Home of Missouri's LTAP
MLTRC
Missouri Local Transportation Resource Center
UMR
MOinfo
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FALL ◆ 2003

in this issue

RURAL TRAVELERS HEAR THE RUMBLE OF SAFER ROADS
Center line rumble strips improve rural road safety.

NEW ONLINE RESOURCE
Highway specifications are now available on the web.

MISSOURI PROFESSIONALS LEARN A NEW EXPANSION JOINT REPLACEMENT METHOD
MoDOT demonstrates the XJS Expansion Joint System.

MARCH 18–20
2004 Midwest Regional Bike-Ped Conference
Doubletree Hotel in Overland Park, Kans.
Program Info: rosemary@ku.edu
Attendance/Registration Info: www.kutc.ku.edu/region7bikeped

MARCH 30–APRIL 1
2004 Transportation Engineers Association of Missouri (TEAM) Annual Conference
Chateau on the Lake in Branson, Missouri
Program/Attendance Info: Mike Fritz
fritzm@mail.modot.state.mo.us
www.modot.org/TEAM

MAY 10–12
55th Annual Missouri Traffic & Safety Conference
Holiday Inn Select in Columbia, Missouri
Program Info: nemmersc@missouri.edu
Registration/Vendor Info: 573.882.6059

MAY 12–14
2004 APWA Mid-America Conference & Exhibit 2004
Overland Park Convention Center in Kans.
Attendance Info: contact your chapter president

Rural Travelers Hear the Rumble of Safer Roads

Excerpts from "Center Line Rumble Strips Reduce Crash Risk on Rural Two-Lane Roads," a report by Richard Retting of the Insurance Institute for Highway Safety . For a free copy of the full report, email publications@iihs.org.

On a national basis, rural roads account for approximately 40 percent of all motor vehicle travel but 60 percent of all fatal crashes. Approximately 90 percent of all fatal crashes in rural areas occur on two-lane roads, which typically lack physical measures such as wide medians or barriers to separate opposing traffic flows. As a result, a major crash problem on these roads involves vehicles crossing the centerline and either sideswiping or striking opposing vehicles head-on. These types of opposing-direction crashes account for about 20 percent of all fatal crashes on rural two-lane roads and result in approximately 4,500 fatalities annually.

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A comprehensive before-after study was undertaken to estimate the nature and magnitude of crash reductions associated with installation of center line rumble strips on rural undivided two-lane roads. Data were drawn from seven states: California, Colorado, Delaware, Maryland, Minnesota, Oregon, and Washington. In total, 98 treatment sites along approximately 210 miles of road were studied.

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Overall, motor vehicle crashes at treated sites were reduced 14 percent; injury crashes were reduced by an estimated 15 percent. Head-on and opposing-direction sideswipe crashes—the primary target of center line rumble strips—were reduced by an estimated 21 percent, while head-on and opposing-direction sideswipe crashes involving injuries were reduced by an estimated 25 percent. This result, taken together with the fact that installation costs are relatively low, suggest that consideration should be given to wider application of center line rumble strips on rural two-lane roads to reduce injury crashes.

The Missouri Department of Transportation is now conducting a similar investigation of the benefits of center line rumble strips along Rte. 21 in Jefferson County. Study results will be used to evaluate possible implementation on other Missouri roadways.

THE FINE PRINT:

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3 BRIDGES FOR SALE

BUTLER FORD BRIDGE: Ralls County, Missouri
Butler Ford Bridge over Spencer Creek is available for adaptive reuse at a new location. This National Register-eligible bridge was built by the St. Louis Bridge and Iron Company in 1892. Its 100-foot-long center span is a pin-connected, six-panel Pratt through truss with a 14' roadway width. The bridge also utilizes two approach spans, for a total length of 129'. If the bridge is transferred to another party, the transfer deed may include preservation covenants that require the new owner to preserve and maintain the bridge in accordance with established standards for historic bridges. Funding may be available for reuse of the bridge.
Contact: Michael Purol, Great River Engineering, Inc., P.O. Box 1258, Hannibal, MO 63401
T: (573) 221-8443 ♦ F: (573) 221-2230 ♦ E: grtriver@socket.net

COUNTY ROAD 116: Clark County, Missouri
This National Register-eligible bridge is available for adaptive reuse at a new location. The 112.2-foot-long, 12.1-foot-wide, 20-foot-tall, six-panel, pin-connected Pratt through truss has steel stringers and was constructed by George H. Turner in the early 1920s. It currently crosses the North Wyaconda River near Luray, Missouri. If the bridge is transferred to another party, the transfer deed may include preservation covenants that require the new owner to preserve and maintain the bridge in accordance with established standards for historic bridges. Funds may be available for reuse of the bridge.
Contact: James W. Kempker, S & V Consultants, Inc., 2015 Schotthill Woods Dr., Jefferson City, MO 65101 ♦ P: (573) 634-3551 ♦ F: (573) 634-3424

PARISH BRIDGE: Knox County, Missouri
Parish Bridge over the Middle Fabius River is available for adaptive reuse at a new location. This National Register-eligible bridge was build by the Ottumwa Bridge Company in 1907. The 84-foot-long center span is a Pratt through truss with a 12' roadway width. The Bridge also utilizes two steel stringer approach spans for a total length of 146'. If the bridge is transferred to another party, the transfer deed may include preservation covenants that require the new owner to preserve and maintain the bridge in accordance with established standards for historic bridges. Funding may be available for reuse of the bridge.
Contact: Michael Purol, Great River Engineering, Inc., P.O. Box 1258, Hannibal, MO 63401
T: (573) 221-8443 ♦ F: (573) 221-2230 ♦ E: grtriver@socket.net

PUBLICATIONS

Airport Research Needs: Cooperative Solutions — Examination of the idea of creating an applied research program that focuses on the shared needs and problems of airport operators. 102 pages.

An Analysis of Fatal Large Truck Crashes — Study by the National Center for Statistics and Analysis examining the characteristics of fatal large truck crashes. 43 pages.

Creating Safer Work Zones (Five Brochures) — "Work Zone Safety for Drivers"; "Trucking Safely through Work Zones"; "Accommodating Pedestrians in Work Zones"; "Worker Safety and Visibility"; and "Improving Traffic Control for Night Work Zones."

Intelligent Transportation Systems in Work Zones — Examination of the real-world experiences of using ITS in work zones in four locations across the U.S. 46 pages.

NCHRP Report 493: Evaluation of Traffic Signal Displays for Protected/Permissive Left-Turn Control — Protected/permissive left-turn traffic controls increase the left-turn capacity and reduce delay at intersections by providing an exclusive turn phase for left turns as well as a phase during which left turns can be made as opposing traffic will allow. This is an evaluation of such design. 83 pages (working papers are on an enclosed CD-ROM.)

NCHRP Synthesis 317: Dealing with Truck Parking Demands — Information to assist transportation agency administrators in identifying the practices that have been used to manage the increasing demand for truck parking. 37 pages.

NCHRP Synthesis 318: Safe and Quick Clearance of Traffic Incidents — Information to assist transportation agencies in facilitating the safe and quick clearance of traffic incidents. Profiles laws, policies and procedures for facilitating clearance of traffic incidents, primarily those initially blocking travel lanes and attended to by the vehicle operator on highways in urban and rural areas. 143 pages.

NCHRP Synthesis 319: Bridge Deck Joint Performance — Summary of performance data for each commonly used expansion joint system type & contains examples of selection criteria and design guidelines. 46 pages.

NCHRP Report 500, Vol. 6: A Guide for Addressing Run-Off-Road Collisions — Strategies that can be employed to reduce the number of run-off-road collisions. 112 pages.

NCHRP Research Results Digest, No. 274: Quality Assurance of Structural Materials — Study which examines the state of the practice of quality assurance related to critical structural materials and components—those for which failure poses a threat to public safety or the integrity of the transportation system. 21 pages.

NCHRP Research Results Digest, No. 278: Accessible Pedestrian Signals: Synthesis and Guide to Best Practice — Report covering pedestrian safety considerations, including installation of audible traffic signals and signs at street crossings. 21 pages.

NCHRP Research Results Digest, No. 279: Making the Business Case for Translating Non-English Transportation Information — Study which provides an assessment of the benefits that could be realized through translation of non-English language transportation technical information. 40 pages.

TCRP Research Results Digest, No. 62: International Transit Studies Program — Overview of an investigation of transit operations in central and eastern Europe, including lessons learned and discussion of practices which could be applied in the U.S. 43 pages.

TCRP Report 71, Vol. 2: Transit Switch Design Analysis (Phase I) — The results of a study conducted in cooperation with the Association of American Railroads/Transportation Technology Center, Inc. As part of the study, a new switch design concept for transit was developed. A prototype of the switch will be produced and tested in Phase II of the effort. 39 pages.

TCRP Report 86: Public Transportation Security Vol. 4: Intrusion Detection for Public Transportation Facilities Handbook — Report that addresses transit agencies' needs for facilities and transit vehicles. 117 pages.

TCRP Report 91: Economic Benefits of Coordinating Human Service Transportation and Transit Services — Examination of the net economic benefits associated with various strategies and practices for coordinating human service transportation and general public transit. Report provides quantitative estimates of these strategies and practices and identifies innovative, promising coordination strategies and practices. 173 pages.

TCRP Report 94: Fare Policies, Structures and Technologies Update — Report which identifies, describes, and evaluates key fare structures, policies, and technologies that are being considered by transit agencies, with a focus on their impact on customers, operations management, and effective and equitable fare integration. 200 pages.

TCRP Synthesis 48: Real-Time Bus Arrival Information Systems, a Synthesis of Transit Practice — Information on relevant technical capabilities, agency experience, cost and bus rider reactions to information systems. 61 pages.

Transportation Research Record, No. 1819, Volumes 1 & 2: Eighth International Conference on Low-Volume Roads 2003 — Presentation of practical solutions for administration, planning, design, construction, environmental management and maintenance of low-volume roads. 50 pages per volume.

Transportation Research Record, No. 1820: Water Transportation, Ports, and International Trade — A compilation of various studies related to water transportation, ports and international trade. 81 pages.

Transportation Research Record, No. 1821: Geology and Properties of Earth Materials 2003 — A compilation of various studies related to geology and properties of earth materials. 114 pages.

Transportation Research Record, No. 1824: Highway Maintenance Safety, Support, and Services — A compilation of various studies. 59 pages.

Transportation Research Record, No. 1826: Intelligent Transportation Systems and Vehicle Highway Automation 2003 — A compilation of various studies. 59 pages.

Transportation Research Record, No. 1827: Highway Pavements and Structures Maintenance Security — A compilation of various studies. 74 pages.

TR News, No. 227 — Compilation of articles regarding changes in the air. Features include "Clean Air Act Cleaning Up"; "Conforming to Stricter Standards"; "Targeting Air Toxins Locally"; "Multimodal Approach to Curb Urban Emissions"; and "Preparing for Potential Impacts of Climate Change." 48 pages.

Using Metropolitan ITS Deployment Tracking for Regional ITS Planning — Evaluation of the utility of deployment tracking data and indicators to local planners. Data collected from an examination of the ITS deployment planning experience in Tucson, Arizona. Report traces the development of deployment goals in Tucson using a network-based methodology and demonstrates the use of deployment tracking indicators in creating an accurate picture of the metropolitan-wide planning goals resulting from this planning. 15 pages.

ELECTRONIC PUBLICATIONS

NCHRP - Environmental Law and Transportation, Volume 3 — Covers 6 principal areas: environmental law & transportation planning, project environmental analysis & requirements, other environmental laws applicable to transportation projects, acquisition of sites, environmental laws applicable to construction and project operations, and litigation issues. 56.5 megabytes.

VIDEOS

Bike 'N Ped Driver Ed — Helps to increase awareness among motorists about laws for bicyclists and pedestrians. Training booklet included. 16 minutes.

To check out items in the MLTRC library, please call toll free 1 (866) MO-ROADS or send email mltrc@umr.edu.

New Online Resource

The new National Highway Specifications website presents highway construction specifications from all 50 states. The site represents a collaborative effort of the Federal Highway Administration (FHWA) and the American Association of State Highway and Transportation Officials (AASHTO). In the library section of the resource, users can search for and download current specifications and other specification-related documents. Other features of the site include discussion forums on a variety of topics and a listing of related online specifications resources.

Check it out:

www.specs.fhwa.dot.gov

MISSOURI PROFESSIONALS LEARN A NEW BRIDGE EXPANSION JOINT REPLACEMENT METHOD

by James "Skip" Wilson, Non-State Bridge Inspector, MoDOT District 3

On May 12, 2003, members of the MoDOT District 3 bridge maintenance crew gave hands-on instruction of a new concept in expansion joint construction and rehabilitation. The XJS Expansion Joint System was demonstrated to bridge crew members and engineers from Audrain County, Lincoln County, and the City of Hannibal. During the training program, an Elastomeric Bridge Joint on Missouri Route J in Ralls County over Mark Twain Lake was replaced in the northbound lane, allowing traffic to still be maintained on one lane of the bridge.

The XJS System combines a wear-resistant polymer for expansion joint nosing with rapid-curing, high-movement silicone for joint sealing. The cold-applied system is designed to provide a watertight, chemical-resistant seal to accommodate high traffic loads and remain pliable in cold and warm temperatures. The silicone sealant will bond to itself. Thus it is ideal for maintenance applications in which only one lane of traffic can be sealed at a time, as it can provide a continuous seal.

If you are interested in learning more about the XJS Joint Replacement System please contact MoDOT District 3 Bridge Maintenance Supervisor Birney Herrick at 573.248.2449.

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Research, Development and Technology

Quarterly

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TECH BRIEF

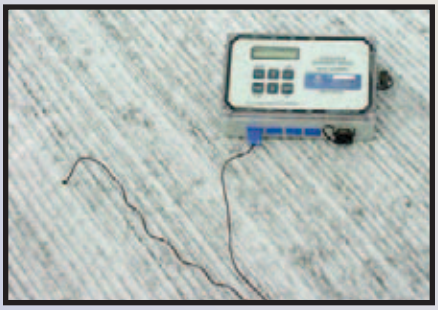
Application of Maturity Technology

When MoDOT repair crews were faced with emergency repair of a heavily damaged overpass on I-70 in December 2002, inspectors looked to the concrete maturity method to facilitate reconstruction operations of one of the structure's northern bents, which was severely impacted in a tractor-trailer accident. The maturity method, a non-destructive means of estimating in-place concrete strength as a function of time and temperature, is recognized as a more reliable and timely method as opposed to testing conventional 6"x12" compressive strength cylinders. Following placement of the bent footings, columns and cap on the I-70 overpass, thermocouples were inserted in the fresh concrete and a maturity value was calculated at desired times. In-place strength was then estimated from a pre-established relationship between maturity values and compressive strength. Application of the maturity method allowed earlier form removal and completion of the I-70 bridge repairs than if concrete cylinders had been used for strength determination. As a result, the bridge was open to traffic several days earlier than anticipated had conventional methods been used.

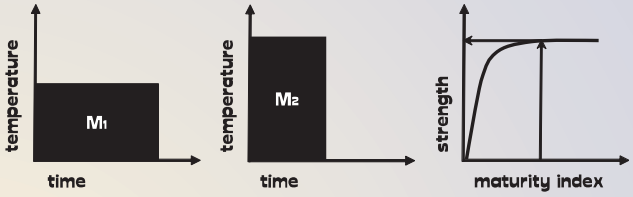
The Maturity Concept

While the maturity method has been around since the 1950's, it hasn't been until recent years, due to the increasing need to speed up construction operations and improve inspection efficiency, that the method and its benefits have been fully recognized. Based on the combined effects time and temperature have on strength gain in concrete, the maturity method is identified as a simple and reliable approach to estimating in-situ concrete strength in lieu of conventional 6"x12" cylinders. Although representative of concrete delivered to the site, conventional cylinders aren't necessarily representative of the in-situ concrete. Differences in fabrication, curing conditions, and handling of standard cylinders can have a direct impact on tested strength results. However, establishing a relationship prior to construction between mix strength and maturity (computed from its time-temperature history), followed with time and temperature monitoring of the mix during construction, reliable and real-time in-situ strength can be estimated. Application of maturity technology can provide an ideal, non-destructive means of facilitating construction operations including sawing pavement joints, coring pavement, opening pavement to traffic, removing formwork, cold and hot-weather concreting, and others.

ASTM C 1074, the standard practice established for estimating concrete strength by the maturity method, provides two mathematical functions acceptable for generating the strength-maturity relationship or curve for a concrete mix. Depending upon the function used, the maturity index can be determined in terms of time-temperature factor (TTF) using the Nurse-Saul equation or equivalent age (t_e) using the Arrhenius equation. Because of its simplicity and accepted reliability, the Nurse-Saul function using a datum temperature of 14°F (-10°C) is the more widely used, and preferred by MoDOT, of the two equations. To establish the strength-maturity curve, compressive strength is determined from cylinders at various ages along with corresponding maturity values or TTFs for a mix prior to construction. Strength is then plotted against maturity, providing the relationship necessary to estimate in-situ strength. During construction, time and temperature of the placed concrete are monitored and calculated maturity values are correlated to a determined strength using the curve. As a result, timely construction decisions can be made based on more credible information and the labor and guesswork associated with conventional cylinders can be minimized or avoided.



A maturity meter recording time and temperature of in-place pavement concrete.



Maturity Concept: $M_1 = M_2$ = Maturity Index

Application on UTW Overlay Placement

While MoDOT's Research, Development and Technology (RDT) program has been familiar with the maturity concept for some time, serious consideration of its application came as a result of recognizing its potential benefits to speed up construction of a fast-track, ultra-thin whitetopping (UTW) overlay in the late summer of 2000. Using maturity technology on the fast-track overlay at the busy intersection of Rte. YY and Belt Highway in St. Joseph provided an excellent opportunity to demonstrate its benefits in the field. Prior to construction of the UTW overlay, RDT staff worked with the ready mix producer at the plant to generate a strength-maturity relationship for the mix to be used. During construction, thermocouple wires were inserted mid-depth in the 3 in. overlay at various locations to monitor time and temperature. Throughout construction, strength of the in-situ pavement was estimated according to the maturity curve, enabling efficient decisions to be made concerning the optimum time to saw joints and to open the pavement to traffic causing minimal disruption.

Application of the maturity method on another fast-track, UTW overlay at the intersection of Rte. 291 and 23rd Street in Independence was just recently completed. Like the St. Joseph project, a strength-maturity curve for the high early strength overlay mix was established prior to construction. Time and temperature of the newly placed concrete was monitored during construction, and the in-situ concrete strength was estimated according to the curve. As a result, sawing of the pavement joints and opening of the intersection to traffic was handled much more efficiently reducing total construction time.

Maturity Equipment

The maturity method can be conducted simply using minimal equipment such as thermocouple wire and a data logger, where mix time and temperature data are collected then used to manually calculate maturity values. Commercial maturity meters, more sophisticated devices capable of monitoring time and temperature and automatically computing maturity values in terms of time-temperature or equivalent age as desired, even more simplify the use of maturity technology. Commercial maturity equipment has advanced recently to the availability of sacrificial sensors placed in the concrete with wireless transmission of the data directly to inspectors

continued on the back cover...

TAGs PART III:
Improving Pavement Performance through Innovative Design

The Pavement Technical Advisory Group (PTAG) reviews pavement-related research ideas submitted by people inside and outside the Missouri Department of Transportation (MoDOT). The PTAG, which is composed of representatives from MoDOT, UMR, UMC, and FHWA, evaluates the ideas using several criteria including perceived need, cost effectiveness, and implementation feasibility. Ideas and associated work plans for improving pavement performance on Missouri State roads, which receive a favorable rating, are forwarded to the RDT Administration Team with a recommendation for funding approval to initiate research investigations.

Active MoDOT pavement-related research investigations include the following:

Fiber-Reinforced Unbonded Concrete Overlay
MoDOT
An unbonded PCCP overlay was constructed in the southbound lanes of I-29 in Atchison County in 1998, with certain sections of the overlay reinforced with either steel or polyolefin fibers. Eight test sections, each 2500' long, varied in thickness from 5" to 11", and had transverse joints spaced from 15' to 200' apart. The primary purpose of adding fibers to the concrete used in the unbonded overlay was to increase the service life of the overlay by improving its capacity for energy absorption and thus reducing its fatigue damage.

Sand Anti-Fracture (SAF) Overlay
MoDOT
A asphalt overlay project was constructed in the southbound an northbound lanes of I-29 in Holt County in 1998 with a sand anti-fracture (SAF) interlayer. An SAF is a highly polymerized fine-graded asphalt mix interlayer placed between an existing concrete pavement and asphalt overlay. The purpose of the SAF layer is to retard reflective cracking from occurring in the AC overlay. This project also evaluated two different asphalt cement grades, two degrees of pavement repair, and two AC overlay thicknesses.

Ultrathin Whitetopping
MoDOT
Ultrathin concrete overlays were constructed on US 60 near Neosho and at the intersection of Rt. 169 (Belt Highway) and Rt. YY in St. Joseph in 1999 and 2000, respectively. Ultrathin concrete overlays are typically 2" to 4" thick, sawed into 2' to 4' square panels, and often reinforced with fibers. They are bonded to existing asphalt pavements and designed to perform as stiff flexible surface layers. The purpose of the ultrathin overlay is to prevent the rutting and shoving that typically occurs on asphalt surfaces at locations where heavy traffic is slowed, turning, or brought to a complete stop, such as at an intersection.

Granular Base Permeability
UMC & MoDOT
MoDOT currently designs new pavements with two types of unbound granular bases: 4" dense-graded Type 5 and 2' rock fill. The purpose of this study was to determine the permeability of these bases.

Longitudinal Joint Keyways
MoDOT & ARA/ERES Consultants Inc.
Keyways are a traditional means of providing load transfer at longitudinal construction joints. Missouri has used keyways on nearly all longitudinal construction joints for many years. The purpose of this study was to determine their load transfer capacity and whether load transfer is even necessary in certain situations.

Precast Post-Tensioned Concrete Pavement Panels
UMC & MoDOT
A precast post-tensioned concrete panel project will be constructed on a segment of I-57 in Mississippi County. The purpose of this design is to greatly reduce the structural thickness required for heavy-duty pavement and shorten the lane closure time necessary to replace old pavement.

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TEAM 2004

The Transportation Engineers Association of Missouri (formerly the Highway Engineers Association) will hold its 94th Annual Conference next spring. The conference will include four breakout sessions with a variety of presentations from which to choose. Check the winter issue of *RDT Quarterly* for agenda details. For registration information, log on to the association website:

www.modot.org/TEAM

When: March 30—April 1
Where: Chateau on the Lake
Branson, Missouri

MoDOT wants to hear from you!

If you have a research idea that could benefit the state transportation system or a new product to be reviewed, please fill out the corresponding RIS or New Product Evaluation form included in this issue.

New Resources in the RDT Library

BRIDGE ENGINEERING

Measured behavior of a curved precast segmental concrete bridge erected by balanced cantilevering
ID: RD0003140

Investigation of differences in deterioration of two North Carolina bridges due to alkali-silica reactivity (ASR)
ID: RD0003154

Boundary conditions for bridge scour analysis
ID: RD0003150

Moisture content variations of nail laminated timber bridges in a northern climate
ID: RD0003153

ENVIRONMENTAL TECHNOLOGY

Overview of the quality and quantity of roadway runoff and current status of phase II storm water rules
ID: RD0003155

ENGINEERING & CIVIL ENGINEERING

Textural and mineralogical characterization of Kansas limestone aggregates in relation to physical test results
ID: RD0003161

Seventy-five years of aggregate research in Kansas
ID: RD0003159

HIGHWAY ENGINEERING, ROADS, & PAVEMENTS

Highway operations: progress and products update
ID: RD0003172

Evaluation and modification of sight distance criteria used by TxDOT
ID: RD0003174

Polish resistance of selected Kansas aggregates
ID: RD0003152

Phase II environmental site investigation procedures and technologies for property transfer and PS&E development
ID: RD0003145

Guidelines for mixture design and thickness design for stabilized bases and subgrades
ID: RD0003142

Evaluation of the use of shredded tires around buried pipes
ID: RD0003156

Development of a procedure to rate the application of pavement maintenance treatments
ID: RD0003162

Evaluation of radar for snowplows: initial results
ID: RD0003177

Design of an ITS-level advanced traffic management system: a human factors perspective
ID: RD0003165

Maintaining the traffic control system
ID: RD0003180

Fabric for reinforcement and separation in unpaved roads
ID: RD0003160

Developing maintenance strategy selection procedures for pavements incorporating semi-rigid or chemically stabilized layers
ID: RD0003141

Evaluation of the performance of Texas pavements made with different coarse aggregates: project summary report
ID: RD0003183

Repair of thermally cracked bituminous pavements with fiber reinforced plastic composites
ID: RD0003158

Geosynthetic reinforcement of flexible pavements: laboratory based pavement test sections
ID: RD0003143

Summary report on permanent deformation in asphalt concrete
ID: RD0003171

Study to improve asphalt mixes in South Carolina: Volume III, Modified mixes
ID: RD0003144

Performance evaluation of fine graded Superpave mixtures for surface courses
Book or CD Rom available
ID: RD0003167 or RD0003168

Current refining practices for paving asphalt production
ID: RD0003169

A guide to evaluating thermal effects in concrete pavements
ID: RD0003163

Alternate polish value and soundness specifications for bituminous coarse aggregates
ID: RD0003149

High performance concretes: a state-of-the-art report
ID: RD0003170

METEOROLOGY & CLIMATOLOGY

Utilization of precipitation estimates derived from composite radar
ID: RD0003157

MOTOR VEHICLES

Development of a strategic plan for commercial vehicle operations in Texas
ID: RD0003179

An overview of development of a strategic plan for commercial vehicle operations in Texas
ID: RD0003178

Human factors evaluation of GAINS, a prototype in-vehicle navigation system
ID: RD0003182

The virtual bumper: a control based collision avoidance system for highway vehicles
ID: RD0003181

TRANSPORTATION & COMMUNICATION

Information systems for transportation agencies
ID: RD0003147

The railroad system of Texas: a component of the state and national transportation infrastructure
ID: RD0003146

A summary of the railroad system of Texas: a component of the state and national transportation infrastructure
ID: RD0003176

Six county rural transit feasibility study: final report
ID: RD0003173

Enhancements of the KRONOS simulation package and database for geometric design planning, operations and traffic management in freeway networks/corridors: phase III
ID: RD0003148

Effective traffic calming applications and implementation: final report
ID: RD0003151

Investigating speed management techniques
ID: RD0003175

TRANSPORTATION RESEARCH RECORD

Traffic flow theory and highway capacity, 2000
ID: RD0003166

Geology and properties of earth materials, 2003
ID: RD0003164

The RDT Library includes a variety of materials related to transportation research. The library is located at the MoDOT Research, Development and Technology office at 1617 Missouri Blvd., in Jefferson City, Missouri. The facility is open Tuesday through Thursday, from 11:30 A.M. to 4:30 P.M. CST. Items can be requested by phone at 573.526.4326 or via email to liaoc1@mail.modot.state.mo.us

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MANY OF THE RDT TECHNICAL BRIEFS AND REPORTS ARE NOW ONLINE!

www.modot.org/services/rdt/byTitle.htm

during construction, further increasing the efficiency and effectiveness of the maturity method.

RDT's initial experience with maturity testing equipment included various data loggers and thermocouple wire. Depending upon the type of data logger used, problems were sometimes encountered due to the equipment's sensitivity to extreme ambient conditions (high humidity, heat or cold) and some data loggers were felt to be awkward or difficult to manage in the field. In addition, values for maturity had to be manually calculated. RDT currently uses commercial maturity meters to conduct maturity testing and have found these devices to be dependable and operate much more efficiently than equipment used in the past.

Procedure Limitations

While the maturity method is no doubt a valuable tool, it does have some limitations. The following should be kept in mind when applying the method. The maturity method assumes that sufficient moisture is available during cement hydration and, therefore, does not account for inadequate curing. Hence, any variation in strength due to poor curing during construction would not be reflected in the maturity curve. Once the strength-maturity relationship for a particular mix has been established prior to construction, no changes in mix design constituents or proportions during construction should be allowed other than minimal changes within acceptable tolerances. Otherwise, the accuracy of the maturity curve to estimate strength of the mix during construction will be compromised, resulting in an unreliable curve. Early age temperatures of the mix used to establish the maturity curve similar to those anticipated of the mix during construction are also recommended for improved reliability. The maturity method does not take into account any errors in placing and consolidation; thus, good construction practices are essential, as with any project. Each of these issues can and should be easily addressed through good project quality control and should not serve as an obstacle to applying maturity technology.

Future of Maturity and MoDOT

The maturity method has demonstrated itself as a desirable and reliable means of indicating in-situ compressive strength and facilitating construction operations. When procedures are properly followed, maturity can be an exceptional tool allowing timely decisions impacting construction operations. With a specification recently developed and in-place, MoDOT intends for contractors to invest in maturity equipment and conduct their own testing to facilitate work on future projects, as opposed to MoDOT providing the equipment and conducting maturity testing on previous projects. Recently, the new specification was included in the contract for the construction of an unbonded concrete overlay on I-55 in St. Louis, which required accelerated construction and optional contractor application of the maturity method. Application of the maturity method is also currently allowed on MoDOT QC/QA (quality control/quality assurance) paving projects as an option to the contractor for determining the earliest time pavement cores can be retrieved for thickness and design strength verification. As more contractors become familiar with maturity technology and recognize its benefits, future application in Missouri is only expected to increase.

For more information...

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