PAVEMENT PERFORMANCE DATA ANALYSIS FORUM
April 24, 2014
Sponsored by the TRB Data Analysis Working Group
3rd International Conference on Transportation Infrastructure
Pisa, Italy

The DAWG is an international forum for the discussion of methods of analysis of pavement performance data. Presentations at DAWG-sponsored forums address the technical interests of professionals engaged in highway research and engineering design, maintenance, and rehabilitation who are engaged in collecting, processing, and analyzing such data and developing insights into the behavior of pavements. Presentations offered by forum attendees (by prior arrangement) focus on work-in-progress concerning the development of techniques for extracting and analyzing data, and early results of recent applications of these techniques. Topics such as model building, sensitivity analysis, and development of transfer functions linking structural response to distress are especially popular and welcome.

A DAWG-sponsored forum has a minimum of formality to encourage open discussion among attendees and minimize the time between the presenters' preparation and dissemination of analytical results. The agenda is prepared in advance, based on responses to a call for abstracts. Abstracts are reviewed solely for conformity with DAWG guidelines, and as many as time permits are placed on the agenda. Presentations are not subjected to prior technical review. Copies of presentation materials are not distributed. Presentations are not published. Comments by forum attendees are not recorded.

DAWG-sponsored forums are held twice each year: immediately preceding the TRB Annual Meeting in Washington DC in January, and approximately at the midyear at another location. The midyear meeting is usually held in conjunction with a major highway pavement conference where it is expected that many attendees will also be interested in participating in a DAWG forum. If requested by the organizers, the DAWG will arrange and conduct a formal paper session conforming to all the policies and procedures of the conference.

As a TRB committee, the DAWG has appointed members who serve as a steering committee to guide the planning of future meetings. However, DAWG forums are open to everyone interested in the subjects to be discussed, and all attendees enjoy equal status. There is no registration requirement or fee required to attend meetings, but advance notice of the intent to attend a particular forum is recommended and appreciated.

Inquiries are welcome from those interested in adding their names to the DAWG's mailing list, and those wishing to submit abstracts of presentations for consideration for presentation at a particular forum. Inquiries and abstracts should be directed to A. Robert Raab, PhD, Senior Program Officer, Transportation Research Board, rraab@nas.edu

Concurrent Technical Session 5 Sala Tony Bin	
13.30-13.40	**Chairman's Welcome** *Brian Ferne, TRL Ltd., Wokingham, UK*
13.40-14.00	**Introduction to the DAWG** *A Robert Raab, TRB, Washington, DC, USA*
14.00-14.30	**Evaluation and Analysis of the LTPP SPS-2 Distress Data** *Changwei Xu* *University of Cambridge, Cambridge, UK*
	Discussion
14.30-15.00	**Accurately Measuring Faulting at High Speeds** *D.J. Swan* *Fugro Roadware, Mississauga, Ontario, Canada*
	Discussion
15.00-15.30	**Evaluation of Gravel Road Roughness Using Mobile-Based Response-Type Road Roughness Measurement Device** *Wynand JvdM Steyn* *University of Pretoria, Pretoria, South Africa*
	Discussion
Concurrent Technical Session 6 Sala Tony Bin	
16.00-16.30	**Implementation of a Data Base for the Environmental Evaluation of Pavements** *Maria Chiara Zanetti* *DIATI, Politecnico di Torino, Torino, Italy*
	Discussion
16.30-17.00	**Identifying Structural Defects On Rigid Pavements With Continuous Deflection Measurements** *Brian W Ferne, Transport Research Laboratory, Berkshire, UK*
	Discussion
17.00-17.30	**Definition of Predictive Models of Permanent Deformation Behavior of Cement-Bitumen Treated Materials** *Monica Meocci, University of Florence, Firenze, Italy*
	Discussion

TRB's DATA ANALYSIS WORKING GROUP ("the DAWG")
PRESENTATION ABSTRACT FORM

Title of Presentation:

ABSTRACT:

Guidelines:

- *Any person who wishes to brief the DAWG on the status of his/her unfinished and unpublished work is invited to submit an abstract.*
- *Each abstract must contain a small set of questions on issues being considered by the submitter in the further development of his/her project.*
- *Each briefing will be followed by a period devoted to consideration of the presenter's questions and requests for advice.*
- *Briefings should focus on techniques for extracting, processing, and analyzing pavement performance data, as well as preliminary results of applications of these techniques.*

Note: Please delete the guidelines and use this space for your abstract.

PRESENTER'S QUESTIONS: I would like to receive comments, suggestions, and feedback from the meeting's attendees on the following matters:

1-

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PRESENTER'S STATEMENT: This work is still in progress, and has not been submitted for presentation or publication at another meeting.

Name
Title
Affiliation
Mailing Address
Telephone
Fax
Email

Completed forms should be sent to:
A. Robert Raab
Senior Program Officer, TRB
Email: rraab@nas.edu

Evaluation and Analysis of the LTPP SPS-2 Distress Data

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ABSTRACT:

Our work focuses on analyzing the LTPP (Long Term Pavement Performance) SPS-2 (Specific Pavement Study for jointed plain concrete pavements) monitoring distress data over years. We evaluated the distress data quality and quantity of all 156 core test SPS-2 sections in the 13 USA sites. The trends (including magnitude and location) of some typical distress (such as longitudinal and transverse cracking, pumping, etc.) over years in some sections with good data were studied. The effects of pavement structural factors (base type, PCC slab thickness, width and strength) and loading conditions(traffic and climatic conditions) on such trends were also investigated. For example, our analysis shows that thinner PCC slabs are cracked in early years and to a greater extent. Our study shows that in terms of longitudinal and transverse cracking, and pumping resistance, LCB base has the worst performance and PATB has the best performance. Our preliminary study shows that edge pumping in pavements affects the locations of longitudinal cracking.

PRESENTER'S QUESTIONS: I would like to receive comments, suggestions, and feedback from the meeting's attendees on the following matters:

1. Which structural factors (PCC slab thickness, base types, slab width, slab strength) plays a major role in a specific distress?

2. Accurate and reliable mechanistic models or equations to predict the distress trends (such as cracking length, or pavement cracked)

3. How do various distresses of pavements affect each other ?

PRESENTER'S STATEMENT: This work is still in progress, and has not been submitted for presentation or publication at another meeting.

ACCURATELY MEASURING FAULTING AT HIGH SPEEDS

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ABSTRACT:

The measurement of joint/crack faulting by pavement profilers has been historically accomplished by using the longitudinal profile, like roughness. However with 3D technologies now available, more information is available than ever before. Faulting can be measured across the full width of the road instead of just the wheelpaths and a much higher level of accuracy is now available.

A full description of the historic and newly developed algorithms will be presented to discuss the difference and impact on results. A comparison of the new techniques with other manual measurement techniques will also be presented.

This information will demonstrate the range in potential outcomes from faulting measurements at highway speeds and try to determine which outcome is most desirable to road agencies.

PRESENTER'S QUESTIONS: I would like to receive comments, suggestions, and feedback from the meeting's attendees on the following matters:

1. What is the accuracy level required by agencies for “network level” and “project level”?

2. Is the fault measurement relevant outside of the wheelpath?

3. What counts as a fault? How should vertical changes be identified if there isn’t a crack/joint present? What fault level is best used to remove false positive identification of faults.

PRESENTER'S STATEMENT: This work is still in progress, and has not been submitted for presentation or publication at another meeting.

EVALUATION OF GRAVEL ROAD ROUGHNESS USING MOBILE-BASED RESPONSE-TYPE ROAD ROUGHNESS MEASUREMENT DEVICE

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ABSTRACT:

Road roughness or riding quality data are typically used as input into Pavement Management Systems (PMS) to enable tracking of road condition. On paved routes this is done routinely using various types of devices, mostly through measuring actual road profile with laser-based profilometers.

South Africa has around 79 per cent of gravel routes that require management as much as the paved network. On this network, laser-based profilometers cannot be used reliably. Traditionally, response-type measurements provide a less-expensive method to obtain an indication of the riding quality. Older methods required the installation of equipment into a specific vehicle for these measurements to be collected. An Android application (RoadRoid) was developed in Sweden which can be used to determine response-type road roughness measurements using the accelerometers in an Android smartphone. The benefit of such a device, if accurate enough, is the provision of quicker, easier and up-to-date road roughness measurements for project level evaluations.

This presentation reports on an initial study that is conducted to investigate whether the device is a viable tool for measuring road roughness of typical gravel / unpaved roads in South Africa. Effects such as changes in the profile and reproducibility are investigated.

PRESENTERS' QUESTIONS: I would like to receive comments, suggestions, and feedback from the meeting's attendees on the following matters:

1. Are there any other current non-published studies using mobile RTRRMS devices for monitoring unpaved / gravel road condition?

2. Are there fundamental reasons why this technology cannot be used for this application?

3. Which parameters would play a major role in comparison between different runs on the same route and what level of variation is expected for similar road conditions?

PRESENTERS' STATEMENT: This work is still in progress, and has not been submitted for presentation or publication at another meeting.

IMPLEMENTATION OF A DATA BASE FOR THE ENVIRONMENTAL EVALUATION OF PAVEMENTS

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ABSTRACT:

Environmental sustainability is becoming a major element for Public Administration in Italy in order to decide the kind of pavement to adopt. This approach is also determinant for the evaluation of new technologies specially concerning the use of recycled materials (RAP, tyre rubber, and so on) in pavements.

Here we present two approaches for the evaluation of the environmental sustainability of pavements: the gas emission collection and measurements in the laying of mixtures (linked with the risk analysis procedure for workers) and the Life Cycle Assessment (LCA) approach. In order to analyze data and to draw some consequences in relative terms (one pavement is more environmental sustainable than the other) it is important to build a data base concerning gaseous emissions and input data for LCA for several pavements changing the technology (kind of bituminous mixtures, plant and production parameters) and environmental external conditions (temperature, pressure, wind and so on). The building of data base is actually in progress.

PRESENTER'S QUESTIONS: I would like to receive comments, suggestions, and feedback from the meeting's attendees on the following matters:

1. Do you have any ideas about similar data base in controlled conditions (it is important to know mix design parameters and performance characteristics of pavements)?

2. Other kinds of approach for the evaluation of the environmental sustainability of pavements?

PRESENTER'S STATEMENT: This work is still in progress, and has not been submitted for presentation or publication at another meeting.

IDENTIFYING STRUCTURAL DEFECTS ON RIGID PAVEMENTS WITH CONTINUOUS DEFLECTION MEASUREMENTS

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ABSTRACT:

Equipment to measure the continuous deflection response of road pavements at traffic speed has now been developed and implemented in a number of countries. The emphasis to date has been on the measurement and interpretation of the response of flexible pavements but a number of countries include a significant proportion of rigid pavements in their road networks. Because of the very localized nature of deterioration of rigid pavements the operation and interpretation of continuous deflection measurements on rigid pavements needs very different analysis to that on flexible pavements. In 2005 TRL acquired a Traffic Speed Deflectometer on behalf of the English Highways Agency. Since then TRL have developed this equipment and implemented surveys of the strategic road network with an associated method of interpretation for flexible pavements. Preliminary research has suggested that the TSD may have the potential to provide information on the structural condition of jointed concrete road pavements up to 100 times faster than existing techniques. More recently TRL has carried out some limited trials on continuously reinforced rigid pavements as part of a European cooperative project TRIMM. The author will present and discuss some results from these early unfinished trials.

PRESENTER'S QUESTIONS: I would like to receive comments, suggestions, and feedback from the meeting's attendees on the following matters:

1. Can anyone suggest better methods of identifying meaningful signals within very noisy measurements?

2. How can we validate the areas of deterioration in a rigid pavement identified by TSD without full forensic detailed investigations?

3. Could the same techniques be used to identify discrete features of interest in flexible pavements, e.g. potential potholes and serious areas of cracking?

PRESENTER'S STATEMENT: This work is still in progress, and has not been submitted for presentation or publication at another meeting.

DEFINITION OF PREDICTIVE MODELS OF PERMANENT DEFORMATION BEHAVIOR OF CEMENT-BITUMEN TREATED MATERIALS

Monica Meocci
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ABSTRACT:

The use of cement-bitumen treated materials rapidly increased over the last 10 years for two main reasons: the first is represented by the economic and environmental benefits, the second is represented by improved structural performance showed over the time.

The mechanistic-empirical design procedure needs to define performance predictive model to analyze the structural and functional distresses of different layers of road pavement. The literature review shows that there are many researches addressed to the definition of the fatigue models and stiffness modulus of cement-bitumen treated material, but there are not many studies concerning rutting performance during the design life.

This research is focused on definition of permanent deformation of this type of materials which are not comparable with traditional asphalt concrete materials for the influence of the cement and active filler content in the mixture and they are not comparable with traditional cement-stabilized material for the influence of the bitumen content (bitumen emulsion percentage).

The main goal of the research is the evaluation of rutting behavior of cement-bitumen materials by means of laboratory test that represent traffic loads. The laboratory measurements are conducted with the “Orniereur” equipment on rectangular specimens with variable thickness.

PRESENTER'S QUESTIONS: I would like to receive comments, suggestions, and feedback from the meeting's attendees on the following matters:

1. Appropriate laboratory test methods to investigate the rutting performance of cement-bitumen treated materials.

2. Appropriate in situ test methods to investigate the rutting performance of cement-bitumen treated materials.

3. Literature references and/or ongoing research focused on the rutting behavior of cement-bitumen treated materials.

4. Suggestions of most important variables that affect the phenomena.

PRESENTER'S STATEMENT: This work is still in progress, and has not been submitted for presentation or publication at another meeting.

Substitute

RAIL-HIGHWAY GRADE CROSSING ROUGHNESS QUANTITATIVE MEASUREMENT USING 3D TECHNOLOGY

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ABSTRACT:

Quality of surface is an important aspect affecting both the safety and the performance of at-grade rail-highway crossings. Roughness may increase the risk of crashes for both trains and automobiles. No quantitative method currently exists to quickly and economically assess the condition of rail crossings in order to 1) evaluate the long term performance of crossings and 2) set a quantitative trigger for their rehabilitation. The conventional method to measure the surface of quality of crossings is based on expert judgment, whereby crossing surfaces are classified as poor, fair or good after an inspector visits and drives over the crossing. However, actual condition of the crossing may be quite different from the subjective rating. Objective/quantitative measures based on vehicle accelerations would be more desirable. To date, however, there is no cost effective way for inspectors to quantify performance at the nation's mode than 300,000 at grade crossings. Poor condition rating crossings may not always present the most cost-effective locations for preventive maintenance to lower overall life-cycle costs.

With rapid advances in computer science, 3D sensing, and imaging technologies, a cost-effective quantitative method should be developed to determine the need to rehabilitate rail crossings and assess long term performance. The project focuses on the development of an accurate, low cost and readily deployable sensor capable of rapid collection of this 3D surface. The research team has is developing a large scale "structured-light" sensor. The research team is also investigating the use of other, low cost sensors such as Microsoft's Kinect and Occipital's new iPAD-based Structure sensor.

The UK team is also developing a vehicle dynamics models based on vehicle and surface conditions to discover the relationship between vehicle performance and crossing roughness. 3D models from the structured light sensor feed into the vehicle dynamic model and can be used to approximate readings obtained by field accelerometer tests.

Position and speed of vehicle crossing the tracks is clearly an important determinant in the estimation of accelerations. We are also evaluating technology to determine vehicle lateral placement. To combine the crossing 3D surface cloud with the vehicle wheel path and vehicle dynamic models, this research is seen as a first step towards automating the crossing inspection process, ultimately leading to the quantification and estimation of future performance of rail crossing.

PRESENTER'S QUESTIONS: I would like to receive comments, suggestions, and feedback from the meeting's attendees on the following matters:

1. Is there a market for such an approach? E.g., could short term settlement be a predictor of service life?
2. Does anyone currently use a quantitative method for evaluating crossing roughness and safety?
3. What equipment or technology exists that may be useful to this project?
4. Would a quantitative rating be helpful in managing crossing assets (e.g., prioritizing maintenance to reduce life cycle costs, keep the public happy, etc?

PRESENTER'S STATEMENT: This work is still in progress, and has not been submitted for presentation or publication at another meeting.