

RESEARCH AND TECHNOLOGY

REVIEW

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RESEARCH DIVISION

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RESEARCH BULLETIN

RD&T PROGRAM

One Big Pot of Money for Research

With all state DOT's contributing funding to the National Cooperative Highway Research Program (NCHRP), the total amount available for research projects currently is about \$28,000,000. As a means of pooling funds, each state contributes 5 and ½ percent of its State Planning and Research funds annually to NCHRP; for FY 2003, NDOT contributed \$208,397.

In April of each year, research problem statements are solicited from all the AASHTO member departments. In addition to the new

problem statements submitted, NCHRP staff makes recommendations for the continuation of projects begun in prior years. Some of the most notable and long lasting continuation projects are NCHRP - IDEA (Innovations Deserving Exploratory Analysis) and Synthesis of Information Related to Highway Problems.

All proposed research topics, whether new to the program or a continuation, are rated by each member state via AASHTO's Research Advisory Committee (RAC). The rating are compiled by the NCHRP secretariat, then provided to the AASHTO Standing Committee on Research for their consideration in setting the final version of the yearly NCHRP. Currently, NDOT along with other member states is in the process of rating 150 new problem statements along with 22 continuation problem statements submitted for the FY 2004 NCHRP.

After the yearly program is established, technical panel nominees are solicited, again via the RAC. Technical panels meet to finalize the scope of work for the project and to select a contractor for the research. One benefit to small states in participating in NCHRP panel membership is that it provides a good opportunity to gain

exposure to national research efforts that affect their individual states.

Since its creation in 1962, NCHRP has proven to be very effective at conducting national research in problem areas that affect highway planning, design, construction, operation, and maintenance.?

NDOT RESEARCH IN PROGRESS:

Advancing Pavement Markings in Nevada

The Nevada Department of Transportation (NDOT) is tasked with providing safe roads for the traveling public. Pavement markings are a crucial component of road safety and can reduce collisions and improve traffic flow. Nevada has a wide range of traffic volumes and weather conditions throughout the state. It is important to customize pavement marking placement for specific traffic volumes and environment. By customizing pavement marking placement, NDOT can optimize its resources while minimizing traffic interruption due to

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less frequent restriping operations. A research study involving the construction of pavement marking test sections is underway to investigate state-of-the-art pavement marking materials available on the market and determine the cost-effectiveness of the markings for each location.

NDOT placed five pavement marking test sections in August, September, and October of 2002. They are located on SR 28 in Washoe County (MP 0.00 to MP 8.00), SR 431 in Washoe County (MP 4.00 to MP 5.50), US 50 in Churchill County (MP 31.42 to MP 43.76), US 93 in Clark County (MP 59.00 to MP 70.00), and US 95 in Clark County (MP 63.50 to MP 66.50). These test sections were established in an effort to compare new or improved products to products that NDOT currently uses. They will be monitored for reflectivity, color, and durability over a two-year period. These objective measurements will track the effects

of severe sunlight and high temperatures of the Las Vegas area to the punishment of sanding and snow plowing in the Lake Tahoe region.

A total of 26 pavement marking products are being monitored on the test sections. These products include ten waterborne traffic paint products, four alkyd thermoplastic products, six polyurea products, and six epoxy traffic paint products. NDOT Maintenance Forces from Ely, Winnemucca, and Las Vegas placed the waterborne traffic paint products. Manufacturers' representatives placed all other products. A special feature of the US 50 test section is that the products will be compared using two different wet mil thickness, two types of bead, and two bead loadings. The SR 431 test section is unusual in that a grinder was brought in to grind out a swath for the products to be inlaid under the surface of the open-graded wearing course. This should prevent the snowplow damage that typically occurs in the area.

The overall performance of pavement markings is comprised of three factors. These factors are reflectivity, color, and durability. The reflectivity is the

brightness of the pavement markings when illuminated by vehicle headlights at night and is measured with a reflectometer. Pavement markings that maintain an appropriate color over the life of the marking are important as color degeneration can reduce the visibility of the markings. A specialized piece of equipment called a color guide is used to identify the exact color of the pavement markings. Durability indicates the degree of resistance to wear of the pavement markings. The reflectivity, color, and durability of the products will be monitored at frequent intervals for two years or until product failure. NDOT expects to expand the Qualified Products List, write new or improved pavement marking specifications, and develop a customized pavement marking matrix for Districts to use after analyzing the gathered data. Please call Gayle Maurer at 775.888.7252 for more information about the test sections.?



Photo 2. NDOT Ely's Striping Crew Places Waterborne Pavement Markings on US 50.



Photo 1. Equipment Grinds out a Swath to Inlay Products on SR 431.

Product Evaluation Committee (PEC) Meeting Recap

APPROVED

Hot Applied Thermoplastic Pavement Markings

The PEC approved a proposal from Traffic Engineering to establish a QPL for hot-applied thermoplastic pavement markings. Thermoplastic materials are specified under sections 634 and 732 of NDOT Standard Specifications and represent a durable delineation technique.

Hot-applied thermoplastic materials are synthetic resins that soften when heated and harden when cooled without changing the inherent properties of the materials. They can be applied by either spray or extruded methods in a single uniform layer to the road surface in a molten state. The growing popularity of thermoplastic materials as alternatives to conventional traffic paints is attributable to their readiness for immediate use, durability and visibility to motorists. Meanwhile they require more care during installation and more efforts to remove than conventional paint.



Photo 3.

In the past, NDOT established a QPL for preformed thermoplastic materials to provide quality control over usage of pavement striping materials for the department. To ensure a high quality of materials proposed for use on NDOT projects and to enable the State Purchasing Division, contractors and NDOT maintenance forces to choose either preformed or hot-applied thermoplastic pavement striping material, Traffic proposed that a separate QPL for hot-applied thermoplastic materials be established.

Since a QPL has been established, new hot-applied thermoplastic pavement markings can be added to this QPL based on recommendations from the Traffic/Safety and the Materials Divisions. ?

APPROVED

Surface Drainage Products - Trench Drains

Based on a recommendation from Hydraulics Engineering, the PEC approved establishment of specifications and a general QPL for surface drainage products - trench drains.

Trench drains are part of drainage structures used for removal of **water from rain or** melting snow, or both, that falls directly on a road or comes from adjacent terrain.

Since 1997, manufacturers of various surface drainage products have requested that NDOT evaluate



Photo 4.

and approve their systems for use on NDOT projects. In the past, Hydraulics used these systems on a case-by-case basis based on available information and the specific requirements of their projects. There were no acceptance criteria and/or standard specifications for surface drain systems.

To ensure quality of products used on NDOT projects, Hydraulics recently **developed** acceptance criteria including minimum specification requirements and a general QPL. Initial, this QPL encompasses already known and used trench drains from ABT inc., and ACO Polymer Products, Inc.

Future approval of this type of product for use on NDOT construction projects will depend on a product's compliance with projects' specific Special Provisions. If trench drains and associated drainage structures are included in a project, the contract Special Provisions will specify the requirements to be met and a product will be selected based on site-specific characteristics. ?

APPROVED

Sign Lighting Fixtures

The PEC approved another proposal from Traffic Engineering regarding establishment of a QPL for lighting assemblies - sign lighting fixtures. This type of product is covered under section 623.03.15 of NDOT Standard Specifications.

Currently, Traffic Engineering is evaluating the inductive lighting system from Allied Lighting Systems. Induction lighting systems were developed to take advantage of recent advances in lighting and reflector design technology to offer a 100,000 hour rated life by utilizing an induction system that may not require re-lamping for over 20 years. Our current standard requirements for lighting assemblies specify use of high-pressure sodium and metal halide lamps. At present, Traffic

Engineering has been working with maintenance staff to standardize overhead sign lighting fixtures to ensure that only those fixtures that can be easily retrofitted with induction lamps will be acceptable for use on NDOT projects. The acceptance criteria for sign lighting fixtures for placement on the established QPL include high quality, compliance with Caltrans' test requirements for light distribution and ease of being retrofitted with induction lamps.

The initial QPL encompasses two products that have been used on NDOT projects from Holophane Corporation (Panel-View series) and from Allied Lighting Systems (MSR series). Based on Traffic Engineering's recommendation, those products that meet the acceptance criteria will be added to a QPL.?



The Research Division administers the department's research, development and technology transfer program and serves as the "clearing-house" for product evaluations.

Research and Technology Review is published quarterly by the NDOT Research Division. Its purpose is to provide the latest information on the NDOT research activities including product evaluation and other pertinent research topics.

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If you have comments or need additional information regarding any of the topics discussed in this issue, please contact **Alan Hilton**, Research Division Chief, at (775) 888-7803. ahilton@dot.state.nv.us

NDOT LIBRARY RECENT ACQUISITIONS

(Received October 1 through December 31, 2002)

HYDRAULICS/ENVIRONMENT

A Two Stage Evaluation of NCDOT Stream Mitigation Practices: Stage 1. Syntheses of Current Stream Mitigation Practices and Stage 2. Development of Criteria of Effective Mitigation (FHWA/NC/2002-015), North Carolina DOT; (hardcopy & CD) **8772**

Contaminant Arresting Systems (FHWA-NJ-2002-003), New Jersey DOT; **9103**

Biological Control of Weeds (Joe Balciunas Research Report), US Department of Agriculture; **9117**

Sampling and Testing of Stormwater Runoff from North Carolina Highways (FHWA/NC/2010-002) North Carolina DOT; (also CD) **9273**

Field Verification of Structural Performance of Thermoplastic Pipe Under Deep Backfill Conditions (FHWA/OH-2002/023), Ohio DOT; **9297**

GIS Applications in Geotechnical Engineering (FHWA 2002-06), New Jersey DOT; **9331**

MAINTENANCE

Mobile Fog Dispersion with Liquid Carbon Dioxide (FHWA/UT?93.05), Utah DOT; **9095**

Cost-Benefit Assessment of Implementing Automatic Vehicle Location (AVL) in Kansas DOT's Maintenance Vehicles (KTRAN-KU-01-5), Kansas DOT; **9120**

Evaluation of Louisiana's Maintenance Chip Seal and Micro-Surfacing Program (363), Louisiana DOT; **9251**

MATERIALS/PAVEMENTS

Evaluation of the Fundamental Engineering Properties of Bituminous Mixtures Containing Hydrated Lime (FHWA/LA-02/306), Louisiana DOT; **7443**

Identification and Stabilization Methods for Problematic Soils (FHWA/LA-02/357), Louisiana DOT; **7521**

Aggregate Resource Inventory and Needs Forecast Study (FHWA-OR-RD-03-03-SPR-314), Oregon DOT; **8885**

Use of FWD Multi-Load Data for Pavement Strength Estimation (FHWA/NC/2002-006), North Carolina DOT; (CD & Paper) **8978**

Evaluation of Corrosion Resistance of Type 304 Stainless Steel Clad Reinforcing Bars (FHWA-KS-02-3), Kansas DOT; **9122**

Aggregate Resource Inventory and Needs Forecast Study (FHWA-OR-RD-03-03), Oregon DOT; (CD) **9176**

Evaluation of Rutting Potential of Hot Mix Asphalt Using the Asphalt Pavement Analyzer (ORA 125-6660), Oklahoma DOT; **9178**

Development of an Accelerated Creep Testing Procedure for Geosynthetics (LA-307), Louisiana DOT; **9199**

In-Place Voids Monitoring of Hot Mix Asphalt Pavements (CDOT-DTD-R-2002-11), Colorado DOT; **9225**

2000 NTPEP Pavement Marking Second Year Field Performance History & Lab Test Results on Select Products (2000 Urban, California Test Deck); **9244**

First Year Field Performance & Laboratory Evaluation of Permanent Raised Pavement Markers (RPM) (200 Georgia Deck NTPEP Report 4006.1); **9245**

Humectants to Augment Current from Metallized Zinc Cathodic Protection Systems on Concrete (FHWA-OR-RD-03-08), Oregon DOT; **9253**

Declamination and Shoving of Asphalt Concrete Layers Containing Baghouse Fines (FHWA/NC/2002-011), North Carolina DOT; **9302**

Evaluation of Seismic Pavement Analyzer for Pavement Condition Monitoring (FHWA-NJ-2002-012), New Jersey DOT; **9329**

Evaluation of Standard Right-of-Way Fence Post Anchors Versus Drive Anchors (FHWA-2000-07), New Jersey DOT; **9330**

Models for Pavement Deterioration Using LTPP (FHWA-NJ-1999-030), New Jersey DOT; **9332**

PLANNING/PROGRAM DEVELOPMENT

Deterrence, Protection, and Preparation; The New Transportation Security Imperative (Special Report 270); **9031**

Applying an Integrated Model to the Evaluation of Travel Demand Management Policies in the Sacramento Region (FHWA/CA/OR-2001-28), California DOT; **9106**

Improving the Effectiveness of Partnering (FHWA-OR-RD-03-09), Oregon DOT; **9112**

Cost-Effective Data Collection in Louisiana (337), Louisiana DOT; **9114**

Data Transmission Options for VMT Data and Fee Collection Centers (FHWA-OR-VP-03-06), Oregon DOT; **9188**

User Manual for Outsourcing Decision Assistance Model (FHWA/LA-364), Louisiana DOT; **9201**

Designing a Comprehensive Model to Evaluate Outsourcing of Louisiana DOTD Functions and Activities (FHWA/LA-358), Louisiana DOT; **9202**

Tourism's Impact on Future Transportation Needs (FHWA-AZ-01-507(3), Arizona DOT; **9227**

Technology Evaluation for Implementation of VMT Based Revenue Collection Systems; Final Report (FHWA-OR-VP-03-07), Oregon DOT; **9229**

Institutional Options for VMT Data and Fee Collection Centers (FHWA-OR-VP-03-05), Oregon DOT; **9230**

RAC Mentoring and Training Framework Educational Guidelines (2003-05), Pennsylvania DOT; **9257**

Simulator Training Evaluation Program (PA-2002-014-97-04(96), Pennsylvania DOT; **9258**

Opportunities and Options: A Marketing Roadmap for the Pennsylvania Infrastructure Bank (FHWA-PA-2002-004-97-04(78), Pennsylvania DOT; **9259**

Simulations of Urban Growth and Land Use Changes 1997-2025 in the Area of Corridor O and I99 Road Construction (PA-2002-028-97-04(69), Pennsylvania DOT; **9272**

Traffic Safety-Related Research "Knock the Socks off of Our Customers" Signs and Paint Campaign in Central Pennsylvania; Assessment of public Attitudes and Reactions (FHWA-PA-2002-017-99-04), Pennsylvania DOT; **9293**

Developer-Planner Interaction in Transportation and Land Use Sustainability (FHWA/CA/OR-2002/06), California DOT-MIT; **9328**

California, Oregon Advanced Transportation Systems (Rural Costs) - ; **9333**

STRUCTURES

Effect of Incipient Decay in Compressive Strength and Stiffness of Timber Piles (FHWA/LA-02/306), Louisiana DOT; **1092**

Glass Fiber Reinforced Polymer Bridge Deck (FHWA IBRC Project # NC-01-01) North Carolina DOT; **(Video) 8806**

Repair and Rehabilitation of Bridge Components Containing Epoxy-Coated Reinforcements (D10-37C), NCHRP; **9101**

Assessment and Mitigation of Liquefaction Hazards to Bridge Approach Embankments (FHWA-OR-RD-03-04), Oregon DOT; **9113**

Steel Bridge Fabrication Error Indexed Examples and Solutions: Combining Rules and Cases (KTRAN:KU-98-8), Kansas DOT; **9119**

Torsional Analysis for Exterior Girders Version 2.0 (KTRAN:KU-00-3), Kansas DOT; **9121**

Cyclic Load Testing of Weldable Shear Connectors for Glulam Decks on Bridge Girders (FHWA-PA-2002-021-97(113), Pennsylvania DOT; **9248**

Assessment and Mitigation of Liquefaction Hazards to Bridge Approach Embankments Appendix SPR Project 361, Oregon DOT; **9250**

TRAFFIC/SAFETY

Southeast Regional Fatal Study - A Casual Chain Analysis in North Carolina , (FHWA/NC/2002-007), North Carolina DOT (also CD); **9104**

Development of a Plan for Compliance with NCHRP 350 for Temporary Concrete Barriers (FHWA-AZ02-531) Arizona DOT; **9228**

Design Recommendations for the Proportioning and Detailing of Long-Span Tri-Chord Sign Structures (FHWA-PA-2002-024-97-04(110), Pennsylvania DOT; **9247**

Effectiveness of Double Fines as a Speed Control Measure in Safety Corridors (FHWA-OR-DF-03-1-), Oregon DOT; **9249**

Continuous Evacuation of In-Service Highway Safety Feature Performance (FHWA-AZ-02-482), Arizona DOT; **9305**

REFERENCE BOOKS

CFR's New Edition 7/1/2002

AASHTO 2002 Annual Meeting (Alaska DOT) (CD); **8981**

Regulations of Weights, Lengths, and Widths of Commercial Motor Vehicles (Special Report 267), transportation Research Board; **9009**