RDT

ANNUAL REPORT FY 2002

Missouri Department of Transportation

Research, Development and Technology

RDT ANNUAL REPORT FOR FY 2002

To our Research, Development and Technology Customers:

The Missouri Department of Transportation's (MoDOT) strategic priorities is to maintain the system we have, finish what we have started, and to build public trust to all who use our transportation system. The Research, Development and Technology Unit (RDT) plays a key role in assisting MoDOT to meet these goals by identifying, developing, and implementing new technologies, innovative materials, and best practices to provide a safe, dependable, and convenient transportation system.

"If you always do what you have always done, you will always get what you've always gotten." I have quoted that age-old statement often as a philosophy supporting the time, effort, and dollars spent pursuing appropriate research, development, and technology transfer within MoDOT.

In the past couple of years RDT has concentrated on developing a Technical Advisory Group (TAG) to assist our efforts. We have expanded our role of policy research to assist decision-making throughout the department. RDT recently completed our second peer exchange. The objectives of the peer exchange were to verify and improve research related processes, identify ways to increase the effectiveness of RDT to serve MoDOT's strategic goals and objectives, and benchmark performances. The exchange team noted many areas where RDT had made significant gains in processes and accomplishments since the previous peer exchange. They identified areas of opportunity to further strengthen the value of RDT to MoDOT.

As a result of this peer exchange, RDT will focus the coming year on the following: increasing policy research, strengthening implementation efforts, expanding communication with the districts and functional units of MoDOT, soliciting involvement from an expanded customer base, and working towards faster results with our research, development, and technology transfer efforts.

RDT is a service unit to MoDOT. For RDT to be successful at what is expected, we have to work side by side with our many partners. We offer our thanks to the Technical Advisory Group members, the Technical Review Committee, those performing contract research through the University of Missouri System, our Federal Highway Administration partners, MoDOT management, and especially to a dedicated RDT staff.

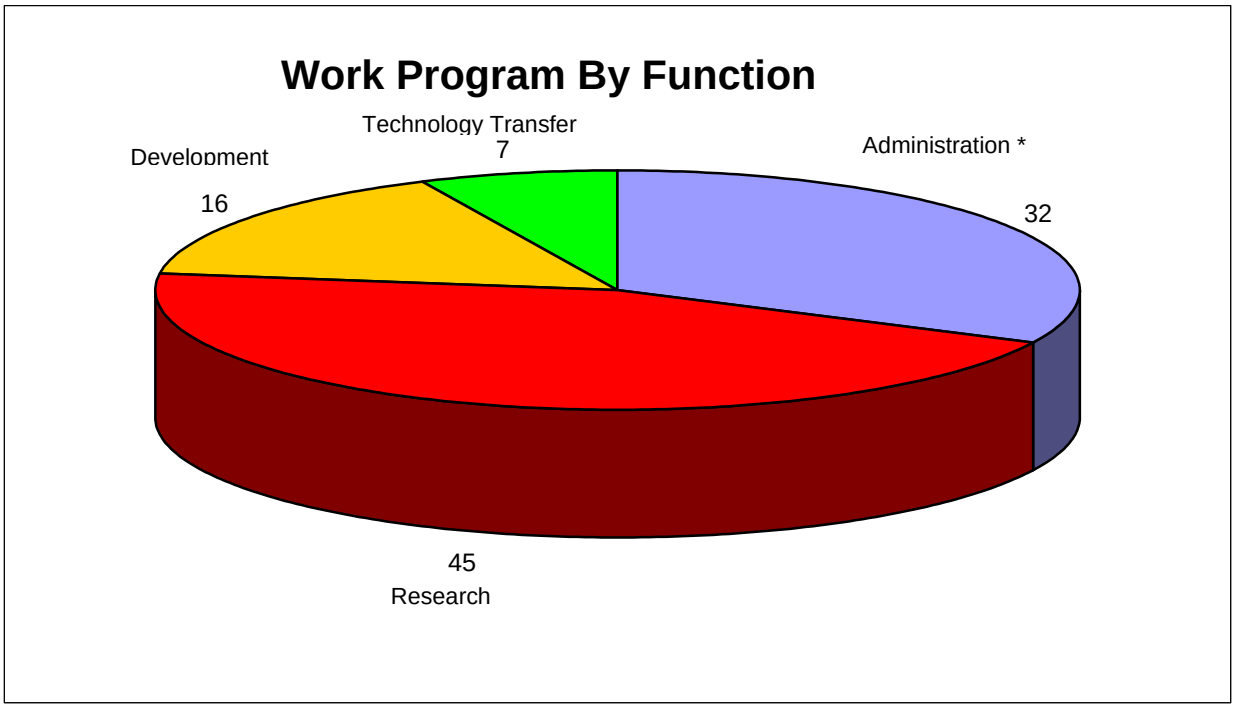
The past year has been productive, as you will see in this summary report. The year ahead offers challenges as well. I believe you will agree we aren't doing what we've always done!

Respectfully,

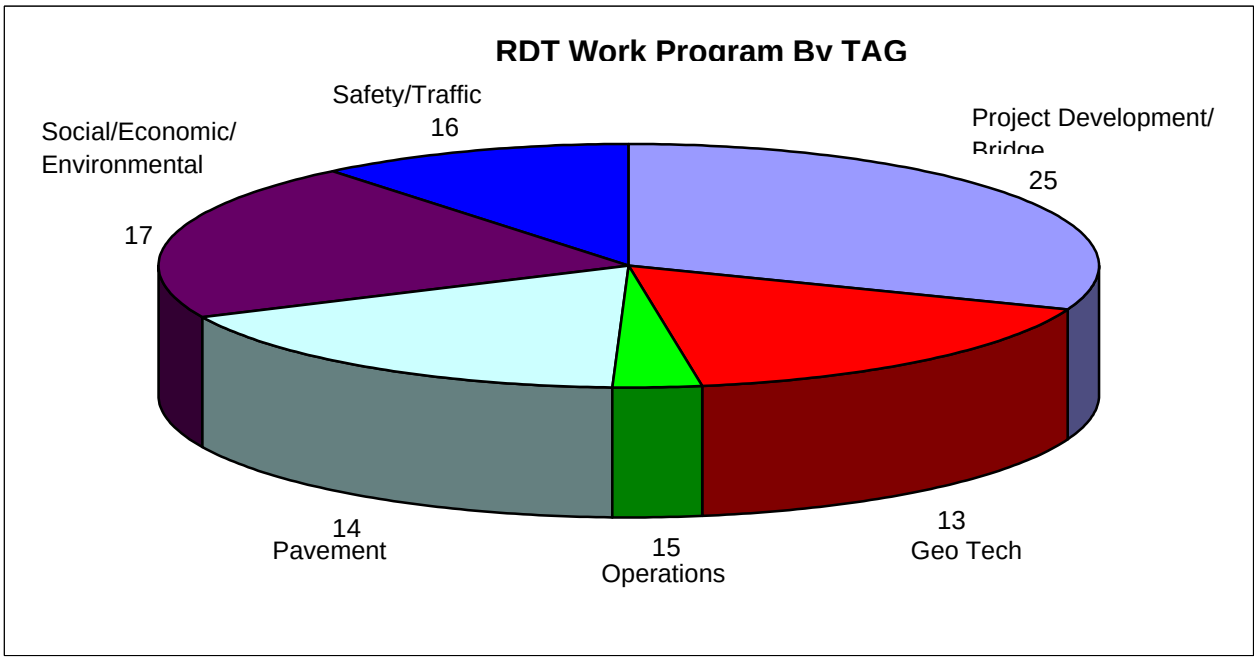
Ray L. Purvis, P.E.
State Research, Development and Technology Engineer

RDT Work Program by Function

	Amount	Percentage
Administration	$1,770,730	32
Research	2,458,984	45
Development	863,008	16
Technology Transfer	384,320	7
Total	**$5,477,042**	**100**



* Includes AASHTO Pooled Fund Studies & RDT Cont.



Research Ready For Deployment

RI00-008 – Guidance for Missouri Pavement Rehabilitation and Preventive Maintenance Strategies

Purpose - The purpose of this effort is to provide guidance for the selection and implementation of cost-effective preventive pavement maintenance and rehabilitation strategies. Findings from current and past MoDOT pavement-related studies combined with pavement management system (PMS) performance and inventory data will be used to develop performance trends for all feasible rehabilitation and preventive maintenance techniques.

Performance information not readily available from Missouri locations will be obtained from other States. This guidance will enhance the short and long range planning process.

Savings - An enhanced understanding of the expected performance of preventive maintenance and rehabilitation treatments will empower the Districts to wisely select cost-effective strategies.

Status - As of mid-April 2002, a draft for the preventive maintenance manual had been written and given to Maintenance for distribution and comments. Continued modifications will be necessary as comments come in and new data becomes available to keep the preventive maintenance information up-to-date. The rehab/reconstruction part of this project has been forwarded to the pavement type selection committee for their review and consideration. The final report for the rehabilitation strategies is expected in November 2002.

RI 98-029 - Pavement Marking Management System (PMMS)

The study on PMMS was completed in district 7 showing positive results for the management of our highway striping. The expansion of the PMMS has expanded to providing and installing the software in district 4. This same expansion was halted in district 1 until Maintenance can compare the PMMS system with another system developed by district 5. When this comparison is complete, maintenance will decide which management system to use and implement in all districts.

PD 98-055 - Ultra-thin hot-mix asphalt overlay

Purpose – The purpose of this project is to determine if ultra-thin hot-mix asphalt utilized primarily in urban, high volume locations, will improve conditions where frequent wet accidents occur and provide longer asphalt pavement life cycles. Ultra-thin hot mix asphalt provides a surface that is expected to maintain friction values during wet weather due to its open-graded mix design. Instead of precipitation draining across the top of the surface creating a thin sheet of water, precipitation with the ultra-thin hot-mix asphalt overlay is allowed to drain down through the surface to a liquid membrane placed under the mix. Since moisture is not traveling across the surface to drain, this reduces hydroplaning. In addition, without excess moisture on the surface to be thrown up by vehicle tires, visibility is increased with the ultra-thin hot-mix asphalt overlay.

Savings - The reduction in wet accidents and improved customer satisfaction is the goal of this project. The material is about two times the cost of a regular one-inch hot-mix surface. However, if the surface performs well in reducing accidents and increased visibility, it could be used as a tool for high accident and tightly configured weave areas.

The material was initially placed at two locations, I-29/I-229 north junction placed in 1998 and another at the I-29/I-229 south junction placed in 1999. Three additional locations for the study have been placed. Two locations on Rte. 13 in Greene/Polk Counties and another location in Greene County covering approximately 400 feet at the end of the ramp from southbound U.S. 65 to westbound U.S. 60. Yearly evaluations are currently being performed. Completion of the evaluation for the I-29/I-229 north junction section is scheduled for October 2003.

Status - Due to favorable results of this preventive maintenance treatment in district 1, districts 4, 6, 8 and 9 have requested and placed this treatment. A specification for the ultra-thin hot mix asphalt has been written and districts are beginning to use this surface treatment as a preventive maintenance measure.

More exposure and applications of the ultra-thin hot mix overlay to varying pavement and traffic conditions will aid in determining proper applications of the treatment and in preparing the final report at the completion of the study.

RI 99-012 - Evaluation of Ultra-Thin White Topping

Purpose - To determine the constructability and evaluate the effectiveness of placing an ultra-thin white topping (UTW) overlay as a means of pavement rehabilitation, at the intersection of Belt Highway and Route YY in St. Joseph, and on Route 60 in Neosho.

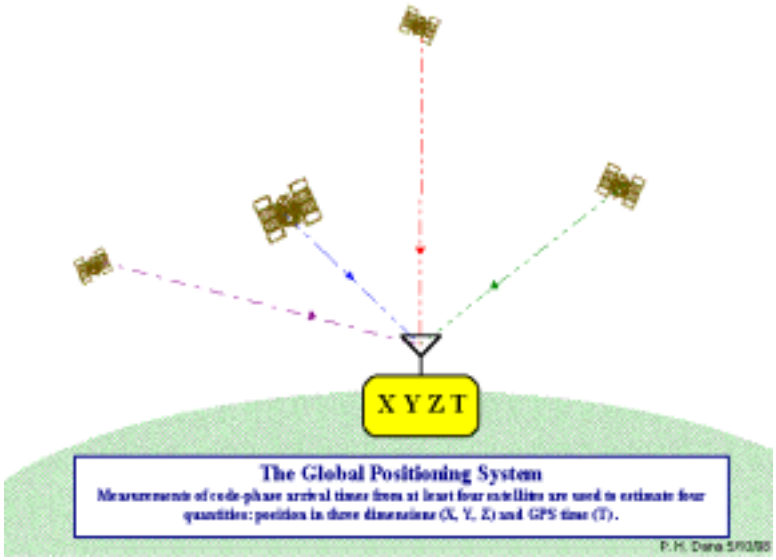
Savings-The UTW with fast-track characteristics should last 2 – 3 times longer than asphalt overlays and will reduce the construction time required. Reducing the construction time and providing longer lasting pavement will minimize traffic delays and safety risks.

Status - An initial report was completed in October 2001. Both projects will be monitored on a yearly basis.

RI01-007 - Development of an Environmental Roadside Inventory Using Spatially Oriented Databases

Purpose – This project is designed to develop data collection and mapping tools that allow for the effective planning and management of vegetation, mowing, herbicide use and environmental planning of MoDOT right of way. The project uses Global Positioning Systems along with Geographical Information Systems to develop mapping tools to provide information to roadside managers and environmental specialists. Better information on the roadside environment will result in the reduced mowing, herbicide and labor costs. Additional benefits will accrue during environmental documentation and mitigation when improvements are scheduled along roadways that require environmental clearance.

Status – The second year of fieldwork is now underway. The work has resulted in a roadside spatial database used in mowing and herbicide policy and is linked to the automated, truck mounted herbicide sprayers. The work in District 3 has been well received at the MoDOT statewide roadside managers meetings as well as by national leaders in prairie management. At the conclusion of this research a guidebook will be distributed and training will be provided to roadside managers across the state to aid in the adoption of this cost and time saving technology.



RI00-047 – MoDOT Workzone Guidelines

Purpose - This project is designed to establish workzone guidelines for construction, maintenance and utility activities on MoDOT right of way. This project was based on setting acceptable service level for corridor types, identifying a measure of delay and incorporating guidance into appropriate manuals and operations.

Savings – This research has resulted in an increased awareness of how the traveling public is affected by work zones. It has provided information and options to allow MoDOT personnel to make better decisions to reduce the impact work zones have on road users.

Status – The workzone research is in the implementation phase. All construction contracts, maintenance programs and utility operations have been reviewed statewide and are now following the guidelines in the MoDOT Work-Zone Guideline research.

High Performance Concrete

Purpose - High Performance Concrete (HPC) is concrete with enhanced properties, such as strength or durability, designed to optimize those properties for a specific application. Bridges and pavements constructed of high performance concrete should have a more economical design and/or an extended service life over facilities made with conventional concrete, while at the same time, require less maintenance during that life.

Savings - High performance concrete structures and facilities should have lower life cycle cost when compared to those made of conventional concrete. High performance concrete bridges can be designed with fewer members, such as piers or girders, resulting in a savings of material and labor.

Status - Current HPC projects include a HPC bridge deck on Route 291 over Route 150 in Jackson County, and an HPC bridge (girders and deck) on Route 412 in Pemiscot County.

RI00-001 – Addition of Water Reducers to PCCP Mixes

Purpose- This project determined the benefits and cost savings of adding a Type A water reducer and reducing the cement content in MoDOT's PCCP mixes. The concrete characteristics of the water reducer mix were compared to MoDOT's standard mix in the laboratory and in two MoDOT paving projects.

Results- Compared to MoDOT's standard mix, the water reducer mix proved to have increased compressive and flexural strengths, lower permeability, and equivalent freeze/thaw durability and air-void structure. The water reducer mix costs approximately $0.20/yd3 less than MoDOT's standard mix.

Implementation - As a result of this research investigation, MoDOT's specifications were changed to allow the contractor to use Type A water reducers with a ¼-sack (23.5 lb) reduction in cement content. This provision became effective as of July 1, 2002.

Temporary Concrete Traffic Barrier

Four states, Missouri, Kansas, Iowa and Nebraska, combined funds to work with the Midwest Roadside Safety Facility to design a temporary traffic barrier that can be accepted by all four states. This allows a contractor to use the same traffic barrier in these states, which saves the contractor and states money. The barrier is primarily used on construction zones for bridges and minimizes deflection from feet to inches. The 12' 6" sections are attached by using a pin and loop connection at the top and bottom of the barrier and attached to the bridge deck with three pins on the traffic side of the barrier. This design is presently being incorporated into our standard drawings and specifications.

RI99-033 – Evaluation of Early Entry Sawing

Purpose - Early entry concrete saws allow the placement of control joints in concrete at an early age before internal stresses are very large. For this reason, the joints may be sawed at shallower depths than those sawed with conventional saws. Preliminary tests have produced good joints with a higher production rate (ft/saw/hr) than conventional sawing.

Savings - The production rate with the early entry saws should yield a project cost savings. The shallower joint depth may lead to longer saw blade life, although this has not yet been proven.

Status - The initial report was completed in August 2001. A specification was prepared and is currently in effect. Early-entry sawing may now be used as an alternate to conventional concrete sawing.

Pooled Fund Studies

RI 98-034 - Wind-induced Vibration in Cable Stay Bridges

The purpose of the investigation was to develop guidelines for enhanced design for future structures and mitigation of vibration on existing structures created in cable stay bridges by the combined action of wind and rain. In late 1999 MoDOT agreed to be the lead state and participate in the $800,000 national pooled funded project. Eleven other states and the FHWA agreed to participate. The study also included brief studies on live load induced vibrations and criteria to respond to the comfort levels of drivers and pedestrians.

Status - Design guidelines were developed for the mitigation of vibrations based on wind tunnel tests and analytical and experimental research covering a range of linear and non-linear dampers and cross ties.

RI00-028 - Cooperative Vehicle Highway Automation System (CVHAS) Pooled Fund Study

MoDOT is participating with 11 other State DOTs along with Honda Corporation Research and Development on this innovative research program. The purpose of this research is to refine and demonstrate CVHAS technologies with the ultimate goal of providing for the implementation of these technologies in the transportation system.

Status – There are currently three research projects underway with the CVHAS program. In Chicago the Lake Front Busway study is designed to assess the automation of bus route along this transit dependent area.

Also in Chicago, there is a feasibility study underway to assess the reduction in congestion of container movements for the Port of Chicago trucking area.

In Washington, an automation study of straddle carriers is underway to increase the efficiency of cargo movement by straddle carriers. All three of these projects are designed to make CVHAS technology available to commercial facilities in order to increase adoption of the technology. See the CVHAS website at: http://www.cvhas.org/.

RI98-006 - Image Analysis of Hardened Concrete

Purpose - On a routine basis, MoDOT analyzes hardened concrete to determine its air content and air void structure for research and evaluation purposes. The air content and characteristics of the air void system are known to be an indication of a concrete's ability to resist freezing and thawing conditions, which are frequently encountered in Missouri. The current means of analyzing hardened concrete is a manual operation, which is tedious, time-consuming, and requires skilled and experienced personnel. The effort of this study is to automate the system using image analysis techniques.

Savings – Automating the system would save both time and effort for increased efficiency, and it would also improve the consistency and repeatability of the operation for improved accuracy. Complete development of the system would enable implementation by many in the field of concrete materials, construction, and research.

Status – A cooperative effort between MoDOT and the Department of Energy – Kansas City Plant (operated by Honeywell Federal Manufacturing and Technologies) has resulted in significant progress towards development of an automated image analysis system. MoDOT is currently serving as the lead agency in a pooled fund study effort, involving twelve other states, to complete development of the system. A study completion date of early 2004 is anticipated.

RI 98-039 - Intellizone – Freeway Work-Zone Speed Advisory System (w/UMC)

Purpose – The Quixote Intellizone system is a freeway work zone speed advisory system. The Intellizone system consists of three mobile count units per lane, mobile command unit and two variable message signs (VMS) units. The Intellizone project is part of the Midwest States Smart Work-zone Deployment Initiative, which studies improvements within work zones. The three mobile counter units measure the speed, density and flow of the traveling public within the work zone. The mobile command unit will take information from the three mobile counter units on average speed and send signals to the VMS units to indicate an appropriate message located approximately two miles and five miles upstream from the mobile counter units. The mobile command units communicate with the VMS units using line-of-sight or cellular communication. VMS units will provide a standard warning of the construction zone under free flow conditions. When traffic queues cause significant speed reductions the VMS units will warn of the reduced speed ahead by displaying the downstream speed.

Savings – The Intellizone provides no direct cost savings. If the system can reduce traffic conflicts before the workzone area then savings are made through reduction in property and time loss.

Status - The Quixote Intellizone was implemented as a freeway work zone speed advisory system located on Eastbound I-70 near Wentzville, which is just west of St. Louis. The data has been collected and currently University of Missouri-Columbia personnel are preparing a final report.

RI01-030 - A New Approach to Assessing Road User Charges

The focus of this study is on identifying and developing a new revenue stream for transportation in light of declining gas tax revenues. Currently, phase 1 of the research, which includes product review, feasibility, reliability and privacy analysis, is nearing completion. The study thus far has focused on GPS tracking methods to charge travel based on the miles traveled.

Status - Phase II of the study will demonstrate the feasibility of the proposed GPS tracking method and will seek additional funding in the Reauthorization of the Transportation Bill. The project team is also working with AASHTO to coordinate the value-pricing concept with other road user charge work occurring across the United States and in Europe.

RI01-055 – Construction of Crack Free Bridge Deck

Purpose - Cracks in concrete bridge decks provide easy access for water and deicing chemicals that shorten the life of the deck. Both materials increase the effects of freeze-thaw damage. Measurements taken at cracks show that the chloride content of the concrete can exceed the corrosion threshold at the level of the reinforcing steel by the end of the first winter. The purpose of this study is to implement the most cost-effective techniques for improving bridge deck life through the reduction of cracking. The work will involve cooperation between cement companies (including the development of coarser, low-shrinkage cement), contractors, and designers.

Savings - State departments of transportation expend significant effort and resources on the construction of durable reinforced concrete bridges and bridge decks. Existing data indicates that specific modifications to construction procedures, materials, and design details will significantly reduce the degree of cracking in bridge decks, and thus reduce exposure of reinforcing steel to the corrosive effects of deicing chemicals and decrease freeze-thaw damage If successful, the result will be a major reduction in bridge deck cracking, an improvement in durability, and an increase in the useful life of bridges.

Status – Missouri has pledged funding for all three years of the project. KDOT has received approval of FHWA funds and will begin study July 2002.

RI01-059 - National Pooled Fund Asset Management Research Program

Purpose - The purpose of this research project is to supplement national asset management research efforts, prevent duplicity of coexisting efforts, and provide a means for regions and state DOTs to share resources, technology, and ideas regarding asset management in a coordinated environment.

Status- The Wisconsin DOT is lead agency on this effort in cooperation with the Midwest Regional Transportation Center, the Midwest Transportation Consortium, the Federal Highway Administration and other participating states. The program was undertaken in May 2002 and promises to aid in the adoption of sound asset management practices by state DOTS.

Project Development/Bridge

RI92-004 - Statewide Study of Cathodic Protection Systems

Purpose - The objective of this study is to provide guidance for MoDOT's program for cathodic protection (cp) of bridge decks as well as looking at new CP technology. A cathodic protection team with members from six different business units administers this program.

Savings - Cathodic protection is the only known means to stop corrosion of uncoated steel reinforcement. It will remain an option for rehabilitating existing bridges as long as uncoated bars remain in our bridges or alternate reinforcing materials are not practical enough to replace steel. Besides the eighty bridge decks using impressed current systems, two projects using galvanic or passive anodes (no AC power is needed to run the system) were initiated this year. A surface applied Zinc-Hydrogel Anode, a zinc coating using a conductive adhesive, was used on the outside of pier caps on two bridges that had just received extensive concrete repairs. A second project is underway using Galvashield XP Anodes, embedded galvanic anodes, in reinforced concrete bridge deck repairs.

Status – The 80 impressed current systems are maintained and monitored continuously and the systems adjusted every spring as needed. The Zinc-Hydrogel project will be monitored until 2004 and the Galvashield embedded anodes will be monitored until 2006 to determine their effectiveness in halting corrosion of the rebar and the soundness of the concrete patches they are protecting. Cathodic protection will protect the reinforced concrete for up to twenty years.

RI97-020 - Cracking in Bridge Barriers

Purpose - Based on reports from district and bridge crews, this study started with the objective "to determine the cause of excessive cracking of bridge safety barrier curbs." The current bridge rail design is a New Jersey shaped safety barrier with a cage of reinforcing bars. Common practice is to slip form this barrier using a concrete mix that is stiff enough to support the three-foot wall height and then to use wetted burlap for curing. Problems with both slip forming and wet burlap curing have been noted and are suspected of causing excessive cracking in the barriers.

Savings - Cracks in bridge safety barriers are a concern because premature failures increase maintenance, trigger other failures, and shorten the entire structure's life. Problems may also indicate MoDOT is not receiving the quality of construction that is being paid for, structurally or aesthetically. These failures have costly consequences and represent a potential savings if they can be prevented at a reasonable cost. The potential for net savings can be determined once the cause, the prevention needs, and the prevention costs can be identified.

Status - A final report should be available 2003.

RI97-025 – Hydro-Demolition and Repair of Bridge Decks

Purpose - The objective of this study is to make observations of bridge decks being repaired using hydrodemolition to determine if this procedure is less destructive to bridge decks and more cost efficient than present mechanical preparation methods.

Savings - Hydro demolition is less harmful to the concrete that will remain in place, causing fewer failures of patches in the future. Hydrodemolition removes all the deteriorated concrete and cleans the reinforcing steel so that when debris is removed the deck is ready to be patched and overlaid with concrete. This eliminates steps of sandblasting and continual cleanings needed using conventional methods. Additionally, if patching and applying the overlay are done concurrently or at the same time, even more time and labor can be saved.

Status – Because of the success of the method on the first bridges several additional bridges have been awarded and are being repaired by hydrodemolition. A final research report on the first bridge is being reviewed and will be distributed in December 2002.

RI98-001 - Ground Penetrating Radar (GPR) (w/UMR) and RI99-016 - Advanced Bridge Deck Inspection Technology (Hermes II)

Purpose - Ground Penetrating Radar is a non-destructive method of testing various products of highway materials. It has been used by MoDOT to test concrete bridge decks for deterioration, pavement thickness during new pavement construction, pavement layer thickness of existing pavements, and to try and determine pavement deterioration.

Savings - Substantial savings in cost and destruction of coring pavements, bridge decks and boring in soils and rock can be saved during investigations on highway structures. Use as a quality control device on concrete and asphalt-paving can save coring costs and destruction plus defects can be caught immediately during construction. Costs of closing lanes of traffic and the safety of not having to have personnel exposed to traffic or motorists subject to congestion can be realized if high speed GPR acquisition can be attained.

Status - A final report entitled "Bridge Deck Condition Studies in Missouri Utilizing Ground Penetrating Radar" was completed in 2001. A final report on pavement investigations using GPR is being reviewed and will be available in September 2001. Final reports are available on various other GPR investigations MoDOT has initiated. MoDOT is a member with twenty other states in a pooled fund project called HERMES II. This is a multi-year project to develop a second generation High Speed Electromagnetic Roadway Measurement and Evaluation System, which could re-construct a picture of a pavement or a bridge deck in three dimensions much like a CAT scan and acquire the data at highway speeds. The first phase to come up with a better radar antenna was completed in Summer 2001 and a decision to make a second prototype will soon be made.

RI99-044 - Void Detection at Bridge Approaches

Purpose - To evaluate a method of void detection under concrete slabs near their joints. Loss of load transfer at PCC pavement joints, due to fines pumping out, weaken the structure and hasten cracking and deterioration. A falling weight deflectometer (FWD) is used to detect these voids. Recommendations are then made for slab undersealing.

Savings - Early void detection and undersealing can be an effective preventive maintenance strategy that will prolong the life of a PCC pavement until major rehabilitation or replacement.

Status - Final report is to be completed in December 2002.

RI00-027 - Stainless Steel Reinforcing Bars in Bridge Decks

Purpose – The main objective is to extend the service life of bridge decks. This study will determine if using stainless steel reinforcement in place of epoxy-coated reinforcement in bridge decks will reduce corrosion so to extend the service life of the bridge deck long enough to make them cost effective. This will be done by doing yearly checks on fiber optic chloride sensors, permeability, and half-cell potentials along with visual inspections on the bridge deck to determine the extent of corrosion of the rebar.

Savings – Although the stainless steel reinforcing bars are more expensive than epoxy coated reinforcing bars, they are designed to more than double the service life of the epoxy- coated reinforced bridge decks. By reducing the corrosion, the need for patches and overlays would also be reduced, which would result in decreased life cycle costs. This would therefore reduce the overall all costs of maintaining the bridge.

Status – The Rte. 6 Grundy County Bridge that is using stainless steel reinforcement was opened in 2001 and a construction phase report is under review. An interim report will be completed in 2005. Future monitoring will be done and reports will follow as appropriate. In the future, a final report will be prepared that will discuss the overall performance of the stainless steel reinforcement versus the epoxy-coated reinforcement and discuss project findings.

RI01-037 – Installation and Initial Performance of 60" ADS N—12HC® HDPE Pipes

Purpose - The objective of this study is to document and analyze the installation and performance of two 60" HDPE pipes, in order to determine what makes them perform well and what does not.

Savings - This objective fits into the bigger picture to track and monitor the performance of different pipe materials to install the most cost-effective pipes given the location and conditions. To accomplish these objectives HDPE pipe installations were observed and documented and pipe deflection data was collected to act as the basis for performance analysis.

Status – A report was published on the installation as well as initial pipe deflection data. Both pipes will be inspected yearly to monitor their progress and to document any additional deflection.

RI02-002 – Steel-Free Hybrid Reinforcement System for Concrete Bridge Decks - Phase 1 (UMC & UMR)

Purpose – The main objective of this collaborative research is to develop nonferrous hybrid reinforcement system for concrete bridge decks using continuous fiber reinforced polymer (FRP) rebar and discrete randomly distributed polypropylene fibers with a view to eliminate corrosion in bridge decks.

Savings - Limited service life and high maintenance costs are associated with corrosion, fatigue and other degradations of highway bridges and reinforced concrete structures. The combination of FRP reinforcement with the use of polypropylene fibers offers an innovative hybrid bridge deck system that can eliminate problems related to corrosion of steel reinforcement while providing requisite strength, stiffness and desired ductility.

Status - Research Advisory committee consisting of representatives from MoDOT, UMC, UMR, the FRP rebar manufacturer and fiber manufacturer has been formed to oversee the progress of the project. Study has started on the first of 9 tasks that will lead to fabricating and testing of a full-scale steel free slab. The project will be completed by June 2004.

RI02-007 – Strengthening of Martin Springs Outer Road Bridge, Phelps Co. MO (UMR)

Purpose - The proposed project aims at demonstrating the feasibility of fiber reinforced polymer (FRP) systems for the flexural strengthening of concrete bridge structures. The bridge selected for this demonstration project is the three-span concrete slab bridge located on Martin Springs Outer Road in Phelps County. This bridge is composed of a 14 in thick solid reinforced concrete (RC) slab for which posting can be removed as the result of the proposed strengthening scheme.

Savings - In the state of Missouri and surrounding Mid-America states, several bridges exhibit similar conditions and are in urgent need of strengthening to remain functional.

Status - This demonstration will consist of three major tasks; (1) design of strengthening scheme, (2) load tests before and after strengthening, and (3) field construction. All of these steps have been completed except for the after-strengthening load tests. Post testing will occur immediately after and at one year. It is envisioned that this strengthening technique will lead to a bridge strengthening protocol for consideration by MoDOT for future applications.

RI02-008 - Evaluation of FRP Repair Method for Cracked PC Bridge Members (UMR)

Purpose – To provide a regional evaluation of methods of flexural and shear strengthening of PC members as well as fatigue characterization. This will lead to the development of feasible ways to repair cracked pre-stressed concrete bridge members as an alternative to replacing them.

Savings – Expected cost saving includes: costs of closing the bridge and the expense of fabricating, receiving and installing the new members, as well as the expense of removing and disposing of the damaged members. With the large number of bridges with cracked PC members, the cost of the study to develop new repair methods could possibly pay for itself within the first year of implementation.

Status – The University of Missouri – Rolla will begin work in July 2002 on Phase II of the project, which includes shear strengthening, and Kansas State University will begin working on flexural strengthening and fatigue characterization. The project is scheduled for completion by June 2003. A quarterly report was published in August 2002, with two other reports to follow in November and February. A final report will be prepared by June 30, 2003.

Fiber Reinforced Plastic (UMC & UMR)

Purpose - Fiber Reinforced Plastic (FRP), a high performance composite material, offers an alternative solution to conventional structural materials due to its non-corroding and strengthening capabilities. There are currently a number of structural applications for FRP materials, including FRP repair and strengthening, FRP seismic retrofitting, FRP rebar/reinforcement, and FRP composite material.

Savings - Implementing FRP in lieu of conventional materials provides a potentially cost-effective means for bridge rehabilitation and construction. FRP's corrosion resistant and strengthening capabilities, along with its lightweight structure, make it a desirable and economical material for bridge deck reinforcement, seismic retrofitting, bridge strengthening, and repair to damaged bridges.

Status - A number of FRP projects have been completed or are currently underway by the University of Missouri-Rolla (UMR). Studies completed this year include the following: *Repair and Strengthening of Impacted PC Girders on Bridge A4845*, report RDT01-017 (repair and strengthening with CFRP strips); *Construction and Long-Term Monitoring of a Concrete Box Culvert Bridge Reinforced with GFRP Bars*, report RDT01-016 (a box culvert reinforced with GFRP); and *Strength of an Impacted PC Girder on Bridge A10062, St. Louis Co., Missouri*, report RDT01-013 (repair and strengthening with CFRP strips). FRP research projects currently underway with UMR address various applications such as FRP seismic retrofitting, FRP rebar/reinforcement, FRP composites, and FRP strengthening. A joint research study between UMR and the University of Missouri – Columbia (UMC), Steel-Free Hybrid Reinforcement System for Concrete Bridge Decks, is also underway to develop a bridge deck reinforced with FRP and polypropylene fibers.

RI02-019 – New Placing & Curing Specifications for Bridge Decks

Purpose – The objective of this study is to observe bridge decks being poured and to do routine checks on them to determine if using a dissipating curing compound, 7 day wet cure, and the new B21 concrete mix design are helping to reduce early cracking in newly poured bridge decks.

Savings – Reducing early cracking in bridge decks, will reduce the maintenance costs for the bridge and will extend the life of the bridge. By reducing cracking in the deck it will reduce the need for patching and applying overlays by slowing down the rate of corrosion, which will save material and labor expenses. This expected to result in decreased costs and longer service life.

Status – Several bridges being poured using both the old and new placing and curing specifications have been observed where data was collected and follow-up checks have been made. Initial findings show that the new specifications are not adversely affecting the contractor costs or delaying operations. A final report should be available in late 2003.

RI01-044- Laboratory Testing of PCC Bridge Deck Mixes

Mix No.	Cementitious Materials
1	Control, 728 lb/yd^3- (No pozzolans)
2	Control, 728 lb/yd^3- (15% FlyAsh)
3	602 lb/yd^3 - (No pozzolans)
4	602 lb/yd^3- (15% FlyAsh)
5	602 lb/yd^3- (35% FlyAsh)
6	602 lb/yd^3- (25% Slag)
7	602 lb/yd^3- (50% Slag)
8	602 lb/yd^3- (6% Silica Fume)
9	602 lb/yd^3- (15% FlyAsh & 25% Slag)
10	602 lb/yd^3- (15% FlyAsh & 6% Silica Fume)
11	602 lb/yd^3- (25% Slag & 6% Silica Fume)

Table 1 – Cementitious Replacement

Purpose - The objective of this investigation is to develop and test different PCC mix designs for MoDOT bridge decks to minimize shrinkage cracking and increase performance characteristics. Less shrinkage cracking would increase the life and performance of bridge decks.

Status - Most of the laboratory performance tests of eight new bridge deck mix designs are completed. Table 1 list the different mix designs that were laboratory tested. Performance results of the different mix designs are listed in Table 2.

Mix Number	28-Day Compressive Strength (psi) [1]	28-Day Chloride Permeability (Coulombs) [2]	90-Day Ponding Test for Chloride Ions @ 2 in depth (lb/yd3) [3]	Freeze/Thaw *Durability Factor* [4]
1(Control)	*5630*	*3720*	*.16*	*97*
2(Control)	*5770*	*3000*	*.12*	*97*
3	*5120*	*2860*	*.12*	*97*
4	*5550*	*2820*	*.23*	*96*
5	*5990*	*2480*	*.20*	*96*
6	*5320*	*2520*	*.31*	*97*
7	*5840*	*1260*	*.23*	*95*
8	*5750*	*1540*	*.16*	*94*
9	*5670*	*1830*	*.31*	*96*
10	*6120*	*1430*	*.23*	*92*
11	*5920*	*970*	*.27*	*93*

1 - Compressive Strength >= 3500 psi
2 - 28-Day Permeability < 2000 Coulombs
3 - Chloride Ion Content < 2 lb/yd3
4 - Freeze/Thaw Durability Factor >= 85

Table 2- Performance Results

Conclusions & Recommendations –

The recommendations stated are preliminary and are based on data obtained to date. Durability testing for salt scaling are still pending and will be finished in mid-December 2002. Cost information can vary depending on location and project size.

- Comparisons of PCC mixes by laboratory shrinkage tests are not conclusive at this time. Shrinkage characteristics of each mix should be monitored and determined in the field. Sources indicated that decreasing cementitious material in a mix would mitigate shrinkage and cracking of PCC.
- MoDOT should decrease cement content in the bridge deck design from 728 lb/yd^3 to 602 lb/yd^3 as long as a Type A water reducer is used in the mix design.
- Type C flyash is recommended as a suitable replacement for Type 1 Portland cement up to 35%. Flyash enhances strength, lowers permeability, and in some locations, costs approximately $50/ton less than Portland cement.
- Ground Granulated Blast Furnace Slag (GGBFS) is also a suitable replacement for Portland Type 1 cement up to 50% replacement (pending salt scale results). GGBFS enhances long-term strength, lowers permeability, and costs approximately the same as Portland Type 1 cement.
- Silica Fume is suitable for up to 6% replacement of Portland Type 1 cement. Silica Fume increases strength, significantly reduces permeability, but cost more than Type 1 Portland cement. Some sources indicate increased tendency for shrinkage with the use of silica fume if proper curing precautions are not taken.

Research Period

The research will end in December 2002 and a report will be published by January 2003. Further developments of a laboratory shrinkage tests will be continued.

Geotechnical

RI99-029 - Determination and Prioritization of MoDOT Geotechnical Related Problems with Emphasis on Effectiveness of Designs for Bridge Approach Slabs and Pavement Edge Drains. (UMC & UMR)

Purpose - The objective of this study was to identify, document and prioritize geotechnical problems; such as slope instability, soil erosion, and roadway subgrade instabilities on Missouri highways and adjacent rights of way. While all geotechnical related problems were considered, particular emphasis was placed on evaluating the effectiveness of recently implemented designs for bridge approach slabs and pavement edge drains. The geotechnical problems were prioritized and an evaluation of the effectiveness of recently implemented designs was provided along with recommendations for approaches, which could be applied to solve the identified problems.

Savings – The study will help identify areas where improvements are needed to minimize costly repairs and failures in geotechnical areas of roadway design and construction.

Status – This study was a cooperative effort between the University of Missouri-Columbia and the University of Missouri-Rolla. The final report was presented to MoDOT in July 2002.

RI00-019 - Soil Stabilization with Fly Ash

Purpose - The purpose of this study is to evaluate the benefit of soil stabilization to initial pavement smoothness of various base and subgrade designs. An improved subgrade is expected to lead to improved pavement construction and initial pavement smoothness. Test sections that are modified with fly ash or lime will be compared to a control section with Type 5 base and a control section with two-foot rock base.

Savings - The initial smoothness of a pavement is believed to contribute to a longer lasting pavement requiring less maintenance than a rougher pavement. The reduced maintenance and repair costs, along with the expected longer life of the pavement, will offset the cost of subgrade modification and is likely to lead to a lower life cycle cost.

Status - Construction of the test sections began in June of 2001. The construction report is currently being prepared.

RI02-003 - Preparation of Construction Specifications, Contract Documents, Field Testing, Preparation of Educational Materials and Course Offerings for Trenchless Construction Methods (UMC)

Purpose - The scope of work for this project includes trenchless construction methods (TCM's) engineering analyses, method evaluation for a specific application, preparation of contract documents, review and completion of current MoDOT construction guidelines and specifications, course materials, and course offering for MoDOT engineers and construction, permit inspectors and other MoDOT personnel.

Savings – During recent years, there has been remarkable progress in development of new trenchless technology equipment. Improved equipment, procedures, specifications and training will result in better quality installations which are less likely to fail in some fashion necessitating costly repairs.

Status – This contract research with the University of Missouri-Columbia was initiated in January 2002.

Operations

PD00-017 - Road Armor Chip Seal

Purpose - This product is currently being evaluated to provide an economical alternative for a preventive maintenance treatment for higher volume roads. Currently, the only options available for preventive maintenance treatments for higher volume roads are hot-mix overlays and micro-surfacings.

Savings - When this product is developed to the point where it can be used on higher volume routes, savings will be realized due to its lower cost and greater life expectancy as compared to a hot-mix overlay. This chip seal product is estimated to cost approximately ½ less than the hot-mix or micro-surfacings designed for the higher volume routes.

Status - Currently, at two of the three locations where this product is being tested, it has resulted in failed performance. We have discussed the possible causes for the failure with the supplier and they will make the adjustments necessary to prevent the failure from occurring in the future. MoDOT is planning to setup another test section for this product in the near future.

PD02-014 - AC15-5TR Chip Seal

This product is being evaluated to provide an alternative economical option for a preventive maintenance treatment for high volume roads. Currently, the only options available for preventive maintenance treatments for high volume roads are hot-mix overlays and micro-surfacings.

Savings - Savings will be realized when placing this treatment for preventive maintenance applications. This chip seal product is estimated to cost approximately ½ less than the hot-mix or micro-surfacings designed for the higher volume routes.

Status - This product was recently placed at the end of May 2002. To date, it is performing well. However, until the product has had adequate exposure to stresses imposed by varying temperature changes and been subjected to the wear and tear of traffic and snow removal for at least one full year, preliminary results of the product's performance will not be available.

Pavement

RI97-045 & RI99-042 - Sand Anti-Fracture (SAF) Overlaid with SuperPave

Purpose - This study evaluates the effectiveness of a 1-inch SAF layer in reducing reflective cracking in asphalt overlays. The SAF layer is a fine graded asphalt mixture containing highly polymerized asphalt cement, high asphalt content, and low air voids. An SAF interlayer has been placed on two construction projects: RI97-045, I-29, Holt County (98') and RI99-042, Rt. 36, Dekalb County (00').

Savings – The benefit anticipated from the SAF layer is a longer service life of the asphalt overlay, which remains to be determined through annual performance evaluations.

Status – Construction reports for both projects, I-29 and U.S. 36, have been published (RDT 00-001 & RDT00-001B, respectively). A third year performance report was completed in August 2001. The I-29 and U.S. 36 project evaluations should conclude in 2003 and 2005, respectively. A thorough review of other state DOT projects will also be performed with final evaluation of the product in 2005.

RI 91-013 D - Cracking of Pavements

Purpose - "D-Cracking" is a particular type of deterioration cracking believed to be related to freeze-thaw damage of certain aggregates. Minor damages accumulate until major problems appear to develop suddenly around 15 years. It's also believed that a smaller aggregate size will prevent or delay the problem. This study is an extensive field survey of pavements with different size aggregates over time. It combines the work from several research projects, the earliest started in 1977. It is hoped that the statistically significant number of pavements surveyed will reveal a pattern to either agree with or disprove current beliefs.

Savings - Proper understanding of D-cracking will allow better future construction to avoid D-cracking and improve pavement life. It will also allow better prediction of existing pavement performance, and thus better programming of cost effective repairs or replacements.

Status - The majority of pavements in the study are now reaching the 15 year age. Surveys are continuing for the next few years, along with preliminary analysis. Further reports will be made as results develop.

RI 97-035 - Unsealed Joints in PCCP

Purpose - Joints are cut into portland cement concrete pavements (PCCP) to control cracking. Normally these joints are sealed with an asphalt-based compound to seal out moisture and other contaminates in an effort to make the pavement more durable. However, studies by others have suggested that sealed joints might actually be less durable than unsealed joints. This study is a limited field trial, comparing sealed and unsealed joints within the same project.

Savings - Joint sealing is an extra construction cost. If it's not needed, if unsealed joints are as good as sealed joints, then this cost can be eliminated. If unsealed joints are better than sealed joints, there would be savings in reduced maintenance and increased pavement life.

Status - After five years, the pavement is still in nearly new condition with no apparent difference between sealed and unsealed joints. It's too early to draw conclusions other than to note that the unsealed joints have not developed early problems. An interim report is being compiled.

RI96-025A & B – Evaluation of Diamond Grinding New Portland Cement Concrete Pavement

Purpose - The objective of this study is to determine if diamond grinding is a cost effective method to provide smoothness, texturing and improved long-term performance on newly constructed Portland Cement Concrete Pavement (PCCP). Two locations are being studied in these investigations. The first is Route 60 in Butler County and the second is I-44 in Greene County.

Savings - Research indicates that the smoother a pavement is initially, the better it will perform over time and the longer it will last. The diamond ground test sections on these projects had a significantly improved initial smoothness as compared to test sections that were textured with the standard transverse tining method.

Status - A performance update for these projects should be issued in the fall of 2002. Both projects will continue to be monitored on a yearly basis. A standard specification for diamond grinding of concrete pavements is currently being reviewed.

RI99-022 - New PCC Pavement Design Study

Purpose - To evaluate the effectiveness of the new PCC pavement design. The new PCC pavement design was first initiated in 1993. The new design utilizes unreinforced concrete, 15' joint spacing with dowel bars, 14' wide paving in the driving lane, tied shoulders, and greater slab thickness. The old design utilized reinforced concrete, 61.5' joint spacing, 12' wide paving in the driving lane, and no tied shoulders.

Savings - Elimination of early distresses found in the older pavement design will increase the expected design life of the new PCC design.

Status - Performance reports from surveys every three years to 2009.

RI01-006 - Granular Base Permeability Study

Purpose - The objective of this study is to determine the permeability of pavement bases that Missouri uses in new construction projects. Several issues regarding the effectiveness of Missouri's new base types need to be explored. The first is the permeability of the Type 5 base. Neither in-situ nor lab permeability testing has ever been performed. There is growing evidence from field observations that the Type 5 may not provide acceptable drainage. The other issue is the permeability of the rock base. While it is generally believed from field experience that it does drain well, no attempt has ever been made to quantify that ability. An auxiliary issue to these is the variability of permeability from site to site.

Savings - MoDOT will select pavement bases based on a much better understanding of their drainability. Better drainage will be cost-effective and lead to longer pavement durability.

Status - Gradation, density, and permeability testing will be completed between October 2001 and march 2002. Outflow measurements and visual surveys will continue through October 2003. An interim report will be published in early 2003.

RI01-049 - Dowel Bar Inserter Study

Purpose - The objective of this investigation is to determine the accuracy of dowel bar inserters in a PCC paving project and to develop acceptance criteria for future dowel bar placement with dowel bar inserters. Dowel bar inserters (DBI) on concrete paving equipment eliminate the need for manually placing dowel bar baskets. DBI performance will be evaluated at a paving project on US 60 near Van Buren.

Savings - A cost savings should be realized with DBI use through the reduced labor and material costs of placing dowel baskets.

Status - Paving with the DBI will be completed in August 2002. A final report will be completed in October 2002.

RI01-050 - Evaluation of Longitudinal Keyway Joints

Purpose - The objective of this investigation is to determine the effectiveness of keyways at longitudinal construction joints in PCC pavements. Keyways are a traditional means of providing load transfer at longitudinal construction joints. Missouri has used them for many years. The primary question that's been raised is "Are they really needed?" Since tie bars are used in conjunction with keyways there appears to be a redundancy in load transfer. Also, MoDOT's newer PCC design calls for widened driving slabs, which reduce edge stresses and help negate the need for longitudinal load transfer.

Savings - Eliminating keyways would simplify construction and reduce consolidation problems at longitudinal joints, if any exist. It may also provide a modest cost savings in the price of concrete paving. Optimization of tie bar size and spacing may be another benefit.

Status - A final report will be completed by June 2003.

RI02-025 - Rubblization of PCC Pavement

Purpose - To measure the performance and cost-effectiveness of a rubblized PCC pavement with an AC overlay. Rubblizing a PCC pavement is assumed to eliminate the distress that usually shows through AC overlays in a short period of time: reflective cracking.

In theory, a rubblized pavement is fractured to particle sizes that cannot produce the slab-induced stresses required to rupture the asphalt surface, yet provides a stiffer base than conventional crushed stone.

Savings – Rubblization should eliminate reflective cracking in asphalt overlays. If the increase in performance and decrease in maintenance costs more than offset the increase in initial construction costs, it may be more cost-effective than conventional asphalt overlays.

Status – After the rubblization project is built in the summer of 2003 a construction report will be completed shortly thereafter. Subsequent annual reports will be completed after distress surveys are performed.

RI93-007 - Evaluation of the Maturity Method for Estimating Concrete Strength

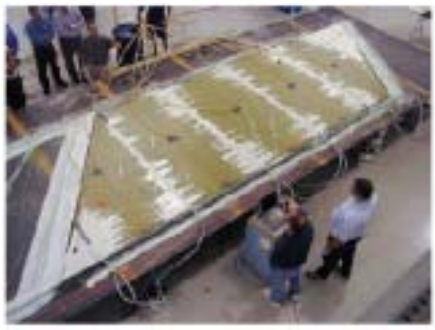
Purpose -. The maturity method offers a means of non-destructive testing for estimating in-place concrete strength based on the concrete's early age and temperature history. The objective of this study is to evaluate the maturity method and to work towards establishing a MoDOT specification for pavement and structural applications in Missouri.

Savings - Accepting the maturity method into practice would facilitate construction operations by providing timely, in-place concrete strengths for opening pavement to traffic, sawing pavement joints, removing formwork, hot or cold-weather concreting, and others. The maturity method would provide valuable in-place strength information that is felt to be more representative than conventional standard cylinders and more efficiently obtained.

Status -The maturity method has been actively evaluated under laboratory and field conditions. Preparation of a specification for implementation in Missouri is currently underway.

Safety/Traffic

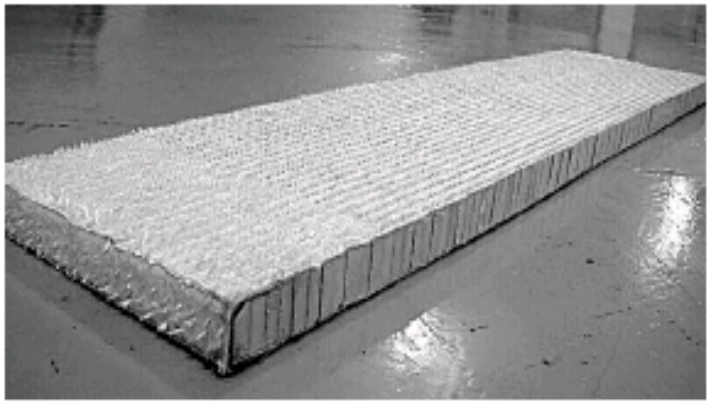
RI02-016 - Design, Fabrication, and Testing of Low-Profile Composite Bypass Road Panel: Phase I (UMR)



Purpose – Currently, MoDOT constructs a temporary by-pass or roadway around a construction site to maintain traffic flow. The by-pass or roadway is normally built of asphaltic concrete or portland cement concrete pavement. When the project is completed, the contractor will tear out the temporary by-pass and will not be able to use the material again in another project. The research investigation will study the feasibility of fiber-reinforced polymer (FRP) systems for low profile by-pass road panels. The ultimate goal would have the FRP panels be a reusable product from one project to another. The proposed panel will be comprised of a sandwich core composite material containing fiberglass skins and an innovative fiber reinforced core material. A low cost vacuum molding process will be used to rapidly infuse the resin throughout the fiber-reinforced polymer panels as shown.

Savings - The initial cost would be higher than asphalt or concrete, but with the reusability of the FRP panels the overall cost of the panels may be reduced.

Status - The University of Missouri-Rolla is currently evaluating the following: (1) literature search; (2) fabrication and mechanical characterization of FRP panels that have been identified as suitable for this application; and (3) development of schematic solutions for site implementation. If deemed necessary, Phase II could consist of detailed technical specifications and possible field application.



SOCIAL/ECONOMIC/ENVIRONMENTAL

RI I00-048 - Cost of Community Services in Missouri Communities (w/UMC)

Purpose – The purpose of this project was designed to perform a fiscal analysis of areas in Missouri and display the cost of services compared to tax revenues derived from varying land development patterns. MoDOT participated with the Missouri Department of Economic Development, Conservation and Agriculture, along with the University of Missouri-Columbia, Community Policy Analysis Center on this project.

Results - The findings indicate that when cost of service ratios for all types of local government are considered, commercial and agricultural land generally have a positive fiscal impact on local government, whereas community services associated with residential land, cost more than the revenues from residential development. The study concludes that residential development does not pay for the cost of services under any of the local government types included in the analysis. The entire report can be reviewed at: http://www.modot.state.mo.us/rdt/rdt.htm.

RI01-010 – Highway/Rail Crossing Project Selection Investigation (UMR/UMC)

Purpose – In cooperation with the University of Missouri, Columbia and Rolla campuses, this project is designed to evaluate the efficiency of MoDOT's use of the Exposure Index formula for ranking highway/rail crossings for possible improvements. With over 4000 highway/rail crossings in the state and limited funding, improving the right intersections is of paramount importance. The project will provide enhancements to the use of the current index formula through the evaluation of eight other indexes used by other states. Additionally, the availability of data for the various models will be evaluated and a recommendation will be made concerning the most effective and safety-enhancing highway/rail crossing indexing method.

Status – The project team has met with an advisory panel consisting of a railroad representative from FHWA, MoDOT, Missouri Department of Economic Development, Federal Railroad Administration and various rail carrier representatives. The team has evaluated available data and

goals of the highway/rail crossing selection process. Currently the other indexing models are being evaluated and a list of crossing intersections is being evaluated by several of the models to compare the relative ranking provided by the various models. With the May 2003 completion of the study, recommendations will be made concerning MoDOT's use of the index formula to ensure that the greatest increase in rail crossing safety is achieved with the limited funding.

RI01-011 – Identification and Development of User Requirements to Support Robust Corridor Investment Models (UMC)

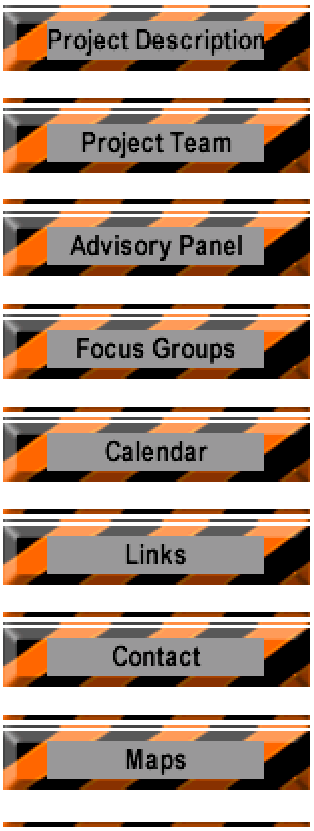
Purpose – The Highway Corridor Investment Model is a research project intended to develop a conceptual framework for evaluating competing corridor investment projects. The resulting decision model will aid in determining which projects are most supportive of transportation-related well-being. As a result of this project, a suitable economic model will be selected for use at MoDOT. This model will estimate the economic benefits of our overall transportation investment for the state as a whole as well as provide estimates of the economic impacts of particular projects for regions and communities.

Status - This project is being completed in cooperation with the Community Policy Center and the Center for Environmental Technology at the University of Missouri-Columbia, and the Midwest Transportation Consortium. A project advisory team has met over the last year and a conceptual framework is near completion. Results and recommendations from this project will be available December 2002. See the project website at:
http://www.cpac.missouri.edu/mtc/links.html.

RI01-046-Assessment of MoDOT's Management Systems

Purpose – The purpose of this project is to evaluate MoDOT's Transportation Management System in order to identify its effectiveness in ensuring that our asset management goals are met. The research will provide a gap analysis between MoDOT's current management system and best practices found in other business climates. The complete utilization of our management systems will provide for greater efficiency in the maintenance and operations of the State's transportation system.

Status – The review of the management system is now underway. An advisory team is being formed and the evaluation will conclude with recommendations to maximize MoDOT's current system in December of 2003.



Links:

CPAC - Community Policy Analysis Center

Midwest Transportation Consortium

MoDOT - Missouri Department of Transportation

Measurable Indicators

Transportation planning article

RI00-049 - Development and Use of Social and Economic Data at MoDOT (UMC)

Purpose – The detailed demographic, social and economic characteristics of Missouri are essential elements of MoDOT planning, project development and environment justice functions. MoDOT staff needs easy access to up-to-date social and economic information that is relevant, authoritative, convenient and understandable.

The Office of Social and Economic Data Analysis (OSEDA) at the University of Missouri-Columbia is working with MoDOT staff to develop and implement authoritative information products, tools and training so that MoDOT staff can efficiently and effectively use social and economic information in their work.

Status - Based on their work with MoDOT staff, OSEDA has developed a census and economic data website with pertinent tables, charts, graphics and narratives explaining social and economic changes occurring across the state. See the MoDOT/OSEDA web page for examples.

With the completion of the data collection and analysis this summer, OSEDA will provide training for the use of the website as well as training designed to allow the user to interpret the information as it affects MoDOT's planning, development and operations. The training will be offered across the state and will include MoDOT employees as well the employees of planning organizations, municipalities and counties.

This project will be completed in December 2002. See the project website at**:** missouri.edu/~diana/oseda/modot_web_project/.

Welcome to the Missouri Department of Transportation Socio-Economic Indicator Resource

Web Page. A joint collaboration between the Missouri Department of Transportation (MoDOT) and the Office of Social and Economic Data Analysis (OSEDA) to provide up-to-date, authoritative data and information for use in transportation planning and project development. The Indicator Resource Web Page makes available data, maps, tables, charts and graphics and analysis at the level of geography meaningful to MoDOT personnel.

Select the geography of interest below in order to access the informational elements of choice.

Missouri Counties

Planning Districts

Regional Planning Commissions

Metropolitan Planning Organizations

Corridor Studies

UEXPLORE

Technology Transfer

After a product has been researched and developed, information is shared within the department, state and the country. Technology Transfer uses many tools to share information internally and externally. Technology sharing methods include research reports, letters of findings, briefs, guidesheets, newsletters and training workshops.

Technology Transfer Assistance program (TTAP)

Purpose - Technology transfer links MoDOT's research efforts to our transportation partners. The success of a research program is measured in implementation of research results. A critical component in implementing our results includes the technology transfer. Technology transfer strategies focus on the practical application of research that improves quality, delivery, and return on investment for our customers.

Thru new communication mediums and customary venues, RDT can share our research findings and conduct training for our employees and our industry partners. Over the past year the T-squared unit at RDT has offered traditional classroom instruction on engineering, technical and asset management strategies. In addition RDT has deployed new learning technologies such as web based conferencing, video downlink training and internet publication distribution to our customers.

Savings – Savings are accomplished thru the implementation of research that meets the required functions at a lower life cycle cost to the department. Society savings are also measured in terms of time, safety and convenience of the traveling public.

Status – This is an annual program.

RI 98-026 - Library Automation Project (UMC – School of Information Sciences)

Purpose – To increase the operation and efficiency of the department's technical library, RDT has begun a project to automate the inventory of its holdings. An automated library will serve as an essential tool for literature searches, research analysis and technology transfer.

Status - The key features of the 1st phase of the project include software configuration, cataloging and physical collection.

Savings – Savings will be achieved through increased searching capabilities and tech transfer.

Technology Sharing

Purpose – The RDT Division has established several goals to foster technology transfer to promote effective use of technology, research and new product findings. This has been accomplished through RDT briefs, brochures, research reports, conference booths and technology scanning.

Savings – Savings are realized as new technology and findings become a part of the department and local jurisdiction processes.

Status – Technology sharing is an annual effort.

Published Reports and Documents shared in Fiscal Year

Research Reports	-	19
Briefs	-	3
Newsletters	-	4

RDT Training Activities

Purpose – Technical training courses are available to provide direction and support to personnel. These courses are scheduled to maintain an understanding of new needs and enhance abilities to support the overall transportation function. Typical audiences include personnel from FHWA, MoDOT, and local government entities. Training is further accomplished by field assistance demonstration, which depict a hands-on, best practices method of sharing.

Savings – Significant savings can be realized as courses are scheduled at locations to minimize or eliminate travel time. Savings can also be realized through partnering at the district and local level to increase efficiency.

Status – Training is an ongoing annual effort.

Training

Name of Course	Date	Location	Attendees	Type
Defensive Driving Training	01/15/02	Salem, MO	30	LTAP
Defensive Driving Training	02/27/02	Potosi, MO	25	LTAP
Defensive Driving Training	03/27/02	Potosi, MO	25	LTAP
Defensive Driving Training	04/23/02	Rolla, MO	25	LTAP
GASB 34/Asset Mgt	02/06/02	Jefferson City, MO	38	LTAP
GASB 34/Asset Mgt	02/20/02	Sikeston, MO	43	LTAP
GASB 34/Asset Mgt	02/27/02	Macon, MO	33	LTAP
GASB 34/Asset Mgt	03/13/02	Lee's Summit	34	LTAP
GASB 34/Asset Mgt	03/27/02	Springfield, MO	27	LTAP
Gravel Roads Workshop	02/13/02	Boone County	25	LTAP
Gravel Roads Workshop	02/15/02	Ripley County	18	LTAP
Gravel Roads Workshop	03/06/02	Wayne County	18	LTAP
Gravel Roads Workshop	03/27/02	Platte County	20	LTAP
Work Zone Safety	10/08/02	Nevada, MO	50	LTAP
Work Zone Safety	02/27/02	Platte County	29	LTAP

Highway Program Financing	07/24-25/01	Jefferson City, MO	38	NHI
Stream Stability and Scour at Highway Bridges	07/24-26/01	Jefferson City, MO	26	NHI
Preventive Maintenance	02/28-03/01/02	Jefferson City, MO	37	NHI
Application of the FHWA Traffic Monitoring Guide	3/12-13/02	Jefferson City, MO	20	NHI
Managing Traffic Incidents And Roadway Emergencies	4/9-10/02	Jefferson City, MO	25	NHI
Highway Capacity Manual Training	08/21-23/02	Jefferson City, MO	30	MODOT

On-Line Web Content Development

Purpose - To be effective, research findings must be communicated before they can be implemented. Previous communication has been limited to word of mouth, presentations, and mass mailings of reports and newsletters. The development of on line publishing via the world-wide web will add to or replace mass mailings. It will improve word of mouth, presentations, and newsletters by providing an easy way for people to follow up and find out more. It will also allow the use of e-mail and search engines to announce or even advertise to a much wider audience. Meanwhile a good, centralized but widely available filing system makes it easier for people to find what they need, when they need it. The more we communicate research results, the more others can implement them.

Savings - There are three cost considerations: Direct, equivalent service, and indirect. The direct costs of producing and publishing reports on-line are less than on paper. If the on-line version replaces paper version, then there will be a savings. If the on-line version is added and the paper version continued, then there will be a slight cost increase. In terms of equivalent service, the on-line version is a vast savings over a paper system that's publicly available 24 hours a day, 7 days a week; that provides full color reports delivered anywhere in the world in terms of minutes instead of days; and that allows unlimited prints. There may also be indirect savings in terms of any implementation done because of improved communications.

Status - Web site and content development is in progress and awaiting approval from the Public Information and Outreach office.

Students from the Summer Transportation Institute Visit RDT

RDT's John Donahue conducts a presentation for a group of high school students enrolled in the University of Missouri–Rolla's (UMR) 4th Annual Missouri Summer Transportation Institute (STI).

High School students from Missouri, Illinois, Washington and Texas participated in a 5-week transportation curriculum at UMR this summer. The purpose of the institute is to introduce the students to careers in transportation and civil engineering. Students enrolled in the program participate in a variety of activities such as: seminars that introduce the modes of transportation; discussions with professionals in both the public and private sector; and enjoy field trips to transportation facilities such as the MoDOT laboratories. Students also develop communication and interpersonal skills through workshops. For the past two years, students also have had the opportunity to take a college level 3-credit course. The program is funded through the combined efforts of the Federal Highway Administration, MoDOT, UMR, Burns and McDonnell, Jacob Civil, Parsons Brinckerhoff and local ITE and ASCE chapters. The program began in 1992 at South Carolina State University. Since 1992 the program has expanded to a total of 42 sites around the U.S. UMR was awarded Missouri's program in 1999. Since 1999 UMR faculty have graduated over 70 students. Dr. Gary Spring and Dr. Mohammad Qureshi oversee UMR's STI program.

Team Conducts Peer Exchange of MoDOT's RD&T Program April 29th–May 2nd in Jefferson City

The Missouri Department of Transportation hosted a Peer Exchange of its research program April 29 - May 2, 2002 in Jefferson City. Members of the Peer Exchange Team included the following:

- Richard L. McReynolds, Kansas Department of Transportation, Team Leader
- Peter Clogston, FHWA, Missouri Division
- David Lippert, Illinois Department of Transportation
- Moy Biswas, North Carolina Department of Transportation
- Leanna Depue, Central Missouri State University
- Bill Schonberg, University of Missouri, Rolla
- Roger Port, FHWA, Tennessee Division (retired)
- Richard Pain, Transportation Research Board
- Ray Purvis, Missouri Department of Transportation

The expressed objectives of the peer exchange were to:

- Verify and/or improve research-related processes
- Increase effectiveness of research, development and technology transfer efforts to best serve MODOT strategic goals and objectives
- Benchmark performance

Several common themes emerged from the discussions:

- Expand communications to improve effectiveness and knowledge of the research process
- Importance of policy research
- Importance of implementation and measurement processes
- Enhance customer service and delivery strategies to meet diverse customer needs
- Efficiency and "the need for speed" to meet MoDOT needs

Implementation Plan

The RD&T office is currently drafting a proposal to implement several of the key planned actions recommended by the Peer Exchange Team. MoDOT management anticipates the Review and approval of these actions.

Peer Exchange Session on April 29, 2002 at the RDT office in Jefferson City. Seated from Left to Right is peer exchange leader Dick McReynolds Research Director for the Kansas DOT, Kevin Keith Chief Engineer for MoDOT, team member Bill Schonberg, Professor and Chairman of University of Missouri – Rolla CE Department and Ken Fryer, State Project Operations Engineer for MoDOT.

National Librarians hold Library Peer Exchange for MoDOT's RDT Library

A Photo taken at the Opening Library Peer Exchange Session. Seated left to right are Barbara Post of TRB, Nelda Bravo NTL, and Roberto Sarimento of Northwestern University.

The Missouri Department of Transportation hosted a Peer Exchange of its library research program August 6th and 7th 2002 in Jefferson City. The library peer exchange team reviewed and made recommendations on the RDT Library Automation Project that is currently under contract with the University of Missouri-Columbia -- School of Information Sciences and Learning Technologies. The team concentrated their efforts in library cataloging procedures, physical collection organization, document distribution and web based library services and linkages.

Members of the Peer Exchange Team included the following:

- Nelda Bravo, National Transportation Library, Team Leader
- Barbara Post, Transportation Research Board
- Roberto Sarmiento, Northwestern University
- Tom Kochtanek, University of Missouri-Columbia
- Paula Meredith, Missouri Department of Transportation
- Donna Ridenhour, Missouri Department of Transportation
- Mike Shea, Missouri Department of Transportation
- Ray Purvis, Missouri Department of Transportation
- Sara Pensgard, University of Missouri-Columbia
- Sean Cordes, University of Missouri-Columbia
- Lori Bain, University of Missouri-Columbia
- Charlie Nemmers, University of Missouri-Columbia
- Mohammad Qureshi, University of Missouri-Rolla

University of Missouri—Rolla Awarded the Missouri LTAP Center Contract

The Missouri Local Transportation Resource Center (MLRTC)

Dr. Mohammad Qureshi

The University of Missouri Rolla has been awarded the contract to administer LTAP program for the next three (3) years (2002 –2004). The program's new name will be the Missouri Local Transportation Resource Center. The LTAP program has been in existence for 18 years since 1984. From 1984 through 1988 the University of Missouri Rolla administered LTAP. From 1988 to the present MoDOT has administered the program in house. Dr. Mohammad Qureshi will direct the program at the University of Missouri – Rolla. Effective July 1, 2002, a new toll free phone number will go into effect at MLRTC. It is 1-866-MO-ROADS. For more information you can also access the MLTRC website at www.umr.edu/~mltrc.

Dr. Mohammad Qureshi has served as an Assistant Professor in the Civil Engineering Department at the University of Missouri –Rolla since August 2000. He has experience in the areas of traffic impact studies, traffic operations, highway safety, highway-rail crossing policy, data collection procedures, and statistical analysis of transportation data. Dr. Qureshi has published papers on signalized intersection operations and rail-highway grade crossing policy. Dr. Qureshi received his B.S. and M.S. in Civil Engineering from the University of California, Berkeley and his doctorate from the University of Tennessee in August of 2000.

The Missouri Local Transportation Resource Center will be seeking an energetic individual to handle primary day-to-day operation of the center. Primary responsibilities will include responding to requests for information or technical assistance, maintaining a client database, and managing the center's library of information. The position will come with full benefits including reduced fees for courses at UMR. The individual selected will be considered for admission to graduate school.

The MLTRC is also looking for recent MoDOT retirees to serve as Ambassadors and Circuit Riders. Duties for these positions are still being developed. These positions will be part-time appointments.

RESEARCH, DEVELOPMENT AND TECHNOLOGY
Task and Activity
July 2001 – June 2002

TA NUMBER	TA REQUEST TITLE
TA01-023	Initiate Lead Effort for Fiber Reinforced Polymers (FRP) Initiative Plan
TA01-020	Longitudinal Cracking in Grade S Pavement – Survey
TA01-024	Compilation of Other State Data on Maintenance Investment per Mile
TA01-025	RDT participation in Employee Suggestion System
TA01-026	Compressive Strength Statistical Data
TA01-028	Coordinate Facilities for an APT TAC Meeting the Week of November 26
TA01-029	Longitudinal Keyed Joint Study
TA01-031	Transportation Planning Management for Special Events
TA01-032	Public Benefits of Highway System Maintenance and Operations
TA01-033	Ray County Lake Road Maintenance
TA01-034	RDT Inventory
TA01-035	State Median Opening Survey–NCHRP 17-21
TA01-036	Publication Cost Efficiency Request by P.A.
TA01-037	UMC Library Publication Transfer
TA01-038	Solicitation of Ideas for T2 & Marketing Funds

RESEARCH, DEVELOPMENT AND TECHNOLOGY
Task and Activity
July 2001 – June 2002

TA NUMBER	TA REQUEST TITLE
TA01-039	Market Research in Transportation Planning
TA01-040	Rapid Repair of Concrete Pavement
TA01-041	AASHTO Francis B Francois Award Application
TA01-042	Communication Cost Efficiencies
TA01-043	NCHRP 24-19 Survey on Environmentally Sensitive Channel and Bank Protection Measures
TA01-044	Partnering Survey
TA01-045	NCHRP 12-58 Survey of Current Practice: Effective Slab Width for Composite Steel Bridge Matters
TA01-046	AASHTO President's Award
TA01-047	Request to fill Vacant RDT Positions
TA01-048	I-70 Scope of Services Review for VE Service
TA01-049	CTE Teleconference – R/W and the Environment
TA01-050	Design Quality Survey
TA01-051	LTRC Project No. 01-1st Continuity Diaphragm For Skewed Continuous Span Precast Beam
TA01-052	Non Destructive Testing Survey
TA01-053	Interaction Between Wildlife Ecology and Roadways

RESEARCH, DEVELOPMENT AND TECHNOLOGY
Task and Activity
July 2001 – June 2002

TA NUMBER	TA REQUEST TITLE
TA02-001	Urban Arterial Pavement Design and Analysis
TA02-002	Maintenance Costs Estimate for U. S. 63 JCPC
TA02-003	Additional Maintenance Funding Analysis
TA02-004	Peer Exchange
TA02-005	Materials Used in Utility Crossing of Roadways
TA02-006	Review of Economic Development Impacts of Transportation Improvements: Two and Four Lane Corridors
TA02-007	Benefits of Intermodal Connects for Port Access in Missouri
TA02-008	A Demographic and Economic Comparison of Selected Counties in Missouri
TA02-009	Succession Planning
TA02-010	Cold in Place Recycling
TA02-011	Storm Water Quality Management Practices
TA02-012	Foamed Asphalt Applications
TA02-013	Broadbanding
TA02-014	Connecticut Truck Mounted Attenuator
TA02-015	Effective Public Communication Methods
TA02-016	Questionnaire on Traffic Structure inventory and inspection practices

RESEARCH, DEVELOPMENT AND TECHNOLOGY
Task and Activity
July 2001 – June 2002

TA NUMBER	TA REQUEST TITLE
TA02-017	Assessing Customer Satisfaction of Highway Operation
TA02-018	Road Profiling/Rut Depth Survey
TA02-019	Base Stabilization Survey
TA02-020	Highway Capacity in Work Zones
TA02-021	Benefits of Fog Seal on Chip Seals
TA02-022	Security and Emergency Response Survey of State Transportation Agencies
TA02-023	Air Quality Program Effectiveness
TA02-024	Pavement Marking Management Systems Survey
TA02-025	Worker Safety Issues in Nighttime Highway Construction in Illinois
TA02-026	Lighting for Night Construction
TA02-027	Night Time Construction Question: Evaluation of Construction Operations
TA02-028	NCHRP Synthesis Topic 33-11, “Including Tourism and Recreation Travel in Metropolitan and Statewide Transportation Planning and Decision-Making”--Questionnaire
TA02-029	TMA/TDM Evaluation Research Massachusetts Highway Department
TA02-030	Epoxy Paint Specifications Survey Montana DOT

RESEARCH, DEVELOPMENT AND TECHNOLOGY
Task and Activity
July 2001 – June 2002

TA NUMBER	TA REQUEST TITLE
TA02-031	Valuation of Temporary Facility Use Losses
TA02-032	Culvert Sliplining Maine DOT
TA02-033	Crack Sealing Questionnaire
TA02-034	Research Administration Methods for On-line Publications
TA02-035	NCHRP Synthesis 33-02, Prefabricated Bridge Components and Systems to Limit Traffic Disruption During Construction
TA02-036	Curb and Gutter Multilane Typical Sections Georgia DOT
TA02-037	New York DOT Research Project C-01-47 Operational and Safety Performance of Modern Roundabouts and Other Intersections
TA02-038	NCHRP Synthesis 33-06, Roadway Safety Tools for Local Agencies – MoDOT's Response
TA02-039	NCHRP Synthesis 33-06, Roadway Safety Tools for Local Agencies – Missouri LTAP Center Response
TA02-040	Friction Testing – Nevada DOT
TA02-041	Stormwater Quality Management Plan INDOT
TA02-042	Organizational Quality Improvement Programs
TA02-043	NCHRP Synthesis Topic 33-05, "Safe and Quick Clearance of Traffic Incidents"
TA02-044	Investigation of Graded Aggregate Base (GAB) Courses
TA02-045	Level of Service Questionnaire Del DOT

RDT Number	Research Request Title
RI02-001	Material and Process Optimization for Portland Cement Concrete Pavements (Pooled Fund)
RI02-002	Steel Free Hybrid Reinforcement System for Concrete Bridges
RI02-003	Construction Specifications, Contract Documents, Field Testing, Educational Materials and Course Offerings for Trenchless Construction Methods
RI02-004	The Erosion Control Laboratory
RI02-005	Side Friction of Drilled Shafts in Shale
RI02-006	Techniques and Equipment for Maintenance Repair of Shallow Slides Using Recycled Plastic Pins
RI02-007	Evaluation of FRP Repair Method for Cracked PC Bridge Members – Joint MoDOT, KDOT project
RI02-008	Strengthening Martin Springs Outer Road Bridge – Phelps Co. MO
RI02-009	Strategic Highway Safety Plan – Phase III NCHRP Project 17-8(3) TPF 2(209)
RI02-010	Post Earthquake Damage Evaluation of Bridge Structures
RI02-011	Techniques for Cap Beams, Columns Experimental Study on Seismic Retrofit and Their Connections of Highway Bridges
RI02-012	Environmental Justice Impact Avoidance and Mitigation for Planning Project Development
RI02-013	Full Scale Accelerated Performance Testing for Superpave and Structural Validation

RDT Number	Research Request Title
RI02-014	Assessment of Alternative Left-turn Phasing Strategies
RI02-015	Design of Single Point Urban Interchange (SPUI)
RI02-016	Design, Fabrication and Testing of Low-profile Composite Bypass Road Panel: Phase I
RI02-017	Proper Gyration Levels for Missouri Aggregate Sources
RI02-018	Benefits and Identification of Candidate Locations for Passing Lanes in Missouri
RI02-019	Effectiveness of New Special Provisions for Placing and Curing Concrete Bridge Decks
RI02-020	Economic and Demographic Analysis of Counties Serviced by Two Land and Four Lane Roadways
RI02-021	Community Benefits and Impacts of Access Management
RI02-022	FRP Bridge Strengthening Initiative
RI02-023	Adaptive Traffic Signal System
RI02-024	Traffic Control Device Consortium
RI02-025	Rubblization on U. S. 54 in Audrain Co.
RI02-026	International Conference on Highway Performance Data Analysis and Design Applications (FHWA Pooled Fund) TPF(041)
RI02-027	Salt Effects on Concrete Pavement

RDT Number	Research Request Title
RI02-028	NCAT Test Track
RI02-029	FWD Calibration Centers
RI02-030	Heat Strengthening Repair of Damaged Steel Bridges
RI02-031	Long Term Maintenance of Load Resistance Factor Design Specifications (LRFD)
RI02-032	Anti-Icing/RWIS Computer Based Training

"Final Publications"
FY 2002

TITLE	RESEARCH REPORT DATE PUBLISHED	RDT BRIEF DATE PUBLISHED
Instrumentation and Monitoring of High Performance Concrete Prestressed Bridge Girders	May 2001	
Pre-Cast 1 Girder Cracking: Causes and Design Details	June 2001	
Earthquake Hazard Assessment Along Designated Emergency Vehicle Priority Access Routes	November 2001	November, 2001
Evaluation of Early Entry Sawing of PCC Pavement	August 2001	September, 2001
Safety & Design Improvement @ Rural Expressway Median Crossover (RDT 01-001 updated to 01-011)	November 2001	
Bridge Deck Condition Studies in Missouri Utilizing Ground Penetrating Radar	August, 2001	
Strengthening of an Impacted PC Girder on Bridge A10062, St. Louis County, Missouri (RDT 01-003 updated to 01-013)	December, 2001	
RDT Summary Report FY 2001	September, 2001	
Evaluation of Ultra-Thin Whitetopping	October, 2001	
Work Zone Guidance	October, 2001	
Construction and Long-Term Monitoring of a Concrete Box Culvert Bridge Reinforced with GFRP Bars	December, 2001	

FY 2002

TITLE	RESEARCH REPORT DATE PUBLISHED	RDT BRIEF DATE PUBLISHED
Repair and Strengthening of Impacted PC Girders on Bridge A4845	December 2001	
Flexural Toughness and Flexural Fatigue Characterization of Fiber Reinforced Concrete Pavement Mixes	January 2002	
Water Reducing Admixtures in PCCP Pavement on Route 60, Carter County	February 2002	
Review of Economic Development Impacts of Transportation Improvements: Two and Four Lane Corridors	April 2002	
Benefits of Intermodal Connections for Port Access in Missouri	April 2002	
A Demographic and Economic Comparison of Selected Counties in Missouri	April 2002	
Installation and Initial Performance of 60" ADS N-12HC® HDPE Pipes	June 2002	June 2002
2002 MoDOT Peer Exchange	June 2002	

MISSOURI HIGHWAY AND TRANSPORTATION DEPARTMENT
RESEARCH IDEA STATEMENT

Research Idea Statements are being solicited under research emphasis areas: For example: (A) Safety, (B) Maintenance, (C) Structures, (D) Traffic, etc.

RESEARCH *(attach additional sheets if necessary)*

Idea Title:

Idea Statement:

Objective:

(Optional)

Emphasis Area:

Application or Research Results:

Pertinent Divisions:

Key Words (Key words are needed to assist in literature search for Research Idea subject):

Name: Date:
Title:
Organization: Div/Dist.:
Address: Phone:

Complete and return to: Missouri Department of Transportation
Attn.: Research, Development & Technology Div.
P.O. Box 270
Jefferson City, Missouri 65102

Phone:
FAX:

http://www.modot.state.mo.us/rdt/rdt.htm

New Product Evaluation Form

When request is submitted, enclose a completed copy of this form and the required information as indicated below.

Circle One: Manufacturer Fabricator Distributor Other_____

Business Name: _____Contact Name:_____

Address:_____City:_____

State:_____ Zip:_____ Telephone No:_____

Fax No:_____ Email:_____ Website: _____

Product: Name of Manufacturer: _____

Name of Product:_____Model No._____

Description and intended application of product:_____

_____

Key words (requested for literature search):_____

List other states using the product:_____

What is the approximate unit cost of the product?_____

Is material available at no cost for lab and field installation evaluation_____

Applicable Specifications: (MoDOT specifications and MSP's are available at www.modot.state.mo.us/business/business.htm or by request.)

	Indicate Yes/No	(If yes, provide specification name/number. If no, attach separate explanation as to why not and why MoDOT should consider the product)
Does product comply with MoDOT specifications?	____	_____
Does product comply with other specifications (such as ASTM, ITE, AASHTO, NEMA, NTPEP, etc.)?	_____	(If yes, provide specification name and number. Attach additional sheets if necessary.) _____

Required Information (to be submitted in addition to this form):

1) Product data (mixing info, installation requirements, product brochures, specification sheets, etc.)
2) Documentation required by the MoDOT specification (if applicable)
3) Applicable test data
4) Unit cost data and whether the unit cost includes installation
5) Material Safety Data Sheet

Submitted by:

(Sign)_____Date:_____

(Print)_____Please send the new product evaluation request form and all other required information to the appropriate address below. Submittals related to the Traffic Signal and Highway Lighting Approved Products List should be submitted to Traffic Operations. Submittals that meet a current MoDOT specification and have a Qualified or Pre-Acceptance List should be submitted to Project Operations. All other submittals should be submitted to Research, Development and Technology. If a sample is required by the specification, submit the sample with a copy of the required documentation to the Central Laboratory. If the specification does not specify a sample or there is no specification, sample submittals will be required upon request.

Traffic Operations	Project Operations	Research, Development and Technology	Central Laboratory
P.O. Box 270 2211 St. Mary's Blvd Jefferson City, MO 65102	P. O. Box 270 2211 St. Mary's Blvd Jefferson City, MO 65102	P.O. Box 270 1617 Missouri Boulevard Jefferson City, MO 65102	1617 Missouri Boulevard Jefferson City, MO 65109

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Jefferson City, MO 65109
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Ray Purvis, State Research, Development and Technology Engineer
Tim Chojnacki, Director/Research
Don Davidson, Director/Development
Michael Shea, Director/Technology Transfer

Implementation Form

Research Investigation and Implementation

Project Information

Project Title:	Project ID: Date:
Technical Advisory Group:	Technical Advisory Chair and Phone Number:
Project Start Date:	Approved Contract Amount:
Project End Date:	Final Project Expenditures:
Final Report Draft Date:	
Principal Investigator:	Principal Investigator Phone: E-Mail:

Technical Advisory Group Recommendation

1. Check one of the two below:

❑ Yes. We recommend changes to current practice based on some or all of the results of this report. The research was sound, and the report's conclusions appear to offer an advance over current practices.

❑ No. We do not recommend changes to current practice at this time. This approach does not appear fruitful OR future study is needed OR our objectives have changed, etc.

2. If implementation is recommended, we suggest the following specific changes to current practice detailed in the final report and timeline. (check applicable items)

❑ Standard Specifications
❑ MoDOT Functional Unit Manual (i.e. Maintenance, Design, Construction, Materials, etc.)
❑ Standard Drawings
❑ Job Special Provisions
❑ Training, Outreach
❑ Other (describe):

3.	Approval of this implementation plan by the Technical Advisory Group (chair on behalf of TAG):	Signature: Date:
4.	Approval of final report and timeline by the MoDOT personnel responsible for the policies described in item # 2 above:	Signature(s): Date:
5.	Approval at Implementation	Name: Functional Unit:

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Ray Purvis, State Research,
Development and Technology Engineer
Tim Chojnacki, Director, Research
Don Davidson, Director, Development
Michael Shea, Director, Technology Transfer

Implementation Plan

Project Title	Prepared By:

1. Scope and objectives of implementation, including specific changes to MoDOT procedures:

2. Estimate cost (if any) to implement.

3. Expected benefits and how they will be measured (dollar savings, time savings, other).

4. Possible pitfalls and how they will be avoided.

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http://www.modot.org/rdt/rdt.htm

December 2002