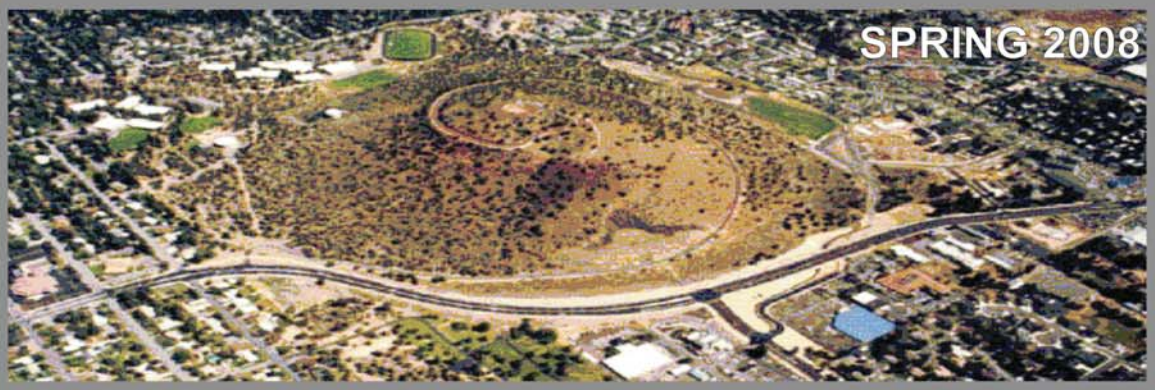
RESEARCH

Oregon Department of Transportation

Research Newsletter
Spring 2008



In This Issue:

Research Projects Prioritized

The ODOT Research Advisory Committee recently met and prioritized research projects for the 2008-2009 fiscal year.

In late February the ODOT Research Advisory Committee (RAC) met to discuss and prioritize funding for potential research projects. A total of 21 projects, outlined in Stage 2 problem statements, were evaluated by the Committee.

During the fall solicitation period, ODOT Research had received about 100 problem statements/research ideas. Those reviewed by the RAC represented the top two or three prioritized projects from each of the following eight Expert Task Groups which advise the Research Unit:

- Construction and Maintenance
- Roadway Design and Human Factors
- Pavements and Materials
- Traffic, Safety, and ITS
- Structures; Integrated Multimodal
- Planning and Economic Analysis
- Hydraulics, Geotechnical, and Environmental

The RAC reviewed the Stage 2 problem statements and heard a short presentation on each proposed project. Time was also allotted for the members to ask questions about the potential projects. The RAC then discussed and prioritized the projects.

The top seven prioritized problem statements were as follows:

- Open Graded Friction Courses for the Pacific Northwest
- Evaluation of [Pavement Marking] Wet-Weather Retroreflectivity
- Replacing Thermal Sprayed Zinc Anodes on Cathodically Protected Steel Reinforced Concrete Bridges
- Calibration of LRFD Resistance Factor for the Wave Equation Analysis of Pile Driving Program
- Calibrating the Future Highway Safety Manual Predictive Methods for Oregon
- Safety Evaluation of Curve Warning Advisory Speed Signs
- Health Risk Exposure to Naturally Occurring Hazardous Minerals During Construction Activity

Funding will be allocated to problem statements based on the RAC priorities; those prioritized highest are more likely to be funded as research projects.

ODOT Research News

Making the Most of What We Have

The 2008 NW Transportation Conference

In an era of constrained funding and limited resources, making the most of what we have through innovative approaches is critical. Paralleling this idea, the recent 2008 Northwest Transportation Conference theme was *"Making the Most of What We Have: Transportation Innovations for the 21st Century."* The conference was held at Oregon State University from February 5th to the 7th. Transportation professionals and researchers from around the northwest and the nation attended the conference. The three-day event included a total of 24 breakout sessions on different topics of transportation and a keynote panel on maintaining future mobility.

The keynote panel consisted of moderator Gail Achterman (Oregon Transportation Commission), and speakers Stephen Andrle (SHRP 2 Capacity Program Manager, Transportation Research Board), Rex Burkholder (Metro Councilor), Rod Diridon (Director, Mineta Transportation Institute), Stephen Lockwood (Parsons, Brinkerhoff, Quade and Douglas), and Alan Pisarski (Economist and Independent Consultant).

A luncheon speech was delivered by guest Michael Meyer, of the Georgia Institute of Technology. Michael spoke on the conference theme, highlighting transportation demand increases and funding decreases. He noted that as a growth state, stress on the Oregon transportation system will increase. Michael foresees that as demand increases states will need to look to multiple sources of funding, in order to have a stable or reliable system.

Conference attendees evaluated sessions. Overall, 90% of people thought that the conference sessions were well organized, had good/excellent content, good/excellent speaker preparation, and a good/excellent discussion following the presentation. Though all sessions were well received, the following sessions were rated highest for organization, content, discussion, and speaker preparation:

- Intersection Safety
- Bike and Pedestrian Friendly Design Innovations for Intersections, Crossings, and Streets
- What's New in Highway Design Guidelines, Handbooks and Manuals
- Pavement Markings – Why, What, When, How and Who
- Road Safety Audits
- Getting People Out of Their Cars Travel-Smart and Other Mode Shift Strategies
- Innovations in Public Transit

In addition to conference presentations and sessions, vendor displays and energy efficient vehicles were featured. Both a Smart Fortwo car and a Cascade Sierra Solutions truck were displayed. The truck, pictured to the right, is reportedly more fuel efficient and cleaner than existing trucks. An electric scooter was also made available to adventurous attendees.

The 2008 Northwest Transportation Conference was sponsored by: Association of Oregon Counties, Benton County Public Works, David Evans and Associates, Inc., DKS Associates, Federal Highway Administration, HDR, Inc., ITS Oregon, Oregon Department of Transportation Research Unit, Oregon T2 Center, Oregon State University Kiewit Center for Infrastructure and Transportation, Portland State University Center for Urban Studies, Oregon Transportation Research and Education Consortium, Tyco Electronics, and the US Forest Service.

Presentations from the conference are available on the conference website at: http://kiewit.oregonstate.edu/nwtc/, or at http://www.oregon.gov/ODOT/TD/TP_RES/docs/2008NWTC/2008_NWTC_LoP.pdf.

Transportation Finance

Oregon State University Studies Possible Impacts of a VMT Fee

Due to various factors such as inflation and increased vehicle fuel efficiency, the revenue generated from the gas tax has not kept pace with the increasing number of cars on the road and the amount of traffic. Over time, this has resulted in greater shortfalls in the funds needed to maintain and improve highway facilities. To look for ways to address this problem the Oregon legislature established the Road User Fee Task Force (RUFTF) to consider a distance-based fee or vehicle miles traveled (VMT) fee as an alternative to the gas tax.

To decide whether such a concept is feasible, however, policy makers will need to answer many questions. There are technical questions about the feasibility of such a system. There are questions about the cost of

administering the system. Over the past several years ODOT has conducted studies to address these questions. There are also questions about the impacts of such a change on people of varying incomes and locations in the state. Would it create more of a burden on people in rural areas, driving longer distances? Would it have an impact on lower income groups, owning a larger share of older, less efficient vehicles?

In the fall of 2006 ODOT Research contracted with Oregon State University (OSU) for a study to investigate workable models to gauge the impacts of a VMT fee on different socioeconomic groups. The objective of the study is to develop models which will compare the impacts of a VMT fee to the impacts of the current per-gallon gasoline tax. The project also seeks to develop statistical models to quantify changes in vehicle ownership and use for different household groups in response to a conversion from the gasoline tax to a VMT fee. The study draws on data from the 2001 National Household Transportation Survey, both from Oregon and from a collection of comparable states. Various approaches have been used to evaluate models which explore the effects of changing from the gas tax to a VMT fee.

- A *static analysis* is the simplest approach. It assumes that behavior is not affected by a change in fee structure, i.e., that each driver will drive exactly the same amount with each vehicle in the household as before the fee was implemented.

- A *dynamic analysis* tries to account for changes in driving behavior in response to the change to a VMT fee. Such analysis is more complex and requires data on more household characteristics, such as vehicle ownership. Three dynamic analysis methods have been employed in the study.

While the results are not yet final, they show that simpler statistical models can be useful in helping ODOT approximate the likely effects of a VMT fee on various population groups. More complex models appear to have only limited value, given currently available data sources. OSU will provide all of the models to ODOT for possible use in testing the effects of various VMT fee structures, to provide information to the Road User Fee Task Force in its policy discussions. A final report on the study is expected to be published by May. For more information, contact Alan Kirk at 503-986-2843.

Incorporating Trucks in Pavement Design

Oregon Weigh-in-Motion Data Used to Develop Truck Axle Spectra

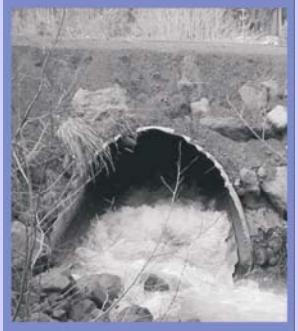
ODOT is switching to pavement design based on the Mechanistic Empirical Pavement Design Guideline (MEPDG), developed by the American Association of State Highway and Transportation Officials (AASHTO). The approach described in the MEPDG is considered the state-of-the-art in pavement design. The MEPDG uses physical causes to account for the performance of the pavement. Pavement personnel believe this approach will achieve more consistent and realistic prediction of pavement life.

Mechanistic empirical design incorporates materials properties, truck loading, environmental factors, and construction considerations. To account for current and future loading, distributions describing truck and axle characteristics must be fed into the design algorithm. A recently completed research project with Oregon State University characterized the truck loading on Oregon's highways and synthesized the data into a format for input into the MEPDG software. This research allows ODOT to use Oregon-specific loading data instead of the default loading distributions assumed by the MEPDG software.

Oregon collects a large amount of high quality weigh-in-motion (WIM) data from twenty-two sites around the state. Raw WIM data from four of the sites, representing different truck volumes, were cleaned, filtered, and sorted into axle groups. These data were used to describe the truck volume as well as axle weights and axle spacings. Traffic direction, freight route type (interstate or state), truck volume, season, location, and sampling method were all examined. A virtual truck classification was created to make the sorted WIM data compatible with the input form required by the MEPDG software. This allowed hourly truck volume, axle weight, number of axles per truck, and axle spacing information to be fed into the MEPDG software.

As ODOT implements mechanistic empirical pavement design, pavement engineers will be able to use Oregon-specific truck loading data. The customized data will increase accuracy of the pavement design process by incorporating more realistic loading conditions rather than a reliance on national data that may not be representative of local conditions. A final report on this project has been completed and is available at: http://www.oregon.gov/ODOT/TD/TP_RES/docs/Reports/Truck_Load_Model_Load_Spectra_final_report.pdf.

Solution to Pollution in Solution



Copper in Highway Stormwater Runoff

The automobile – it is not only an icon of American freedom, but also a polluter of our environment. Over four decades ago we came to realize that automobiles were polluting the air we breathe. Since then, through technology and engineering, automobiles have really cleaned up their act. The tail-pipe emissions from most new cars in the U.S. consist of very little more than water vapor and carbon dioxide. But tail-pipe emissions are only part of the automobile pollution story. Some automobiles also drip grease and oil that is readily recognized as pollution in the rainbow sheen in water running off of roads and parking lots. Another source of pollution that is readily seen, but not necessarily recognized as pollution, is that ugly brownish black grime that accumulates on the wheels of cars. That grime is dust made up of fine particles of metal and other materials that are ground off the brakes every time they are used. The dust settles onto the pavement and shoulders of our roadways as well as on the wheels. When it rains some of the dust is carried off of the roads and wheels into our streams.

The ODOT Research Unit has arranged for Jeff Nason, a new Assistant Professor in OSU's new School of Chemical, Biological, and Environmental Engineering, to investigate what happens to highway derived copper when it goes into solution in stormwater. Recent research has shown that even very small amounts of copper ions in water can significantly impair a salmon's sensory systems. These sensory systems allow the salmon to detect and avoid predators, find food, and navigate the currents in complex stream environments. High enough levels are actually toxic to aquatic life.

Fortunately for the salmon, copper ions bond readily with a wide variety of substances and compounds commonly found in stormwater. The objective of the study, titled *Copper Speciation in Highway Stormwater Runoff as related to Bioavailability and Toxicity to ESA-Listed Salmon*, is to determine how much ionic copper is in highway stormwater runoff, what the non-ionic copper is bound with, and how strongly bound it is. Armed with this information, it is hoped that we can devise strategies to insure that essentially all the copper in highway runoff exists in a form that won't impair salmon.

An interesting footnote to the issue of copper in highway runoff is the fact that the composition of brake pads/linings varies considerably between manufacturers. Some formulations use hardly any copper, while others are composed of over 20% copper. Some have seriously suggested banning or limiting the use of copper in brakes. For more information contact Matthew Mabey at 503-986-2847.

Research Reports

Recently Published Research Reports

Methodologies for Estimating Advisory Curve Speeds on Oregon Highways

(FHWA-OR-RD-08-04)

This report reviews an Oregon research effort to evaluate the identification and posting of advisory speeds on Oregon highways. In particular, this research effort focused on the implications of modified advisory speed thresholds and identification procedures following the most recent and upcoming Manual on Uniform Traffic Control Dedvices (MUTCD) recommendations. The primary objectives of this research effort were 1) to help identify the basis for the current and proposed advisory speed posting procedures (with specific attention to the horizontal curve location on rural roads and passenger vehicle condition); 2) to evaluate Oregon placement strategies at a variety of locations; and 3) to identify potential criteria for establishing advisory speeds for these curved sections on Oregon highways. Included with this evaluation was an assessment of associated costs for implementation of a modified advisory speed policy in Oregon. Through the use of both manual and digital ball-bank devices, the report identifies compliance of current and future advisory speed thresholds for both State- and county-maintained roads, expected costs for upgrading State-maintained facilities, evaluation of alternative computational methods, and an assessment of the differences observed between the two different ball-bank devices.

Regional Precipitation-Frequency Analysis and Spatial Mapping of 24-Hour Precipitation for Oregon

(FHWA-OR-RD-08-05)

For this study, regional frequency analyses were conducted for precipitation annual maxima in the state of Oregon for the 24-hour duration. Results of the research provide an update of 40-year-old data with 21st Century maps. The report summarizes the findings and describes the procedures used for spatial mapping of the precipitation-frequency estimates for selected recurrence intervals.

Development of Truck Axle Spectra from Oregon Weigh-In-Motion Data for Use in Pavement Design and Analysis

(OR-RD-08-06)

Four weigh-in-motion (WIM) sites in Oregon, representing high, moderate, and low average daily truck traffic (ADTT) volumes, were selected to characterize axle weight and spacing spectra on Oregon state highways. The

characterized Oregon WIM axle data were incorporated into the Mechanistic Empirical Pavement Design Guide (MEPDG) software program to permit State and ADTT volume-specific axle weight spectra, average axle group spacing, and hourly volume data to be used in the pavement analysis/design. Implementation of the Oregon WIM data will improve the pavement design process in the State by designing to more realistic local loading conditions.

Evaluation of Solar-Powered Raised Pavement Markers

(FHWA-OR-RD-08-07)

An evaluation of a limited number of solar-powered raised pavement markers (SRPMs) was conducted to determine if this type of marker would be more visible on Oregon highways than retroreflective markers in some situations. SRPMs typically use Light Emitting Diodes (LEDs) that are powered by solar cells. Some markers have retroreflective surfaces as well. The ODOT Research Unit performed preliminary tests which included environmental tests (extreme temperatures, immersion), optical performance tests, and observation tests. Selected markers were sent to the Federal Highway Administration's Photometric and Visibility Laboratory (PVL) at the Turner-Fairbank Highway Research Center in McLean, Virginia for additional evaluation. A series of tests were performed to measure both the LED signal and the retroreflected light. It was found that each type of marker had significant shortcomings, so the project was terminated prior to field trials being performed.

The Older Driver in Oregon: A Survey of Driving Behavior and Cessation

(FHWA-OR-RD-08-08)

In a study of older adults and their travel patterns in Oregon, a statewide mail survey and telephone interviews were conducted with older drivers and older adults who had voluntarily chosen to stop driving. The purpose of the study was to determine: (1) the factors that influence driving cessation; (2) the physical and emotional barriers that delay driving cessation; (3) what opportunities exist for alternative transportation after driving cessation; (4) whether drivers make relocation decisions on the basis of driving cessation; (5) the warning signs that make a driver stop driving; and (6) whether a crisis situation generally forces a driver to stop driving. The report for this project summarizes the study findings.






Research Notes

Recently Published Research Notes

Adjustment of Driver Behavior to an Urban Multilane Roundabout

In 2006, the city of Springfield, Oregon constructed a multi-lane urban roundabout. Researchers from ODOT studied driver behavior at the roundabout, immediately following and then again several months after construction. The study found that drivers rapidly learned to adjust to situations that initially caused them confusion in navigating the roundabout.

Geosynthetic Materials in Reflective Crack Prevention

Transverse cracking across Oregon roadways is common. As new pavement layers are placed, these transverse cracks often appear in the same locations, reflecting through the overlay. Several approaches have been used to stop the pavement from re-cracking. This particular project examined several geosynthetic materials and their effectiveness at preventing or reducing the severity of reflective cracks.

Thin Polymer Overlays on Bridge Decks

Bridge deck repair and replacement is very expensive. In order to address this issue, ways of preserving or protecting bridge decks and improving skid resistance are being explored. One particular approach, which is currently being tested by the ODOT Research Unit, is the placement of thin polymer overlays. Eight polymer products, each from a different manufacturer, were placed on two bridge decks in western Oregon. The test sections are being evaluated based on their overall durability as well as their skid resistance. Polymer resin and aggregate samples have been prepared for lab analysis. The lab specimens will be tested for absorption, tensile strength, elongation as well as compressive and flexural strength, and abrasion resistance.

T2 Center

Oregon Technology Transfer Center

ODOT Research also manages the Technology Transfer (T2) Center. The T2 Center is jointly funded by ODOT, the cities and counties of Oregon, and the Federal Highway Administration, under the Local Technical Assistance Program (LTAP).

The Center publishes information on transportation technology in their quarterly newsletter, *Oregon Roads*. They also distribute informational materials to local agencies through a "Circuit Rider" service, provide technical resources on request, and have a large lending library of available audio/visual programs on a variety of transportation topics.

Oregon *Roads Scholar* Program

The T2 center offers the popular *Roads Scholar* program. The *Roads Scholar* program provides free up-to-date road maintenance and safety related training for local government personnel. The program consists of several training courses on current procedures and the latest technologies that count for credit hours. Those completing program requirements will receive a certificate acknowledging their graduation from the program. For more information on the Roads Scholar program please visit http://egov.oregon.gov/ODOT/TD/TP_T2/RoadsScholarProgram.shtml

Additional information regarding the T2 Center is available at: http://www.oregon.gov/ODOT/TD/TP_T2/index.shtml. The current issue of the *Oregon Roads* newsletter, providing the latest in T2 news, as well as past issues, is also available on the web site. For more information, contact T2 Center Director Bob Raths at 503-986-2854 or by email at Bob.Raths@odot.state.or.us, or T2 Assistant Beth Hunter at 503-986-2855 or by e-mail at Beth.Hunter@odot.state.or.us.

T2

Oregon Technology Transfer Center

Update

Research Personnel Changes

Though research coordinator Alan Kirk retired in late December, you will still see him around the Research Unit as a part-time employee. Prior to his formal

retirement, Alan's primary duties included coordinating research projects relating to planning and economic analysis and editing and preparing research publications. Several research investigators have mentioned their gratitude to Alan for assisting in research oversight and coordination. Research Unit staff members are pleased to have Alan continuing to work alongside them, even if it is now only part-time.

Amanda Bush was promoted to fill Alan's position as the research coordinator for projects in the areas of planning and economic analysis. During the interim, Amanda is working alongside Alan to smoothly transition. Amanda will also pick up Alan's duties as lead report editor and publication specialist.

Vince Van Der Hyde retired from the Research Unit in March. He joined ODOT in 2002 after a long career as a public employee with the states of Alaska, Washington and Oregon. Vince joined the Research Unit as part of a reorganization in 2003. His responsibilities included coordinating projects relating to multimodal transportation and supporting the unit in statistical analyses of research data.

The staff welcomes Jon Lazarus as a new member of the ODOT Research Unit. Jon was hired to lead projects relating to construction and maintenance. Jon's academic experience includes an engineering degree from Heriot-Watt University in Edinburgh, Scotland, and an MBA from Willamette University's Atkinson Graduate School of Management. Since 2003, Jon has been working for ODOT, most recently with the Intelligent Transportation Systems program, where he played a key role in the development of aspects of TripCheck and the 511-phone travel line. Jon joined the Research Unit in early February.

Oregon Department of Transportation
Research Unit
200 Hawthorne SE, Suite B-240
Phone: 503-986-2700
Fax: 503-986-2844
Email: Linda.Perkins@odot.state.or.us

What Can We Do for You?

Let us help you! Do you have a transportation-related problem that you think could be addressed through research? Need help in locating current research on an issue? The Research Unit may be able to help. We are available year-round to help answer transportation-related questions. We often answer information requests from ODOT staff by locating technical references, conducting literature searches, or conducting a research project.

http://www.oregon.gov/ODOT/TD/TP_RES/