOT's use. The RDT Division had many opportunities this first year to develop several new and existing products including truck-mounted temperature pavement sensors, zero velocity spreaders, pothole patchers, scrub seals and plastic ditch blocks.

Pothole Patchers Save Time and Resources

In the past, pothole patching involved a three- or four-man crew working an extensive amount of time under many safety concerns. In the interest of finding a safer and more efficient pothole patching process, the department's RDT Division evaluated several truck and trailer-mounted pothole patchers from October 1996 through February 1997. The pothole patchers are the result of research developed through the federally funded Strategic Highway Research Program (SHRP).

The five-month investigation involved evaluating four different trailer-mounted patchers in all districts, and two truck pothole patchers in three districts. Based on evaluations of field personnel, Research and Development staff concluded that truck and trailer-mounted units could reduce manpower requirements while increasing the safety of MoDOT maintenance personnel during patching operations.

Under the RDT Division's recommendation the General Services Division is currently working on a lease arrangement for MoDOT's 1997 winter season for both the trailer-mounted Dura Patcher distributed by Tri-State Equipment Company and the Wildcat Roadpatcher truck distributed by Key Equipment Supply Company.



A MoDOT employee operates the Wildcat Roadpatcher truck as it patches potholes. MoDOT is currently working on a lease agreement to use this truck for the 1997 winter season.





(Left) The pavement sensors consist of two parts—the sensor head (shown mounted to the outside rearview mirror) and the display. The sensor head detects heat energy from the road surface, much as a camera light meter detects light from the subject. The sensor head, which is mounted on the outside rearview mirror, has a clear view of the road surface.

(Below) The pavement sensor display is a 2-inch round gauge that installs on the dash. A shielded cable connects the sensor head to the display, a ground and 'hot' wire complete the installation. The display has two rows of digital displays. The top display is the air temperature, and the lower (larger) set of numbers is the road surface temperature.



Truck-Mounted Pavement Sensors Could Save Lives

Each winter Missouri highways packed with snow and ice are responsible for roadway accidents, that often cause injuries and sometimes deaths. Prevention of these accidents can save lives and hundreds of thousands of dollars. A pavement temperature sensor, the *Road Watch Warning System*, gives department employees an indicator as to the best time to start applying roadway chemicals, which could help keep roadways clear of snow and ice or help to speed up the removal process. The result of this should mean fewer roadway accidents, injuries and inconveniences.

The Research, Development and Technology Division has used Federal Highway Administration funds to purchase 53 of these truck-mounted pavement temperature sensors. These sensors are mounted to the outside rearview mirror and will be distributed to approximately half of the regional maintenance supervisors in the state for evaluation. RDT is trying to determine if by using these sensors to determine the optimum time to begin chemical application there is a cost savings in material, labor and equipment usage.

Currently, MoDOT can monitor the air temperatures, but these temperatures do not necessarily coincide with the pavement surface temperatures. It is the pavement surface temperature that dictates when precipitation adheres to the pavement.

These pavement sensors will be evaluated from November 1997 through January 1998. A final report of their performance will be available in April 1998. All positive and negative aspects of the sensors will be evaluated during this time. The department will check accuracy of all sensors by comparisons with actual surface temperatures. MoDOT will also keep a record of chemical usage by trucks that have these sensors and those that don't. Chemical usage should be less on a truck equipped with a temperature sensor. If the sensors prove successful, regional maintenance areas will be able to budget for sensors to assist in the snow and ice control effort.



Zero-Velocity Spreader Clears Winter Roads Quickly and Effectively

Since winter 1995, MoDOT has been evaluating a zero-velocity spreader for use where and when it is critical to de-ice highways as effectively and quickly as possible.

A zero-velocity spreader is an attachment that slips in the back of the bed of MoDOT's heavy-duty snow removal maintenance trucks. This attachment shoots the salt used to melt roadway ice straight back behind the truck at a velocity that is the same speed the truck is moving. This allows the salt to drop straight down to the pavement at zero mph, which means better placement and 30 to 50 percent savings of materials. Zero-velocity spreading allows operators to spread de-icing materials at speeds two to three times faster than spinner spreaders. This allows operators to cover more roads in less time.

"The zero-velocity spreaders are great for any areas where we need to cover a lot of miles quickly," says Don Davidson, RDT's director of development. "They're more expensive than our conventional spinner spreaders, so they will be used on high-priority routes, where clearing the roads quickly is more crucial."

For other areas of the state, spinner spreaders are used to de-ice the roadways. Spinner spreaders scatter salt over the road at the same speed of the truck. Some of the material ends up bouncing off the road eliminating its effectiveness. Because the salt is dispersed at the same speed as the truck, drivers have to move more slowly to ensure the least amount of salt is wasted as possible.

The RDT Division is currently developing a final report on the zero-velocity spreader and making recommendations for its usage. Each of MoDOT's 10 districts will have at least one to use in its urban areas; a total of 29 will be distributed statewide.



Scrub Seal Procedure Saves Deteriorating Roads and Money

The Research Development and Technology Division has been developing and encouraging implementation of scrub seal, a new maintenance procedure that will allow MoDOT to maintain roadways that are not on the right of way and construction program for resurfacing, but are continuing to deteriorate.

The first scrub seal material was developed in Arizona last year. MoDOT recently began developing a similar material to use on Missouri highways. This process is designed for a road with a good foundation, but the asphalt is beginning to oxidize and lose aggregate. Scrub seal is an oil-based surface treatment that restores some of the original properties back to the asphalt extending the road's life another three to five years.

"This surface treatment is about half the price of other surface treatments," says Ivan Corp, senior research development engineer in charge of scrub seal implementation. "We have had very favorable results so far, and we hope to make it a permanent part of our maintenance program by 1998."

After the scrub seal is applied directly to the pavement, a 12-foot-wide broom scrubs the oil down into the cracks and carries the excess forward to fill irregularities in the pavement. This process is followed by an aggregate spreader. A second broom scrubs the aggregate into the asphalt. The seal is then rolled with a pneumatic roller. Total cost per lane mile is \$1,700 compared to approximately \$10,000 per lane mile to resurface.

Before the RDT Division developed the scrub-seal material, a process called chip seal was used to extend the life of a road. "The chip seal process involved using three times as much asphalt, it was twice as expensive as the scrub seal, and it had more side effects," Corp says. "The chip seal used larger aggregate that could get loose and fly up and damage or break windshields, whereas the scrub seal uses much smaller aggregate that eliminates those side effects. The scrub seal is also faster to apply."

The RDT Division is currently tracking and evaluating the results of the scrub seal in several projects.



Plastic Ditch Check Provides Efficient and Economic Erosion Control

In September 1996, the Research Development and Technology Division began evaluating a plastic silt stopper ditch check for use as an alternate to the traditional straw bale as temporary erosion control on MoDOT roadway projects.

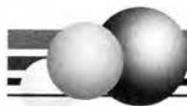
State highway agencies are required by the Environmental Protective Agency (EPA) to provide erosion control measures on all highway projects on which excavation or grading is performed. Erosion controls are necessary to protect landowners adjacent to projects with grading and earthwork from unwanted and possibly damaging silt deposits. The ditch checks are a temporary method of erosion control used while the project is active. They are removed when permanent erosion control, such as seeding and mulching, are in place.

Erosion control is a significant part of a construction project, and if it is not maintained properly, a project can be significantly affected, even shut down. The primary method of controlling erosion sediment in construction ditches has been the use of straw bales. Although inexpensive to use, once straw bales are wet they are difficult to remove or relocate for final grading.

The plastic ditch check is reusable, lightweight, recyclable and weather resistant. It also takes less time to install than straw bales. The plastic ditch checks initially appear to be more expensive, but they can be reused numerous times, so their life cycle cost may be less than straw bales.

Final evaluation of the plastic silt stopper ditch checks is planned for late 1997 or early 1998. RDT staff engineers are responsible for documenting the installation and evaluating the test results every 30 days for the duration of the project. Equal numbers of silt stopper and straw ditch checks will be installed and evaluated.

When the evaluation period is complete, MoDOT will prepare a final report and distribute it to the divisions that use ditch checks as erosion control in construction projects. The results will determine whether the department will allow the use of plastic ditch checks in lieu of straw bales.



Research, Development & Technology Division

Quarterly

Missouri Department of Transportation

Vol. 1, No. 3



Ivan's maintenance experience has been a great benefit to the research, development and technology transfer effort.

Ivan Corp's role

Ivan joined the RDT Division on August 1, 1996, with the assignment to concentrate on maintenance research. He is involved with identifying and implementing research completed by the SHRP Program.

He has traveled to every district in the state, and held follow-up meetings in some districts to discuss the merits of anti-icing, improved cold mix laying operations, and scrub sealing (see scrub seal article). This implementation is ongoing and will continue in the future.

Ivan's overall role is to teach and train with regard to best practices, identified by the SHRP Research Program or established through other documented procedures. He also helps identify, develop and implement new equipment which will help field maintenance crews do their work more effectively.

Scrub seal

The Research, Development and Technology (RDT) Division has been investigating a maintenance procedure called "Scrub Seal". It is a proprietary material developed in Arizona. Ivan Corp reports, "We began working immediately with our local asphalt vendor to develop a similar material. It is a high float cationic, polymer-modified emulsion with rejuvenator. It is applied directly to the pavement with an asphalt distributor, followed with a 12-foot-wide scrub broom that scrubs the oil down into the cracks and carries the excess forward to fill irregularities."

This process is followed by an aggregate spreader. We suggest the rate of 15 pounds per square yard. The next piece of equipment is the



Broom scrubs the oil into the cracks, carrying the excess forward to fill irregularities.

second broom that scrubs the aggregate into the asphalt. The seal is then rolled with a pneumatic roller, completing the procedure.

This process is designed for a road that has a good template, but is beginning to oxidize and lose aggregate.

(continued on next page)

TECH TRANSFER ASSISTANCE PROGRAM

Missouri Transportation Bulletin

Research, Development & Technology Division
Missouri Department of Transportation
Federal Highway Administration
Local Technical Assistance Program

Vol. 14, No. 1

Inside:

Missouri Transportation Finance Corp.
Workshop schedule
Roadway width for low traffic roads
Tire recycling

Howell County, South Central Ozark Council of Governments and LTAP partner in pilot project

The Local Technical Assistance Program recently had the opportunity to meet with Howell County commissioners and South Central Ozark Council of Governments (SCOCOG) officials to develop a pilot project of interest to regional planning organizations.

SCOCOG recently included in their annual work program a pilot project with the mission to identify needs and priorities of local county roads. The specific purpose of this pilot project was to assist Howell County with a long range county road improvement plan. GOAL: Conduct vehicle counts of Howell County roads to determine the most traveled routes in order to establish improvement priorities. Assist other counties in the region to identify and prioritize local needs in cooperation with MoDOT.

Mr. Carl Simmons, Field Testing Technician, in the Research, Development and Technology Division of the Missouri Department of Transportation, installed several different models of traffic counters near

Pamona as part of Howell County commission investigation to determine which counter best fit their needs. Howell County Presiding Commissioner, Roland "Piq" Paul of Willow Springs said commissioners wanted to find out which county roads are the most traveled and use that information as part of their planning for future road maintenance in the county. After the data collection methodology had been shared with the county and the RPC, the meeting turned to project selection and procedures to develop a project through a long range planning process.

Project selection steps included:
Inventory the facilities within the county:

- Roads - mileage
- Bridges - location, year built, condition, load limit, etc.
- Other drainage structures - less than 20 ft., low water crossing, culvert, etc.

Classify (rank) roads by:

- Amount of usage - traffic county
- Their level of service to industry, schools, residential areas, and others
- Condition rating.

Determine the worst roads and bridges in county (or city):



Simmons demonstrates several types and models of traffic counters in county and SCOCOG officials.

- Use knowledge of your maintenance people
- Use any engineering records available
- Use bridge rating scale (history).

Contact the following to determine if there are facilities they can not use; and how often, i.e., all the time, wet (continued on next page)

Technology transfer produces RDT Quarterly, a newsletter that keeps department employees updated on current RDT Division projects.

One of the ways technology transfer shares information externally is with a quarterly newsletter called the Missouri Transportation Bulletin.

Technology Transfer

After a product or process has been researched and developed, it's time to get the word out within the department and to the rest of the state and the country. This is the job of MoDOT's technology transfer emphasis area. By sharing information, there is a better chance these successes will be put to use on roads elsewhere, allowing many more people to profit from the RDT Division's work.

The technology transfer emphasis area uses many tools to share information. Internally, technology transfer sends out a quarterly newsletter, *RDT Quarterly*, that keeps department employees updated on current projects in the RDT Division.

Technology transfer also works extensively with cities and counties to share information as part of the Local Technical Assistance Program (LTAP). One of the ways it shares information externally is with a quarterly newsletter called the *Missouri Transportation Bulletin*.

Two examples of work from this emphasis area include the salt brine technology disseminated across the state in 1996 and 1997 and the development and distribution of the School Transportation and Traffic Safety Guidebook for Local Agencies.



LIQUID
SALT

New De-Icing Method Means Safer Roads

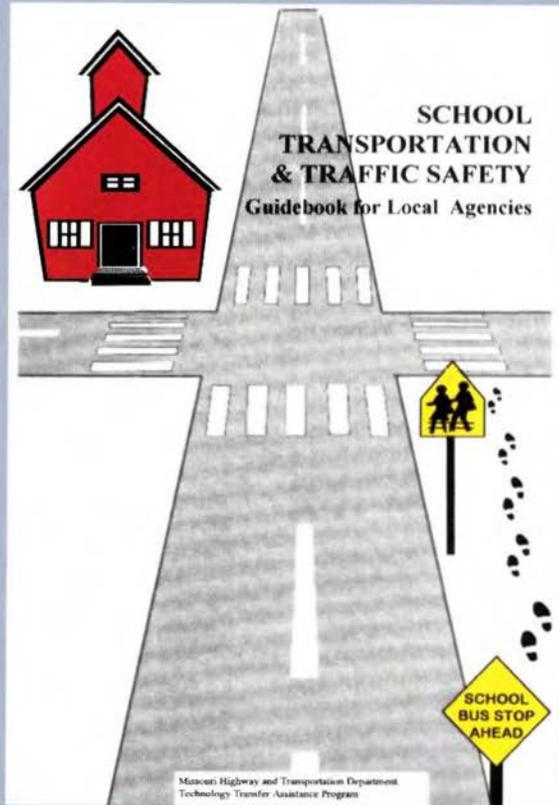
Icy roadways have always presented a hazard for Missouri motorists and the Missouri Department of Transportation. MoDOT recognized that keeping road surfaces safe during winter months often depends on the proper application of chemicals to prevent ice from forming and bonding to the pavement. The problem that faced MoDOT was determining the best method that would use the least chemicals.

The department decided to test a new technology initiated by the Strategic Highway Research Program. The new technology is an anti-icing program that uses sodium chloride solution, also referred to as salt brine, as both a prewetting agent for sodium chloride and as a pretreatment agent to minimize the amount of snow and ice that accumulates on the road surface. This would improve road conditions and cut chemical use in half.

MoDOT tested the salt brine in eight Kansas City area counties. According to Senior Research and Development Engineer Ivan Corp, "there was some initial reluctance and skepticism among maintenance personnel about using salt brine instead of the calcium chloride solution used in the past. But, after using the salt brine during winter 1995, the employees who felt this way are now some of the most ardent supporters of salt brine."

There are many advantages of using salt brine. One overwhelming advantage that salt brine has over the previously used calcium chloride is cost. Salt brine only costs one-tenth as much as calcium chloride. Salt brine is also much less corrosive to concrete than calcium chloride. This is a savings realized by the public in roads and bridges that do not deteriorate as fast and vehicles that do not begin to rust as quickly. But, the most exciting benefit of salt brine is that it outperformed liquid calcium chloride, keeping the pavement clear of ice and snow for up to two hours longer. Utilizing this new anti-icing technique resulted in clearer pavements, which improved motorist safety. The environment was less affected as well since fewer chemicals were used. The RDT Division is currently working with all districts on salt brine implementation.

Guidebook Helps To Ensure Safe Transportation of School Children



The safe and efficient transportation of school children is an objective equally shared by parents, teachers, school administrators, law enforcement and state/local transportation officials. With a technology transfer emphasis, the Local Technical Assistance Program initiated a special project to address school traffic safety issues. Representatives met in spring 1996 to review policies, practices and standards relating to school transportation.

School bus transportation requirements are established by state law and regulated through the Department of Elementary and Secondary Education. MoDOT has the responsibility for traffic issues related to the highway system.

The special project concluded with the development and production of a guidebook to assist school administrators and local agencies in developing safer and more efficient policies, practices and standards relating to the transportation of school children.

After helping to develop and update the guidebook in December 1996, the technology transfer group distributed approximately 4,500 copies statewide in February 1997 to school principals and superintendents, law enforcement personnel, safety advocates, and county and city representatives.

P

ople from various transportation interests statewide participated in a research focus group meeting Aug. 7, 1997, in Columbia. The participants discussed several research, development and technology transfer issues that assisted the RDT Division in identifying major emphasis areas within the department. The RDT Division will use much of this information to structure a 3- to 5-year program and to further define the division's business and strategic plan for the future.

The following emphasis areas will be included in the division's program.

Safety Safety should be the overall emphasis for all research and development projects. Consideration for safety promotes reduced risk for the traveling public, contractors and department employees. Facility designs should reflect practices that exceed safety standards, not meet them. Motorist awareness and training may be a necessary component of this research and development effort. Safety is also identified as a key value in the MoDOT Strategic Plan.

System Preservation As a state with a large existing transportation system, Missouri must make every effort to maintain these existing facilities with best available materials and construction and maintenance practices.

Traffic Mobility The most important goal of any transportation facility is the efficient movement of people and goods. Department decisions should reflect concerns for congestion, maintenance and construction activities.

Innovation MoDOT's RDT Division will try to make innovative use of technology offering the best long-term value for the transportation network users. Intelligent Transportation Systems (ITS) and technological material advances such as the fiber reinforced polymer (FPR) composites from other industries, should be investigated and developed for appropriate use in the transportation industry.

Social/Economic/Environment Research and development needs to be more than math and materials, statistics and theory. Equally important is research that considers the impact of transportation decisions on people, communities and cultures. MoDOT has the opportunity and ability to affect living standards throughout the state with informed decisions on land use, environmental and social-economics.

The following opportunities will be included in the RDT Division's program:

Public involvement MoDOT has a responsibility to develop strong communication ties to the motor-ing public and transportation industry. Research and development partnerships need to bond with Missouri universities, the transportation industry and other innovative parties to utilize existing expertise. Using advisory

groups to help with research and development planning is also a goal. MoDOT has a responsibility for information sharing with other interested parties. RDT should be a leader in internet use and market research studies as a part of technology transfer for the department.

Financial Responsibility A dedicated process is necessary to identify and prioritize research and development projects to assure the best value and practices are given to transportation expenditures statewide. Research and development requires a priority commitment from senior management and all divisions within the department. All research and development projects should directly address MoDOT's strategic plan issues.

Multi-modal An integrated, multi-modal approach to the state's transportation network is necessary to adequately link all communities and users within the state.



**Prepared by the
Missouri Department of Transportation
Public Affairs Division - 11/97**