PAVEMENT PERFORMANCE DATA ANALYSIS FORUM
June 26, 2013

Sponsored by the TRB Data Analysis Working Group

9th International Conference on the Bearing Capacity of Roads, Railways and Airfields
Trondheim, Norway

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

PART 1

13.00-13.10	**CHAIRMAN'S WELCOME** Brian Ferne, TRL Ltd., Wokingham, UK
13.10-13.30	**INTRODUCTION TO THE DAWG** A Robert Raab, TRB, Washington, DC, USA
13.30-14.00	**DARWIN AND THE EVOLUTION OF FWD ANALYSIS** Christian Busch Grontmij A/S, Glostrup, Denmark
14.00-14.30	**FOUNDATION PERFORMANCE SPECIFICATION FOR PAVEMENT AND SLABTRACK DESIGN USING DIFFERENT STANDARDS** Bachar Hakim URS Infrastructure and Environment, Nottingham, UK

PART 2

15.00-15.30	**THE USE OF INFOPAVE FOR PAVEMENT RESEARCH ON THE BEARING CAPACITY OF ROADS** Timothy Martin Fugro Consultants, Inc., Austin, Texas, USA
15.30-16.00	**THE NEW SVAPPAVAARA LTPP TEST SECTIONS** Sigurdur Erlingsson Swedish National Road and Transport Research Institute, Linköping, Sweden University of Iceland, Reykjavik, Iceland
16.00-16.30	**ROUGHNESS WAVELENGTHS INDUCED BY FROST HEAVE** Carl A. Lenngren Lund University, Lund, Sweden

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-

2-

3-

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

DARWIN AND THE EVOLUTION OF FWD ANALYSIS

Christian Busch
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ABSTRACT
The presentation addresses two topics:

- The modeling of subgrade E-modulus as a function of octahedral shear and confinement stresses instead of the currently dominant deviator stress
- The determination of E-moduli of PCC slabs and derivation of Modulus of Rupture.

MEPDG/DARWIN design can apply the Witczak-MEPDG model for characterizing nonlinear behavior of subgrade materials. The constant "1" in the expression leads to very high values of k3, when analysis is based on the surface moduli and stresses at large distances from the centerline, and the resulting model results in subgrade moduli at the centerline that are obviously wrong. If the "1" term is omitted (corresponding roughly to the Witczak & Uzan model), backcalculation results are much more realistic. A combination analysis, where the latter model is used for the backcalculation, but constants for the Witczak-MEPDG model can be determined and reported from the near-center pavement measurements.

Witczak-MEPDG $$M_R = k_1 p_a \left(\frac{\theta}{p_a}\right)^{k_2} \left(\frac{\tau_{oct}}{p_a} + 1\right)^{k_3}$$

Witczak-Uzan $$M_R = k_1 p_a \left(\frac{\theta}{p_a}\right)^{k_2} \left(\frac{\sigma_d}{p_a}\right)^{k_3}$$

PCC slab E-moduli are determined from center and near-center deflection measurements and their differences. These deflections are often very small, and the inherent error margin can lead to derived PCC E-moduli that are unrealistically high (or low). A limiting function can be applied, scaling down unrealistic high values to normally encountered levels, at the same time compensating with an adjustment of the foundation support (k-value). Modulus of rupture is determined according to PCC standards equations.

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

1-The Θ-value should be calculated only from static stresses or contain a dynamic component ?

2-For the static loading use an earth pressure coefficient of 0.5 ?

3-Range of k2 values 0.5 to 1 ?

4-Acceptable to use different models in backcalculation and reporting ?

5-Should both unrealistically high and low PCC moduli be "normalized" ?

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

FOUNDATION PERFORMANCE SPECIFICATION FOR PAVEMENT AND SLABTRACK DESIGN USING DIFFERENT STANDARDS

Bachar Hakim
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ABSTRACT

Foundation performance specification incorporating end product testing was introduced to UK pavement design in 2006, to optimize pavement and materials requirements, to ensure construction quality and to improve future performance and sustainability. The specification permits the use of a wide range of foundation materials including recycled, marginal and secondary materials, provided the specified foundation surface deflections and performance levels are achieved during construction. The pavement bound upper layers are designed based on four foundation classes (1, 2, 3 and 4 with design stiffness of 50MPa, 100MPa, 200MPa and 400MPa). The Falling Weight Deflectometer (FWD) is used to measure the foundation surface stiffness during construction to ensure compliance.

Other European design standards such as the French and the German use a static stiffness value (Ev2), commonly measured by the Dynaplaque to describe the pavement and slabtrack foundation performance. The relationship between the two parameters is material and stress dependent. Hence, in principles mixing elements of the two different design approaches might lead to design inconsistency especially if the design is calibrated using local conditions, observations and testing.

This paper investigates the relationship between the UK FWD foundation surface stiffness and the French/German Ev2 to minimize the design risk, especially when a bespoke German system design such as slabtrack is based on Ev2 and requires to be constructed in the UK using local techniques.

PRESENTER'S QUESTIONS

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

1- Is there any relationship between the FWD foundation surface stiffness and Ev2 values for a range of materials?

2- Have you designed pavement or slabtrack based on foundation Ev2 value, in countries where FWD surface stiffness is specified as design compliance?

3- If calibration between the two approaches is not possible due to project timescale and budget, what are the performance specifications you suggest for question 2 to minimize the design risk.

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

THE USE OF INFOPAVE FOR PAVEMENT RESEARCH ON THE BEARING CAPACITY OF ROADS

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ABSTRACT

This presentation will inform the audience of the developments with the InfoPave software scheduled to be released January 2014. The data relating to the bearing capacity of roadways contained in the LTPP database will be presented with a summary of the volume of data for each data element. These will include the different sources of pavement temperature, layer thickness, materials testing, FWD data including time history files, computed parameters being developed (backcalculated layer moduli, dynamic moduli, joint load transfer) and traffic data with a brief on the newly developed PLUG software. Functionality of the different methods the InfoPave software will utilize to obtain datasets will be presented to the audience through the use of screen shots.

PRESENTER'S QUESTIONS

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

1- What additional features to the InfoPave software should be developed?

2- What additional data sets are desired on the part of the research community?

3- Is there any on-going research in the European community using the LTPP data?

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

THE NEW SVAPPAVAARA LTPP TEST SECTIONS

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ABSTRACT:
A new iron ore deposit was opened in 2012 approximately 100 km north of the Arctic Circle in Norrbotten County, Sweden. The ore material will be transported along the existing local road network by 90 tones vehicles from the iron ore about 150 km were it will be transferred to the existing rail network. The Norrbotten County is a sparsely populated area where the pavements are thin structures with low traffic volume. Due to this increased heavy traffic and large seasonal variations it will be necessary to strengthen the local road network whereas the performance during the spring thaw period is of major concern. As a part of the process to evaluate the performance of suitable pavement structure, four LTPP test structures have been selected and built in 2012. The structures are instrumented with road and climate sensors. The instrumentation consist of soil pressure cells, emu coils and asphalt strain gauges for measuring vertical stress and strain and tensile strain at the bottom of the bound layers respectively. The climate instrumentation consists of a frost rod, moisture rod and temperature sensors as well as a weather station.

The planned monitoring program will include; response measurements under well defined vehicle loading, FWD measurements, RST measurements and high precision profile measurements.

The expected outcome of the project can be summarized as:

- Enhanced understanding of pavement structural behaviour in cold climate under heavy loading
- Pavement performance modelling and predictions during spring thaw
- Better design guidelines for pavements in cold climate

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

1- Is there anything missing in our LTPP program?

2- How should we measure the structural bearing capacity during spring thaw?

3- What performance criteria should be applied to pavement in cold regions (during spring thaw)?

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

ROUGHNESS WAVELENGTHS INDUCED BY FROST HEAVE

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ABSTRACT

An airport located in central inland Sweden is susceptible to frost heave. The runway is particularly uneven at the end of each winter. The Swedish Road and Transportation Research Institute's Laser Profiler was brought to the site in the spring of 1997 in order to study this seasonal effect. Several longitudinal profiles were sampled along the entire length of the runway. The test was then repeated in the fall when the runway had settled. The profiles were then investigated to see if certain criteria were met, like the International Civil Aviation Organization straightedge guideline. Several different wavelength intervals of unevenness were also examined. It was found that the frost heave affected certain wavelength bands more than others. An aircraft take-off simulation program confirmed that the field is rough and difficult for pilots. Furthermore, it was possible to determine the location of the most troublesome spots and if they would adversely interfere with an expansion of the runway. Data from the profiler could also serve as help in preparing guidelines for safety rules related to roughness.

ITEMS TO DISCUSS

1. What are the implications for aircraft exposed to uneven frost heave?

2. In some countries the friction requirements are lower in the winter. Should the friction requirements be higher under such circumstances?

3. Obviously the frost heave roughness affects different landing gear and wheel configurations in different ways. Can the IRI be used for aircrafts or should the data be presented in wavelength intervals or something else?

4. Longitudinal profiles may be converted to ICAO straight-edge values. Is there a better way to do this?

PRESENTER'S QUESTIONS

1. Have similar studies been carried out elsewhere?

2. Is runway roughness an issue at all?

3. How is runway roughness mitigated?

PRESENTER'S STATEMENT: This work has been reported to the Swedish Fortifications Agency and is considered finished.