PAVEMENT PERFORMANCE DATA ANALYSIS FORUM

Sponsored by the TRB Data Analysis Working Group
Hans J. Ertman Larsen, Chairman
A. Robert Raab, TRB Senior Program Officer

January 8, 2005
Blue Room, Omni Shoreham Hotel, Washington, DC

0900-0930am Call to Order
Chairman's Welcome
Staff Report

0930-1000am **ESTIMATING THE BENEFITS OF PAVEMENT CONDITION MEASUREMENTS**
Antti Ruotoistenmäki[1], Tomi Seppälä[2] and Fridtjof Thomas[3]
[1] Inframan Ltd., Espoo, Finland
[2] Helsinki School of Economics, Helsinki, Finland
[3] VTI, Borlänge, Sweden

1000-1015am Presenters' Questions and General Discussion

1015-1030am Morning Break

1030-1100am **SENSITIVITY OF THE NEW PDG TO TRAFFIC DATA INPUT**
A. Thomas Papagiannakis[1] and Newton C. Jackson[2]
[1] Washington State University, Pullman, Washington, USA
[2] Nichols Consulting Engineers, Reno, Nevada, USA

1100-1115am Presenters' Questions and General Discussion

1115-1145am **COMPARISON OF PAVEMENT PERFORMANCE IN DEEP FREEZE REGIONS AND MULTIPLE FREEZE-THAW CLIMATES**
Jason Puccinelli and Newton C. Jackson
Nichols Consulting Engineers, Reno, Nevada, USA

1145-1200noon Presenter's Questions and General Discussion

1200-0130pm Mid-Day Break

0130-0200pm **AXLE LOAD SPECTRA STATISTICS AND THEIR RELATIONSHIP TO PAVEMENT PERFORMANCE**
Feng Hong and Jorge A Prozzi
The University of Texas, Austin, Texas, USA

0200-0215pm Presenter's Questions and General Discussion

0215-0245pm **PAVEMENT SURFACE TYPE AND VECTOR MAP EXTRACTION USING MODERN SPACEBORNE REMOTE SENSING AND SPATIAL TECHNOLOGIES**
Kanok Boriboonsomsin[1] and Waheed Uddin[2]
[1]Ohio Northern University, Ada, Ohio, USA
[2]The University of Mississippi, University, Mississippi, USA

0245-0300pm Presenter's Questions and General Discussion

0300-0330pm **FORECASTING PAVEMENT ROUGHNESS USING NEURAL NETWORKS**
Halil Ceylan
Iowa State University, Ames, Iowa, USA

0330-0345pm Presenters' Questions and General Discussion

0345-0400pm Afternoon Break

0400-0430pm **SPECULATION FOR CORRECTNESS OF MOISTURE DATA IN UNBOUND LAYERS IN LTPP**
Abraham Bae
The Pennsylvania State University, State College, Pennsylvania, USA

0430-0445pm Presenter's Questions and General Discussion

0445-0515pm **JOINT RESEALING: SEAL OR NOT TO SEAL - SUMMARY**
Murari M. Pradhan
Utah Department of Transportation, Salt Lake City, Utah, USA

0515-0530pm Presenter's Questions and General Discussion

0530-0600pm Steering Committee Session

0600pm Close of Meeting

A NOTE ABOUT THE DAWG

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:

Dr. A. Robert Raab, NA-443
Transportation Research Board
500 Fifth Street NW
Washington, DC 20001
Telephone: 202-334-2569
Fax: 202-334-3471
Email: rraab@nas.edu

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: _____
MAILING ADDRESS: _____
_____
_____
_____
TELEPHONE/FAX/EMAIL: _____

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

ESTIMATING THE BENEFITS OF PAVEMENT CONDITION MEASUREMENTS

Antti Ruotoistenmäki[1], Tomi Seppälä[2] and Fridtjof Thomas[3]

[1] Inframan Ltd., Länsituulenkuja 10, FIN-02100 Espoo, Finland
Tel: +358-9-8567 7716, Fax: +358-9-8567 7755, E-Mail: Antti@Inframan.fi

[2] Helsinki School of Economics, P.O.Box 1210, FIN-00110 Helsinki, Finland
Tel: +358-9-431 38 528, Fax: +358-9-431 38 535, E-Mail: Tomi.Seppala@hkkk.fi

[3] VTI, SE-781 27 Borlänge, Sweden
Tel: +46-243 736 75, Fax: +46-243 736 71, E-Mail: Fridtjof.Thomas@vti.se

ABSTRACT:

Many road administrations collect road surface measurements on a regular basis. However, road agencies have started to question rigid measurement programs and are looking for ways to cut expenditures for these programs without sacrificing the information measurements do provide. What is the value of measuring a road section for the second or third or fourteenth time? How much information is added to how we perceive the current serviceability of a road section when measured once more?

Road surface measurements such as IRI or rutting have typically a non-negligible measurement error. Furthermore, the models available for forecasting road condition from historical measurements produce forecasts with appreciable forecast uncertainty. Measuring a road section once more means then to update an uncertain forecast derived from historical measurements with an uncertain measurement value obtained by a current run of a measurement vehicle. This updating can precisely be described utilizing state-of-the-art statistical procedures. We present work that expresses the increase in information from additional measurements in information theoretic terms and relate these concepts to some of the real world decisions a road agency typically faces.

As an example, the direct interest of a road agency is often in the violation of certain threshold values rather than in the exact value of the relevant road surface criterion. Intuitively, measuring road sections known to be not even close to failure (exceeding applicable threshold values) adds very little information to the road agencies decisions process, whereas additional measurements on road sections that are known to be potential candidates for maintenance actions might have a direct impact on the road agencies maintenance program. Consequently, additional measurements taken in the latter situation are of much greater value to the road agency as compared to the ones taken in the former situation.

While it is possible to apply the models with very few road surface measurements per section, the existing LTPP data is an invaluable source for developing these models and demonstrate how they work in practice.

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

1- Given the measurements you do collect at present, how much emphasis would you place on the most recent measurement as opposed to the whole condition history? How is this valuation affected by the rate of deterioration and the measuring accuracy?
2- "We spend too much money on collecting measurements and too little on analyzing them!" – would you agree? Why?
3- Practice of road maintenance: Should measurements be collected for a well specified purpose and focusing on that purpose alone, or shall measurements be collected for "general purposes" because it is "good to know". How can quality assurance work in the latter case?

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

SENSITIVITY OF THE NEW PDG TO TRAFFIC DATA INPUT

A. Thomas Papagiannakis[1] and Newton C. Jackson[2]
[1]Washington State University, Pullman, WA 99164-2910
Tel: (509) 335-4547, Fax: (509) 335-7632, E-mail: pappa@wsu.edu
[2]Nichols Consulting Engineers, Chtd., Reno, NV 89509
Tel.: (360) 923-9359, Fax: (360) 923-9359, E-mail: newtoncj@aol.com

ABSTRACT:

The traffic load input to the new Pavement Design Guide (PDG) is in-terms of axle load distributions, (i.e., load spectra) by axle configuration, (i.e., single, tandem, triple and quad). Ideally, these distributions should be known over time intervals as short as the hour of the day. In practice, these axle load spectra are obtained by combining data from a variety of traffic monitoring equipment, such as weigh-in-motion (WIM), automated vehicle classification (AVC) and automated traffic recorder (ATR) systems, covering various lengths of time. This results in a variation in the estimated axle load spectra, which increases with decreasing data collection effort and in turn produces lower reliability in structural pavement design.

The study at hand uses a comprehensive methodology for relating traffic data collection effort to the variation in the predicted pavement life by distress mechanism. It utilizes continuous WIM data (i.e., 100% sample) from selected LTPP sites to simulate a number of shorter-term traffic data collection scenarios. The established range in the load spectra is input into the PDG to calculate the range in pavement life predictions by distress mechanism. The criterion for deciding on the optimum traffic data collection effort for each pavement design application is the desired design reliability. The ultimate goal of the study is to develop recommendations for the optimum traffic data collection effort required to support reliable pavement designs for particular PDG applications. The presentation offers some of the findings of this study. Work is part of FHWA-funded study DTFH61-02-R-00008

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

1- Are the pavement design reliability levels selected reasonable?
2- Are the traffic data collection scenarios selected realistic?
3- Is the clustering method used for obtaining Regional load and vehicle classification data an improvement over the subjective methods currently used?
4- How do we establish comparable PDG input requirements for input other than traffic?

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

COMPARISON OF PAVEMENT PERFORMANCE IN DEEP FREEZE REGIONS AND MULTIPLE FREEZE-THAW CLIMATES

Jason Puccinelli and Newton C. Jackson
Nichols Consulting Engineers, Chtd., Reno, NV 89509
Tel: (775) 329-4955, Fax: (775) 329-5098, E-mail: Jason@nce.reno.nv.us, newt@nce.reno.nv.us

ABSTRACT:

An analysis project is currently underway performing a comparison of the effects of multiple freeze-thaw cycles and deep frost penetration on pavement performance. While the independent contributions of both climatic conditions have been well documented, the focus of this study is on the tradeoff in performance between the two. Data collected as part of the Long-Term Pavement Performance (LTPP) program is being used to develop performance models for both flexible and rigid pavements. These models include distress accumulation, change in roughness, rut depth (flexible), and faulting (rigid). The presentation focuses on the composition of the dataset used in regression analysis as well as the methodologies utilized to extract and compute parameters within the dataset. Some of the factors deemed important to the analysis were not reported directly in the LTPP Data Release but were computed from available data. The methods employed in this process are also discussed. As this is an ongoing study, key findings established at the time of the DAWG forum will be summarized in the presentation.

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

1- This study involves comparing performance in different environmental zones. Initial analysis involved grouping the data based on freezing index and annual freeze thaw cycles and comparing performance trends of each group. The downfall of this approach is that the method used to group the data has a significant effect on the results. Additionally, the difference in performance was not apparent and was confounded by other variability. Another approach was utilized which eliminated the groupings and included freezing index and annual freeze thaw cycles as explanatory variables in the model development. This technique has resulted in a better indication of the environmental effects on performance. Have others worked with different groupings of the LTPP data in their analysis? If so, what was your experience?

2- One of the keys to developing a model that explains the data reasonably well is to determine the most important contributing factors and to include them in the model. There are many statistical processes that can be used for this process. What are the most accepted processes that have been used to identify these factors?

3- There are many means of identifying outliers in datasets. In some cases these outliers can actually be errors in the data that cannot be fully checked. What are the best means for identifying and distinguishing outliers from errors in the dataset?

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

AXLE LOAD SPECTRA STATISTICS AND THEIR RELATIONSHIP TO PAVEMENT PERFORMANCE

Feng Hong[1] and Jorge A. Prozzi[2]

[1] Graduate Research Assistant and Ph.D. Candidate, The University of Texas, Austin, TX 78712
Tel.: 512-232-6598, Fax: 512-475-8744, E-Mail: fenghong@mail.utexas.edu

[2] Assistant Professor, The University of Texas, Austin, Texas 78712-0278
Tel.: 512-232-3488, Fax: 512-475-8744, Email: prozzi@mail.utexas.edu

ABSTRACT:

The characterization of highway traffic by means of axle load spectra is one of the main improvements in the mechanistic-empirical pavement design procedure developed under NCHRP Project 1-37A: Development of the 2002 Guide for the Design of New and Rehabilitated Pavement Structures. This is a very significant and desirable improvement, however, the need for characterizing all traffic by means of a simple summary statistic, such as ESAL, will remain. To date, there has not been any comprehensive study on the statistical characteristics of axle load spectra in terms of their effect on pavement performance. This presentation is aimed at sharing research that is currently being performed to address this issue. The presentation will include the approach that was adopted, preliminary results and recommendations, and the problems left for further research.

Based on traffic data obtained from Weigh-in-Motion (WIM) station D512 in Texas, the statistical properties of axle load spectra are thoroughly examined in the current study. The research has focused on the following two major aspects:

1. Moment statistics are introduced for the first time to account for the axle load effect on pavement performance. Various moments of the load spectra distributions, both in discrete and continuous forms, are investigated. In addition, the sensitivity of pavement performance to different orders of moments is addressed.
2. Considering the limited WIM data availability in most states and countries, the effect of sample sizes on the results is also investigated and analyzed. Some preliminary relationships between sample size and axle load spectra precision have been established and will be presented.

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

1- Axle load for pavement design will rely heavily on WIM data. However, WIM stations are not widely installed, e.g. in Texas, there are only 20 WIM stations. How can axle load spectra be estimated at sites without WIM? What is a realistic WIM density that should be required to accommodate the axle load spectra data needs in the M-E Design Guide?

2- Since different moments adopted will lead to different pavement performance estimates, which moment order should be used and how should it be determined?

3- Considering that data collected for axle load spectra need a large storing space, what is the minimum time period required to provide effective axle load spectra for traffic forecast in the long run? Is a compound growth model better than a liner model?

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

PAVEMENT SURFACE TYPE AND VECTOR MAP EXTRACTION USING MODERN SPACEBORNE REMOTE SENSING AND SPATIAL TECHNOLOGIES

Kanok Boriboonsomsin[1] and Waheed Uddin[2]
[1] Visiting Assistant Professor, Ohio Northern University, Ada, OH 45810
Tel.: 419-772-2373, Fax: 419-772-2404, E-mail: k-boriboonsomsin@onu.edu
[2] Associate Professor, The University of Mississippi, University, MS 38677-1848
Tel.: 662-915-5363, Fax: 662-915-5523, E-mail: cvuddin@olemiss.edu

ABSTRACT:

The satellite image analysis methodology, developed in this research, uses the high-resolution 1-m multispectral commercial satellite imagery to automatically identify up to eight different surface types. These surface types include asphalt and concrete pavements, soils, buildings, grass, and wooded areas. The IKONOS pan-sharpened multispectral imagery acquired for Oxford, Mississippi, on March 27, 2000, was used in this study to discriminate different surface and landuse types. The results of the pilot study site are reasonably accurate for a highway intersection area in Oxford, which have been validated by the groundtruth map. The IMAGES methodology was validated using two more groundtruth samples. Using nonlinear integer programming optimization techniques the results were slightly improved. The methodologies can be adapted to estimate mileage of pavement areas by surface types, quantify adverse effects of transportation and industrial projects, assist in sustainable development and air pollution control and mitigation strategies, and avoid serious air quality degradation and associated societal costs. The differential societal cost related to traffic congestion, lost productivity, and public health is translated to $4 per vehicle in a small study area of Oxford with 14 % increase in commercial and paved areas estimated from vector maps. This differential societal cost is significantly higher than vehicle operating costs and other user costs, and it is not considered in traditional life cycle analysis of benefits and costs for pavement type selection and value engineering evaluation of pavement alternatives.

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

1- How many participants from highway agencies in the audience would like to see a pilot study by NCHRP and FHWA in an urban area using imagery-based surface classification and production of more accurate vector maps of highways and roads without expensive and time consuming ground surveys?
2- Will the FHWA and state highway agencies be interested in the implementation of societal costs associated with vehicular emissions and air pollution for life cycle analysis of benefits and costs when a congestion mitigation strategy is implemented in urban areas or value engineering evaluation is considered for highway alternatives?
3- Any comment or interest from user agencies in the use of other spaceborne or airborne remote sensing technologies, such as hyperspectral imageries, to estimate age of pavements?

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

FORECASTING PAVEMENT ROUGHNESS USING NEURAL NETWORKS

Halil Ceylan, Assistant Professor of Civil Engineering
482B Town Engineering Building
Iowa State University
Ames, IA 50011-3232
Telephone: (515) 294-8051, Fax: (515) 294-8216, E-mail: hceylan@iastate.edu

ABSTRACT:

This paper focuses on analyzing the Long Term Pavement Performance (LTPP) database to predict the international roughness index (IRI) for different pavement types using artificial neural networks (ANNs). Large number of input parameters such as pavement layer data, initial IRI, pavement age, faulting, rutting, traffic data, and pavement distresses (transverse cracking, fatigue cracking, etc.) for different severity levels (low, medium, and high) were used to predict the IRI values for rigid (jointed Portland cement concrete (JPCC)) and flexible (asphalt concrete) pavements. Substantial amount of pavement performance data queried from large number of pavement sections that belongs to some 40 states were used in developing the ANN pavement roughness prediction models. The developed ANN models were able to successfully predict the measured IRI values with coefficient of multiple determination (R^2) values of 0.8 and higher for training and testing data sets. Research findings showed that the selection criteria for the testing sets are very important when evaluating the performance of the ANN models. It was demonstrated that ANNs are capable of mapping the complex, nonlinear relationship between the large number of pavement input parameters and the pavement roughness indicator of the IRI value. Such models can be used to predict and forecast the pavement roughness index for pavement management system applications. LTPP database provides an excellent opportunity to develop ANN-based models that can be used for analyzing large number of pavement sections. Similar concepts can be used to predict pavement distresses (e.g., transverse cracking in rigid pavements) with available pavement input parameters. In addition to the prediction of the rigid pavement roughness using neural networks, a summary of how computational intelligence tools can be used for analyzing large databases, such as the LTPP database, for knowledge extraction will be presented.

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

1- Which input parameters should be considered in predicting the pavement roughness? Which ones are readily available for State DOTs and which ones they desire to use?
2- How can the predicted pavement roughness values can be used by pavement management engineers?
3- Can the predicted values be taken into account in the initial design stage?

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

SPECULATION FOR CORRECTNESS OF MOISTURE DATA IN UNBOUND LAYERS IN LTPP

Abraham Bae
The Pennsylvania State University, State College, PA, 16801
Tel.: (814) 883-0240, E-mail: sub116@psu.edu

ABSTRACT:

Moisture in pavement unbound layers affects pavement performance related to frost heaving, swelling, and unbound layer strength. Hence, correct estimation for the moisture in unbound layers is required for evaluating pavement performance. However, it was detected that there exist unexpected moisture values in the current LTPP data for moisture. Based on volumetric and gravimetric moisture data in the LTPP database, the degree of saturation value was calculated. The results showed that degree of saturation values for many LTPP sites exceed 100 percent. Three possible causes for these unrealistic moisture values were postulated. The first possible cause is soil dry density. In LTPP, soil dry density is used for obtaining gravimetric water contents from the volumetric water contents which were collected from Time Domain Reflectometer (TDR). Therefore, the soil dry density has some potential for producing large degree of saturation values. The second possibility is specific gravity. Even though the range of specific gravity for soil is small, it can influence the large saturation values. The third potential cause is exactness of TDR measurement itself. Since there are some variables, such as salt concentration, that affect moisture calculations from TDR other than the variables considered in LTPP, the variability resulting from those variables cannot be ignored. In this research, the dominant cause for the unexpected moisture value will be speculated. In addition, the results will contribute to improve the LTPP database and give database users good information when dealing with unbound moisture data.

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

1- Are there other explanations for the large degree of saturation values?
2- Is the data still meaningful for use in analysis?
3- If the data is used, what corrections could be made?
4- Should degree of saturation be limited to 100 percent, or should the full range be used?

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

JOINT RESEALING: SEAL OR NOT TO SEAL - SUMMARY

Murari M. Pradhan
Utah Department of Transportation, 4501 South 2700 West, Salt Lake City, UT 84114-8290
Tel.: (801) 965 4521, Fax: (801) 965-4363, E-mail: mpradhan@utah.gov

ABSTRACT:

The justification for concrete pavement joint resealing is in question. At present concrete pavement joint reseals are planned every 10 years. The estimated cost is $3,000,000 to $5,000,000. The performance of sealed concrete pavement joints was evaluated from seven years of SPS and GPS data gathered at LTPP sites in Utah and a literature review. The Datapave3 software was used in the evaluation. Following are the findings:

- The overall performance of transverse joint seals at all SPS-4 sites in Utah deteriorated at a higher rate, and all failed by 62 months. Failure is declared when more than 50% of the joint length has failed. Failure modes are adhesion, cohesion, and distortion. The assumed consequences of joint resealing are faulting and spalling, both of which did not change between the unsealed and sealed joints.
- At all three Utah LTPP SPS sites, Tremonton site, Salt Lake City, and Heber City no statistical differences in estimated service life were observed among the 3-mm-wide Soff-Cut-sawed (not sealed) and conventionally sawed transverse joints sealed with Dow 890-SL self-leveling silicone. Moreover, the performance (IRI, faulting, and spalling) of the four GPA sites did not change over time. These sites were not resealed since construction.
- There are no substantial cost effectiveness and/or performance evaluation of the joint resealing conducted. However, a conclusion can be drawn from the performance of the pavement before the institute of time bound periodic resealing of the joints. High load transfer efficiency of the pavements without joint resealing indicated satisfactory performance of the joints.
- Studies of the different joint sealing materials used in Utah, PVC-coaltar, silicon, and rubberized asphalt showed that the hot pour (full depth of T/3) rubberized retained its elastic properties for longer time period.
- In Indiana study the survey of practice revealed that most agencies joint/crack sealing policies are based on long standing policy rather than research. The statistical analyses of in service pavements indicated that there are no significant differences between sealed and unsealed sections over the last two years.

The American Concrete Pavement Association estimates the service life for Joint resealing restoration techniques as 5 – 15 years. New York estimates the service lives for joint resealing alone as 2 years. Utah estimates the service lives for joint resealing when in conjunction with partial-depth spall repair as 10 years.

Wisconsin research concluded that joint sealing is not cost-effective for PCC pavements, and recommends that PCC pavement contraction joints should be left unsealed and sawed as narrow as possible. UDOT has implemented the recommendation with single cut narrow joints with additional full cut depth sealing with hot applied sealant.

In summary, narrow cut full depth hot pour need not be resealed. There is a trade off in joint resealing as the joint opening get larger by about 1/8" each time it is resealed. Therefore, joint resealing for each highway section should be evaluated based on pavement joint condition, original material used, and proposed treatment case by case.

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

1- Joint resealing results in wider joints. Does this have any effect on the long term performance of the PCCP pavement?
2- The hot pour on 1/3 times the thickness joint cut is the recommended joint sealing in UDOT which need not be resealed. Do anyone have experience on it?
3- What are the load transfer efficiencies on the resealed joints? Does it remain same or reduce after joint sealing?

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