ODOT Research News

Summer Quarter 2003

ODOT Research News is a quarterly newsletter to bring you the latest research and resources from the Oregon Department of Transportation's Research Unit. The Research Unit manages over 40 active research projects, providing new information and methodologies to improve how ODOT works.

The underlined links throughout the newsletter will take you to different parts of the Research Web Page. There you will find updates on current projects, links to reports and research notes, information on staff specialties, and links to send us questions or suggestions for research. You can also call us at 503-986-2700.

Project Accomplishments:

Calibrating WIM Sites for LTPP As part of our participation in the national Long-Term Pavement Performance (LTPP) program, Oregon contributes traffic classification data and weigh-in-motion data from data recorder sites across the state. Currently, ODOT operates eight automated data recorders that collect traffic data for the LTPP program. Classification data is continually collected from all eight sites and Weigh-in-Motion (WIM) data is collected from six of the sites for one week every quarter.

To make sure the data is accurate, each site is checked quarterly. Evaluations consist of visually classifying 100 trucks and comparing counts to the automated results. If needed, correction factors are adjusted for proper calibration. The WIM system is adjusted at the start of each collection period based on a statistical average for a typical truck. This method corrects for temperature changes from season to season and for sensor wearing that occurs through normal use.

When needed (usually every 6 years), WIM sites are calibrated using known-weighted trucks. In 1991, when the Hermiston site was installed, a Motor Carrier Enforcement crew from the Umatilla Port of Entry stopped 150 trucks and manually weighed each truck before it traveled over the sensors, an expensive and time-consuming process.

Earlier this summer the Umatilla Port of Entry Motor Carrier Enforcement crew worked with Mac Lynde and Eric Brooks, of ODOT's Research Unit, to calibrate the Hermiston site in a faster and less expensive manner.

For the calibration effort, Mac worked with Dennis Schilling and Cody Purcell at the Umatilla Port of Entry to obtain the necessary information about each truck. Plate numbers and a description of the truck were recorded for further use. The plate numbers correlate to the record kept by Motor Carrier for each truck. ODOT identifies interstate trucks by the license plate issued by each carrier's home state or province. Because each plate is different, officers with Motor Carrier helped to properly identify and code each truck.

At the same time, Eric Brooks was stationed at the WIM site located on I-82, 8 miles south of the Port of Entry. Eric recorded truck descriptions and license plate numbers (when possible) as the trucks traveled by at 55 to 60 mph. Collecting the license plate numbers proved to be difficult, even with binoculars; so the description helped to identify individual trucks. WIM record numbers were also noted for each truck so the weights could be accessed later for comparison with the actual weights recorded at the Port of Entry.

The data are still being analyzed to determine the calibration needed for the Hermiston WIM site. Many thanks go to the Umatilla Port of Entry personnel that assisted in this calibration effort. Without them, the process would have taken longer and at a greater cost. Without proper calibration of these sites, the data becomes less reliable and therefore less useful.

The methods used to calibrate the Hermiston site will also be used to calibrate sensors being replaced in LaGrande this fall.

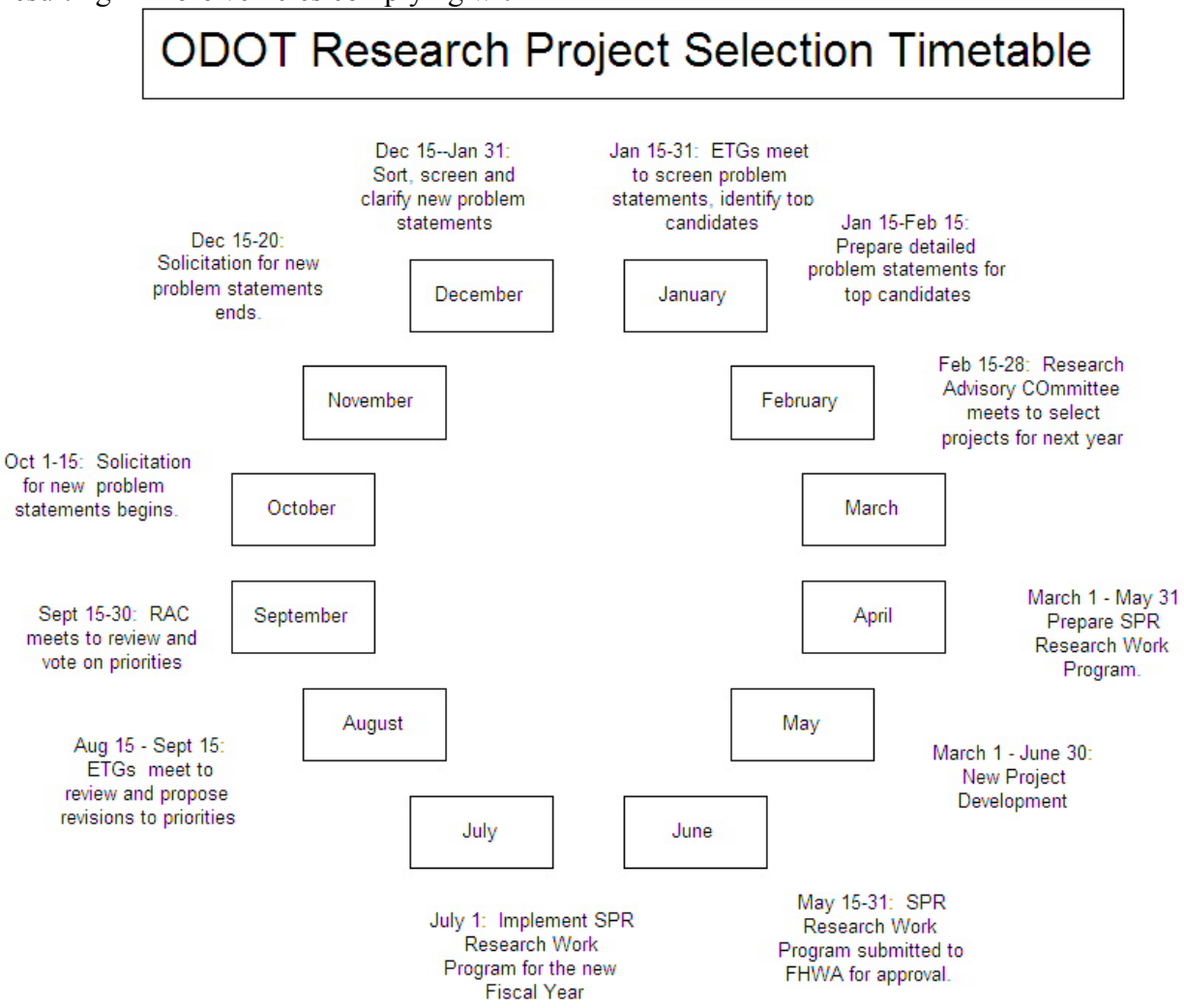
Contact Research Specialist Mac Lynde for more information about the LTPP program.

What Happens to Vehicles that Fail Emissions Testing? Pursuing a Worthy Research Topic…

Due to limited funds, research projects having merit may not be selected for development in the ODOT Research annual solicitation process. Each Research Expert Task Group (ETG) can recommend only 2 or 3 problem statements to the Research Advisory Committee each year, out of the 15-25 submitted for their consideration. Other avenues are available, though, to pursue worthy research proposals.

One such proposal was a study of the impacts of DMV's revised Trip Permit Program on vehicle registrations, operations and emissions. Under the old system, vehicles that failed DEQ emissions tests could continue to operate with DMV trip permits, and these were not monitored to prevent repeated issuance of permits. Starting in January 2002, the program limited the number of trip permits that may be issued for a vehicle and started tracking the permits. Is the new approach resulting in more vehicles complying with DEQ vehicle emissions rules, or are non-complying vehicles being simply operated without registration? While the ETG saw merit to investigating the subject, the proposal was not among those recommended for funding.

Jennifer Dill at Portland State University's School of Urban Studies and Planning decided to submit the idea to the TransNow transportation research center at University of Washington. The merits of the proposal were recognized, and ODOT Research agreed to provide a portion of the matching funds required for the study. The study is now in its early stages, having assembled a body of vehicle inspection data and trip permit records, and beginning to analyze the data to compare what happened to vehicles that failed DEQ emissions tests before and after the new rules went into effect. To supplement the data from DEQ and DMV records, the study will also conduct a survey of vehicle owners who failed emissions tests to determine what was done with the vehicles. An interim report on the study is expected in February 2004.



Do you have a research idea? Here are some key elements to pursuing a topic you believe has merits as a research project:

- Address a researchable question. The topic needs to be of a manageable size and scope. The research needs to address more than simply the collection of data or information; the results should contribute to a better understanding of how systems work.
- Obtaining an answer to the question must be of use to someone. You need to be able to say how the findings of the research would be useful in a program or a policy decision. You also need to enlist the support of the decision makers who would use the research findings.
- Explore various avenues to funding the research. While ODOT Research may have funds for undertaking the project, it is not the only source. If the research is important enough to the unit wanting it, maybe that unit would be willing to help support the research. If the topic is of national interest, other states may be interested in contributing funds to support the effort. A university with interest in the topic may want to pursue it through regional or national funding sources.

If you have a topic that you think would be a good candidate for research the staff in ODOT Research is available to help define the problem and address the items above. For more information, contact the appropriate research coordinator for your area of nterest .

Making it Through the Winter: Testing of Durable Pavement Markings in a Snow Zone

The ODOT Research Unit is watching the performance of two durable pavement marking products within a snow zone on Interstate 84 near Meacham. The project is a significant effort among Research, the ODOT Statewide Pavement Marking Committee and the installation contractor, Apply-A-Line, Inc.

The project is designed to test Dura-Stripe®, a methyl methacrylate, and Permaline®, a thermoplastic. Dura-Stripe® is already used as an inlaid durable pavement marking within some snow zones throughout Oregon, but with limited success. Permaline® has not been used within a snow zone in Oregon, and has had very limited use as an inlaid durable pavement marking in the state.

Both of these products are used extensively in other areas of the state for striping and legends that rest on the road's surface.

Many ODOT regions and districts are reluctant to use durable pavement markings in snow zones because of past performance. Winter maintenance activities and the prevalence of studded tires throughout central and eastern Oregon combine to prematurely wear the durable pavement markings to the point where reduced retro-reflectivity compromises motorist safety.

Kevin Haas, ODOT Research Coordinator, verifies the groove depth on one of the concrete test sections

The Meacham site was chosen due to its severe winter weather and the ability to test both products on asphalt and concrete. Fifteen, 200-foot sections were established for both road surfaces. Each product was applied in

different thicknesses, within varying depths of grooves for each surface type.

Dura-Stripe® and Permaline® were both placed in seven sections on both of the surfaces. Each product was used to stripe the fog line, skips and the yellow line. Paint was placed in two of the 200-foot sections in shallow 125-mil grooves to serve as a baseline. ODOT currently uses Dura-Stripe® within snow zones and inlays the material at a thickness of 260 mils in a 250-mil groove. This design was placed in a section of concrete and asphalt to serve as a control.

ODOT's current design for using inlaid durable pavement markings allows the material to be slightly above the surface of the road, making it very susceptible to snow plow and studded tire damage. The current standard also uses a large quantity of material, which is very expensive when compared to paint. The advantage of using durable pavement markings within a snow zone is that the lines do not have to be re-painted every spring. This not only increases the safety of the motorist, but also of the striping worker. Because of the added cost of using a durable product, lessening the amount of material used would save ODOT money and would allow for more durable striping to be done statewide.

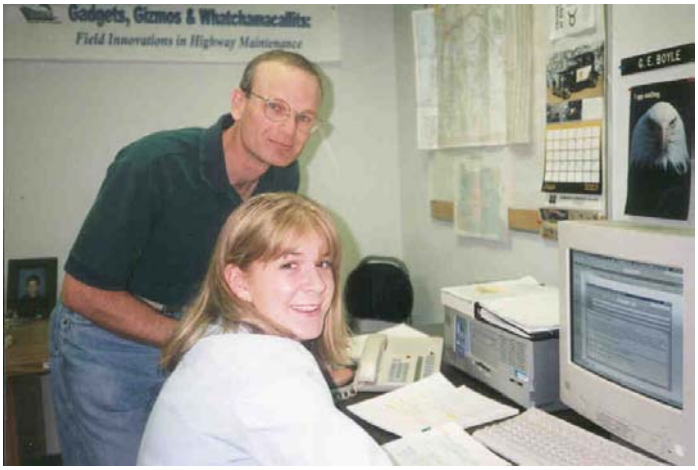
ODOT's Research Unit will monitor the performance of the products during the next two years. The end result could provide ODOT with a cost-effective durable pavement marking design for snow zones that may eventually end the practice of annually re-painting lines.

Contact Kevin Haas for more information about the Durable Pavement Markings research.

This summer ODOT's Research Unit again hosted a high school student through the Apprenticeships in Science and Engineering program. The program provides high school students with an 8 week summer opportunity working in a professional, scientific or engineering environment. Below is an article about her experience.

My Summer of Research Working for ODOT

(by Keely Heintz, Senior at Canby High School)



Keely with ODOT Research Engineer and ASE Mentor Steve Soltesz

As soon as I saw this position description in the ASE (Apprenticeships in Science and Engineering) view book, I knew it was destined to be. After I applied and went through the interview process with Steve Soltesz and Mac Lynde, I could hardly wait to be notified of whether or not I was accepted. And then that magical day came when my loving mother handed me that glorious telephone. "You've been accepted to two positions, positions # 86 and….." That was it!! My lucky number!! The year I was born!! The best number ever invented!! I had been accepted to Position # 86 – Oregon's Experience with Injected Polyurethane Slab Jacking and that was how the most memorable summer of my life (so far) was started….a day that will forever live in infamy.

This summer, my mentor, Steve Soltesz, had me work on several different projects. I'll start out with my favorite – you guessed it – Injected Polyurethane Slab Jacking! One problem that ODOT has is trying to solve the issue of sunken concrete roadways. The problem occurs when a roadway has some type of water drainage problem underneath. This water mixes with the dirt particles and is pumped out from underneath the concrete slabs when traffic drives over the particular site. Some methods used to fix this problem are asphalt pavement overlays, injecting cement grout, or even a complete road surface replacement. A fairly new method (invented in 1975 in Finland) is injected polyurethane slab jacking (this

method, like most other methods will only really work if the drainage problem is first solved).

Polyurethane is a lightweight but sturdy material which helps bring the roadway back to its original profile. Because this product/method is somewhat new, it is hard to know if it actually does its job. In some cases it is not cost effective to use this method. For example, in Corvallis the cost of using the polyurethane method was equal to the projected cost of replacing the section of roadway. Once the two substances are mixed together, polyurethane will expand to 30 times its original volume. Due to the materials large expansion sometimes the concrete slab is jacked more than necessary. Because slab jacking is a fairly new method used to repair concrete slabs, Steve did a research project on it in 2000. *(Follow the link to view the final report Injected Polyurethane Slab Jacking)*

Two parts were integrated into my analysis of slab jacking. The first involved conducting a follow up report on the slab jacking on the southbound off ramp of the I-205 Glenn Jackson Bridge. The slab jacking at this site was originally done as a part of Steve's research and has been monitored regularly for changes in elevation. After three years it is evident that the rate of change in elevation has decreased, but has not stopped completely. If this site continues to be monitored closely the effectiveness of the slab jacking should become evident.

The second part of my project was to travel to different sites within the area to carry out a basic inspection where polyurethane slab jacking was used. After completing the inspection for each location I found that slab jacking is working and has been relatively successful in Oregon.

I was also able to look at some other research projects that ODOT is currently involved with. Some of these include testing the durability of striping materials used within snow zones, cracked bridge beam testing, corrosion control of Coastal bridges, and the replacement of the Broadway Bridge deck.

For the cracked bridge project (Deterioration Models for Shear Cracked Bridges) I was able to visit the Wave Research lab at Oregon State University (Go Beavs!) and watch as a bridge beam was loaded to the point of failure.

For the Broadway Bridge deck replacement Multnomah County is planning on using fiber optic strain gauges to monitor the new composite bridge deck. I was able to explore several different fiber optic strain gauges to find out how they work. Steve had me compare and contrast different technical elements of these elaborate (and tiny!) gauges and prepare a spreadsheet of my findings.

This summer has been unforgettable. I owe it mostly to my mentor, Steve Soltesz, and to all the people working in ODOT's Research Unit. They all taught me something valuable that I will carry with me into the future. Even if it was just getting lost on the way to Corvallis or a hug after you get in your first car accident, I have learned so much. Not only have I learned all there is to know about injected polyurethane slab jacking, but I've learned the importance of teamwork and friendship. Thank you all so much for this excellent opportunity, it has, and will open many new doors for me.

(To view Keely's report click on the following link; Follow-up of Injected Polyurethane Slab Jacking)

New Research Notes: (click on underlined items to go to the notes)

The Bridge Section and Research Unit have been monitoring a support system for bridges to protect them from seismic events. ***Base Isolation Bearings Hold Up*** describes one system which has been in place since 1994 on the Clackamas Highway/Highway 99E connector ramp and the latest inspections after the April earthquakes.

In 1996 two pavement types (SMA and Oregon F-Mix) were used to repair studded tire damage on I-5. ***SMA: Stone Matrix Resists Ruts*** describes how the two pavement types are performing on I-5 and highlights the use of more SMA pavement throughout the state.

Recently Published Reports: (click on underlined items to go to electronic reports)

Short- and long-term effects of common herbicides on rainbow trout and other water organisms were evaluated by Portland State University and the Department of Environmental Quality in this study for ODOT. The impact of herbicide runoff was evaluated, but no clear cause & effect relationships were found. See the full report, ***Effects of Bromacil, Diuron, Glyphosate and Sulfometuron-Methyl on Periphyton Assemblages and Rainbow Trout***.

ODOT conducts some construction and maintenance work at night in order to minimize the disruption of daytime traffic. Nighttime work, however, produces a new set of concerns such as safety, public relations, productivity and quality. The report, ***Selection Criteria for Using Nighttime Construction and Maintenance Operations***, provides a decision model to facilitate the determination of when to use nighttime work. The report has been published on CD along with two tools -- the decision model and a spreadsheet to estimate road user costs for multiple lane roads. The CD is available by contacting the ODOT Research Unit.

The study, ***Development and Evaluation of Fiber Optic Sensors***, investigated the feasibility of using fiber optic sensors to capture traffic data. The prototypes were found to have potential for use in vehicle classification applications and for weigh-in-motion operations. Future studies may eventually allow the sensors to monitor traffic from the shoulder area, reducing disruption and increasing safety.

The concrete ***Maturity Method Demonstration*** performed by Pennsylvania State University documents the findings of an investigation performed for ODOT, demonstrating the use and benefits of the maturity method. The maturity method was shown to be an easily implemented QC/QA tool that can be used to estimate strength development, speed construction operations, and document contractor mistakes.

Asphalt contents are determined by measuring the change in mass between the original asphalt sample and the mass of the final residue aggregate sample after the asphalt is burned off in an ignition furnace. The research, ***Determining Asphalt Content for Recycled Asphalt Pavement (RAP) Materials*** attempted to use volumetric equations to solve for the RAP asphalt content without using the burn-off method.

Research from Other States:

North Carolina DOT provided a copy of a report and CD from their recently completed project, "**Regionalizing Public Transportation Services**." This study identified barriers to integration of transit systems, evaluated best practices from across the country, described incentives to encourage regional integration of transit systems and developed recommendations for policy changes.

The Center for Transportation Studies at the University of Minnesota offers a quarterly **CTS Research E-News**, full of research news and useful links. The latest includes articles about Policy/Planning, Intelligent Transportation Systems, Transit and Alternative Modes, Environment, and Infrastructure. Check it out!

Arizona DOT's Transportation Research Digest compiles summaries of research reports from federal and state DOT's. These 1-2 page summaries often include links to full reports; the October 2003 issue includes studies on air pollution, fuel efficiency, mass transit, hybrid vehicles, congestion pricing, roundabouts, and transportation technology.

And remember, the Research Unit can provide many reports from other states. Here's a ***link to our latest list of reports from other states***. Or if you'd like to find an ODOT report, check out this ***link to the latest ODOT Research reports***. Or send us the topic and we'll do the search for you!

National Resources

The ***Transportation Research Board*** (TRB) publishes an electronic **TRANSPORTATION RESEARCH E-NEWSLETTER,** a brief e-mail message full of web links to events, resources, publications and news items. Check out past editions by clicking the link above –information on how to subscribe is available at the site.

The latest newsletter provides links to:

- the TRB 2004 Annual Meeting in January;
- upcoming TRB Conferences and Workshops;
- recently released TRB publications;
- updates on university research on traffic signal phases and perspectives on land use and transportation;
- international transportation news; and
- a report measuring the health effects of urban sprawl.

One new resource is from TRB's National Cooperative Highway Research Program (NCHRP). **Report 492: Roadside Safety Analysis Program (RSAP)-Engineer's Manual** describes the inner workings of the cost effective analysis procedure and the various algorithms and data sources built into the roadside safety analysis procedure. A separate User's Manual describing the User Interface Program (including the data input process and the program reports) and the RSAP software are on CRP-CD-33, which is included with this report.

Questions? Problems?

Got a transportation-related work problem that you think should be researched? Need a resource to answer a question? Call or e-mail the Research Group and we may be able to help.

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For more information on ODOT's Research Program and Projects, check the website at http://www.odot.state.or.us/tddresearch/