TSB NEWSLETTER

TECHNICAL STANDARDS BRANCH VOLUME 1, ISSUE 3, April 2006

Editor's Remarks

This Newsletter contains a summary of the Transportation Research Board 85th Annual Meeting and the International Municipal Signal Association Conference.

The Newsletter also contains technical articles on "How Long Do Alberta Pavement Treatments Last?" and the "Effect of Wet Film Thickness on Traffic Paint Performance."

Similarly, the article on technical training summarizes the technical training courses delivered in the 2005-06 fiscal year and also provides an outline of the technical training that will be held in the next 3 months.

If you have comments and suggestions, please forward them.

Allan Kwan
Editor-in-Chief

Name the Highway Quiz

Please forward the correct highway number and location to one of the following:

If you would like to forward an article or have something to share please contact:

Nur Versi (780) 415 1005
Ron Stoski (780) 415 1020
Peter Ing (780) 415 1009
Roger Skirrow (780) 427 5578
or Allan Kwan (780) 427 8990

IN THIS ISSUE

Transportation Research Board
85th Annual Meeting
January 21-26, 2006

Roy Jurgens
Highway Asset Management

I had the opportunity to attend the 85th Annual Meeting of the Transportation Research Board (TRB) (http://www.trb.org/meeting/) in Washington, DC.

TRB's mission is to promote innovation and progress in transportation through research. TRB is a division of the US National Research Council, which serves as an independent advisor to the federal government and others on scientific and technical questions of significance. The National Research Council is jointly administered by the National Academy of Sciences, The National Academy of Engineering and the Institute of Medicine (the National Academies).

The TRB fulfills its mission through the work of 200 standing technical committees. (http://www.trb.org/directory/diva.asp).

Of interest to Alberta Infrastructure and Transportation (AIT) are the committees and task forces on Strategic Management; Performance Measurement; Transportation Asset Management; Access Management; Design-Build; Statewide Transportation Data and Information Systems; Spatial Data and Information Science; Transportation Programming, Planning and Systems Evaluation; Transportation Network Modeling; Environmental Analysis in Transportation; Roadway Pavement Preservation; Low-Volume Roads; Pavement Management Systems; Pavement Monitoring, Pavement Maintenance; Sealants and Fillers for Joints and Cracks; Evaluation and Data Storage; Full-Scale and Accelerated Pavement Testing; Pavement Rehabilitation; Frost Action; Surface Transportation Weather; Intelligent Transportation Systems; Freeway Operations; Traffic Signal Systems; Highway Capacity and Quality of Service; Traffic Control Devices; Highway/Rail Grade Crossings; Signing and Marking Materials; Winter Maintenance; Transportation Safety Management; Safety Data, Analysis and Evaluation; and many more. It should be noted that, although becoming a member of a standing committee can be difficult, it is easy to be put on a "friends of" list and receive all emails with respect to ongoing activities on that committee.

Also of interest is the TRB National Cooperative Research Program (NCHRP). The reports produced by NCHRP are very relevant and pertinent to our work. (http://www4.trb.org/trb/crp.nsf)

This year's meeting marked the first time that over 10,000 delegates registered. I would like to highlight a few key events and what I found valuable.

Saturday I attended a dog show (actually its DAWG – Data Analysis Working Group – which is all about pavements). Items of interest were:

- Modeling of Geosynthetic Treatment for Longitudinal Cracking in Pavement over Expansive Subgrade
- Stereovision for Pavement Condition Survey
- Evaluation of Relationships between Deflection-Based Indices and Flexible Pavement Performance
- Field Validation of WIM Smoothness Index

Sunday I attended the Pavement Management Systems International Conferences Subcommittee meeting. In 2005, this subcommittee awarded the 7th International Conference on Managing Pavement Assets (ICMPA) to AIT and the University of Calgary. It will be held in Calgary in June, 2008. Lynne Cowe Falls and I reported on the progress. The meeting went very well. Anyone interested in helping with ICMPA, please contact Chuck McMillan or Wei He (Technical Conference co-chairs). The website is at (http://www.icmpa2008.com).

There was extensive discussion at the Transportation Asset Management Committee meeting about holding the next National Transportation Asset Management conference jointly with the upcoming 7th ICMPA. Our deputy minister had put together a letter offering support for this idea. However, the committee decided to go with a separate asset management conference for the summer or fall of 2007, as they hold their national conference every two years. While the result was not quite as favourable as I had hoped it would be, the committee did offer complete support for the 7th conference and will participate in some fashion.

Monday afternoon I attended the Performance Measurement committee meeting.

- Reference was made to the committee website (http://www.trb-performancemeasurement.org/). The committee is looking for participants, so do not hesitate to get involved. This website keeps me up to date and I find it very informative.
- The AASHTO Standing Committee on Quality (subcommittee on performance measures) hired Cambridge Systematics for a project on "Project Delivery – How do DOT's Compare?" Their report is expected by the end of June.

- Florida DOT gave a presentation on congestion performance measures (reliability, travel time, utilization).

Session 357 – Asset Management: International Perspectives – was held on Monday afternoon. That session had a presentation focusing on the International Scanning Tour that visited AIT on April 8, 2005. The paper was entitled "International Scan on Transportation Asset Management: Overview" and was given by Michael Meyer, who was on the tour and produced the final report. Mike was appointed chair of the TRB Executive Committee at the conference president's luncheon on Wednesday. This is the top non-staff position at TRB. Wow – that's quite an achievement!

The International Scanning Tour report is on the web http://international.fhwa.dot.gov/assetmanagement/2005tam.pdf
The part I like is on page 37 …. "One of AIT's goals is to become the center of excellence for Transportation in North America. In the asset management area, it appears that Alberta is well positioned to become exactly that."

Tuesday morning I attended the Transportation Data and Information Systems (ABJ20) committee meeting. A major initiative that was discussed was data needs for the highway safety manual that is being developed.

Tuesday afternoon I attended the Transportation Asset Management committee meeting, of which I am a member. (Fortunately I have also recently been appointed to ABJ20 so I will be busy in my spare time.) Items of interest from this meeting:

- Dave Geiger (Head of Office Management, Federal Highway Administration – FHWA) announced:
  -there will be a benefit/cost section on the FHWA website soon.
  - 31 states asked for the "independent evaluation of pavement preservation" practices that FHWA is involved with.
- Kirk Steudle (Chair of the AASHTO Task Force on Asset Management) reported that: - eleven states signed up for NT and PT programs that Cambridge Systematics developed for FHWA/AASHTO.
  - an interstate asset management program and the impact of remedial treatments on RSL (remaining service life) are being considered as projects.

Wednesday morning I sat in on Forecasting and Performance of Winter Maintenance Operations, at which Lynne Cowe Falls presented a paper that she, Jack Chan and I co-authored. The paper was on "Performance Measures for Snow and Ice Control in the Province of Alberta, Canada."

I close by mentioning other sessions of interest:

- 245 – Tools for States and Locals: Performance Measures, Asset Management, and Data Management Tools to Improve Communication and Decision Making (poster session)
- 289 – Pavement Preservation: Getting Started
- 343 – Pavement Preservation: Construction and Performance Standards
- 383 – Developments in Pavement Management Systems
- 402 – Crumb Rubber in Hot-Mix Asphalt
- 405 – Good Practices: Incorporating Safety Improvements into Resurfacing and Restoration
- 410 – Surface Transportation Weather: Impacts on Winter Driving and Safety
- 419 – Pavement Surface Friction and Texture Characteristics
- 426 – National and International Experience in Developing Performance Measures
- 469 – Traffic Data and Pavement Design
- 488 – Improving Cost Estimates in Project Development Process
- 489 – Low-Volume Road Issues
- 500 – Innovative Applications in Pavement Management Systems
- 516 – Travel Time Variability, Congestion, and Performance Measures: Where is the Traffic Jam?
- 523 – Pavement Monitoring and Evaluation
- 577 – Rumble Strip Research
- 602 – Forecasting and Performance of Winter Maintenance Operations
- 606 – Pavement Surface Roughness and Profile Characteristics
- 625 – Performance Measures for Operations
- 690 – Maintenance Quality Measures and Assessments
- 710 – Wall Street Speaks: Transportation Asset Management and Ratings
- 724 – Application of Falling Weight Deflectometer Testing in Pavement Evaluation
- 725 – Culvert Testing and Performance
- 731 – Asset Management as a Teenager: Out in the World, But Still Learning
- 735 – Government Accountability Office Studies of Application of Economic Analysis in Transportation
- 804 – Impact of Seasons and Climatic Change on Transportation Systems
- 811 – Climatic and Seasonal Effects on Low-Volume Roads and Pavements
- 814 – Travel Behavior Trends: What the Future Holds
- 815 – User Benefits / Evaluation and Equity Analysis

For additional information please contact
Roy Jurgens by phone at 780 415 0774 or
By email at roy.jurgens@gov.ab.ca

IMSA Conference

Beata Bielkiewicz
Highway Operations

Last week I attended an IMSA conference in Canmore.

For those who are not familiar with the organization, I would like to briefly explain what the IMSA stands for and what is the organization main function.

The IMSA stands for the International Municipal Signal Association and it is the leading international organization for information, education, and certification in the area of traffic controls, roadway lighting, work zone traffic control, emergency medical services and other related systems. The members of the IMSA are engineers, technicians and people with an interest in exchanging ideas on the various fields that the IMSA serves in. The organization is recognized across the United States and Canada for increasing knowledge on the use of systems and equipment in these different fields.

The IMSA conference was organized in the beautiful scenery of Canmore. Two sets of sessions were held during the two days of the conference. Each session was composed of several presentations on topics related to traffic operations and the application of traffic control systems and devices.

There has been a significant progress in the area of roadway lighting, traffic signal control and ITS applications, which was marked by the development of various standards and guidelines in these different areas.

Some of these new ideas and concepts were presented at the conference. In this article, I will highlight a few conference topics that may be of interest to all of you.

One of the presentations provided insight into the newly published TAC Guide for the Design of Roadway Lighting. The publication has been the result of many research studies and reviews of current practices across North America and it covers a broad spectrum of topics ranging from basic lighting concepts, planning and design of roadway lighting to the use of system components.

The Guide, which is the first TAC updated publication on this subject since 1986, incorporates recommendations and guidelines from a number of research documents (mainly IESNA, the Illuminating Engineering Society of North America) as well as guidelines and standards used across Canada.

New and revised issues and concepts covered by the Guide include: definition and management of obtrusive lighting, effective application of lighting design methods, the use of revised illumination levels and recommended computer applications for roadway lighting design.

The TAC Guide for the Design of Roadway Lighting was published last year and it is now available from the TAC internet bookstore.

Another interesting conference topic worth exploring is the signal control and related applications. New standards and guidelines were developed for the use of Advance Warning Flashers (AWF), Traffic Signals, Pedestrian Countdown Devices and related systems. Traffic Signal system was enhanced by introducing LED signal displays (LED stands for Light Emitting Diodes).

There were several interesting presentations in this subject area: one of them was on new ITE standards for LED signal displays, two others on the application of Advance Warning Flashers and Pedestrian Countdown Devices and yet another one on the Traffic Signal Warrant Matrix Evaluation Method.

What might be of interest you are the two new TAC Guidelines for the application of AWF and Traffic Signal Warrant Matrix Method.

Everyone as a motorist encountered the AWF devices when approaching a set of traffic signals. But have you ever wondered if the devices are really effective in reducing the probability of a collision?

The Guide provides detailed recommendations for the AWF device application and discusses various operational problems associated with the use of the device. The overall result is a very useful guide, which will assist designers and operational groups in planning, designing and looking after the device operation.

The presentation on the ITE standards for LED signal displays shed some light on what to expect when new standards for signal displays come into effect and how to deal with the operation and maintenance of the existing incandescent and new LED signal displays.

The presentation on the new Traffic Signal Warrant Matrix Evaluation Method provided an overview of the new TAC method for assessing the need for traffic signals. The method, which replaces the old MUTCDC (Manual of Traffic Control Devices) method, takes into consideration many operational and geometric factors

found in the intersection environment. The result is a comprehensive and very balanced approach to the issue of signalization that will ensure traffic signals are installed at locations which really need them.

To summarize, there has been a progress in a number of traffic operations areas, which was good to observe and reflect on during the conference days.

We will all benefit from new guidelines and standards not only as practitioners but also as road users.

As for the conference itself, it played an important role in bringing the ideas together, facilitating the exchange of information and helped the professionals to connect and talk about important ideas and issues.

And Canmore was beautiful and fresh as always. The Canmore scenery could not be more suitable for a refreshing walk after the busy conference sessions. Good place to reflect and perhaps plan another trip to another place where the transportation crowd can meet.

For additional information contact:
beata.bielkiewicz@gov.ab.ca

How Long Do Alberta Pavement Treatments Last

Wei He, Dale Kossowan and Moh Ashraf
Surface Engineering and Aggregates

Alberta has approximately 31,000 kilometres of highways under the management of the Provincial Government, 86% of which, about 27,000 km, are paved with structural layers. The pavement structures are designed to provide the traveling public with a safe and smooth surface and at the same time to provide protection to the subgrade so that the long term bearing capacity is maintained.

Once constructed, pavement structures are subjected to the forces of traffic load and weather actions continuously. Over time, cracks and deformations start to develop on the wearing surface causing rougher rides and, in some cases, safety concerns. Further deterioration of these conditions cause damage to the structural integrity of the pavement and eventually lead to the failure of the structure, at which point pavement reconstruction is inevitable.

Pavement structures in our province are typically constructed in stages, which include a first stage paving that is designed based on expected traffic and soil conditions, followed by a second stage paving designed based on in-situ deflection tests and 20-year structural needs. Pavement maintenance and rehabilitation play a major role in preserving the value of the pavement asset. These treatments are used to inhibit or even reverse deterioration. In the case of a weakened pavement structure, overlays are used to improve pavement load bearing capacity and restore riding quality.

Our department maintains an as-built pavement structure database in the HPMA (a.k.a. RoMaRa) Pavement Management System, which dates as far back as the 1940s. The database provides a wealth of information for both the structural layers as they were first constructed and the additional layers from subsequent overlays. A comparison between the dates of the initial construction and of the rehabilitation treatments provides insights to the expected lifespan of the pavement construction and rehabilitation treatments. Table 1 is a summary of service life distribution of various treatments from our historical as-built records:

Construction / Treatment	Mean Lifespan (Years)	Standard Deviation (Years)
Base & 1st Stage Paving	2.9*	1.5
2nd Stage Asphalt Concrete (AC) Paving	18.0	8.0
Base & Non-Staged AC Paving	15.0	6.9
Full Depth AC Paving	14.2	7.1
Cold Mill with Inlay/Overlay	8.8-12.5	1.9-4.5
Thin AC Overlay**	9.0-12.9	4.8-6.7
Thick AC Overlay***	14.2-17.6	5.4-6.8

Notes: *The average lifespan of Base & 1st Stage Paving represents the lag time for locations where the 2nd Stage AC Paving was completed. More than 1,400 km of highways waiting for the 2nd Stage AC Paving.
**Thin AC overlays include those less than 60 mm thickness.
***Thick AC overlays are greater than 60 mm thickness.

Table 1

The department also had constructed projects under the categories of Base and PCC Paving, Cold-In-Place Recycling and Overlay, Hot-In-Place Recycling and Micro Surfacing, etc. They are not included here due to insufficient data to make a statistical case.

From the data summarized in Table 1 a number of observations can be made.

First, the benefit of staged paving can be presented by comparing the combined 1st and 2nd staged paving verses Base & Non-Staged AC Paving. On average we can expect to get an additional six [(3+18)-15] years of pavement service life with the staged paving designs.

Secondly, the paving history in our province shows that the Full Depth AC Paving construction does not perform as well as the conventional pavement structure with granular base courses.

Thirdly, rehabilitation treatments with cold milling perform similarly with Thin AC Overlays in terms of expected service life. The larger variation with the AC Overlays, as presented by the standard deviation, comes from the relatively large number of cases.

Fourthly, on average, structure (thick) overlays can be expected to outlast non-structural (thin) overlays by 5 years. The reason could be that thicker overlays address both strength-related and function-related issues, and thinner overlays are mainly used to treat functional issues, such as restoring the riding quality.

Last but not least, the lifespan and the observations in this article are presented "as is." Many short-life cases could have been triggered by non-pavement reasons. In-depth investigations would involve life-cycle-cost analyses that take into account traffic volumes, costs of treatments and performance levels associated with the treatments. The overall economic trends of the province throughout the years should also have played a part in the construction history of our paved network.

For additional information please contact:

Wei He
wei.he@gov.ab.ca

or Moh Ashraf
moh.asraf@gov.ab.ca

or Dale Kossowan
dale.kossowan@gov.ab.ca

Performance of Wet Film Thickness (WFT) of Waterborne Traffic Paint

Joe Filice
Geotechnical and Materials

Alberta Infrastructure and Transportation (AIT) places over 2,000,000 litres of traffic paint on the province's highway system. AIT has traditionally used alkyd traffic paints (solvent is the carrier) on most highways, however with increased environmental pressures to reduce volatile organic compounds (VOC's) limits in traffic markings, waterborne traffic paints (water is the carrier) usage has been increasing yearly.

All traffic paint contains pigments, volatile vehicles (solvent or water), and non-volatile vehicles (resins-drying oils that cure by oxidation after evaporation of the solvent). Today's alkyd paints contain 3 times the VOCs of available waterborne paints. Waterborne paint is a product that will be able to achieve future environmental targets.

Traffic Paint Durability

The durability of traffic paint is dependent on the materials used in the formulation of the paint and the rate at which the paint dries and hardens over time. Highway traffic paint rate of drying is dependent on the application thickness. Highway paint durability is dependent on the film thickness and resistance to mechanical and chemical wear. Typically the thinner the paint the quicker it fails; failure modes for pavement markings include poor adhesion, chipping, abrasion, poor bead retention and discoloration.

Wet Film Thickness Trials

AIT applied various waterborne wet films thicknesses (WFT) to the departments test deck in the 2004 season. Three WFTs (12, 13 & 15mils) were applied in May 2004 on an asphalt concrete surface of the AIT line paint test deck (Highway 16 east, near Elk Island Park entrance). The test deck compares the relative performance and service life of traffic marking materials under existing road conditions. The transverse lines accelerate the wear characteristics and bead retention of fluid traffic markings.

The three WFTs were evaluated monthly for a total of 6 months (July to December). The evaluation consisted of general appearance, luminous directional reflectance (glass bead loss) and retro-reflective readings taken on each test line using the Mirolux 30 Field Retro-reflectometer.

Road Service Test Evaluation

A total of 6 (3 white & 3 yellow) waterborne paint stripes (100mm wide) were applied to a bituminous surface on the department's test deck by Amec Earth and Environmental on May 18, 2004. Transverse paint lines of 12, 13 and 15mil WFTs were put down side-by-side on the test deck. Compared with the normal longitudinal traffic paint lines, the transverse lines get crossed by vehicles much more frequently, which provide for accelerated wearing date.

The test stripes were evaluated by a four member panel to determine general appearance and luminous directional reflectance (bead loss) of each test strip. The evaluation was conducted as per ASTM D713, Road Service Test Evaluation of Fluid Pavement Marking Materials.

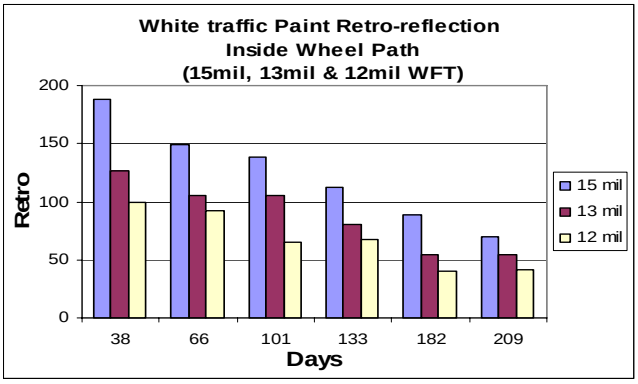
Benefits of Thicker Paint Lines

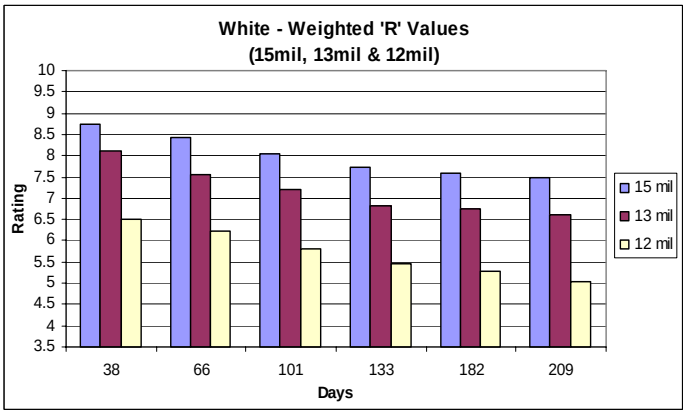
Drivers encounter difficulties in nighttime guidance, especially during conditions of rain and fog. Increasing pavement marking thickness will increase retro-reflectivity thus increasing pavement marking visibility and preview distances. The thicker lines were found to hold a greater number of beads and provide higher retro-reflective values during the evaluation period.

Evaluation Process

The following process was used to evaluate the various WFTs for both white and yellow paint lines:

1. Retro-reflective readings were taken on each line using the Mirolux 30 instrument. Two readings were taken along the wheel path of each line and averaged.
2. The evaluations were conducted for general appearance and bead loss of each line based on the ASTM D713 Road Service Test.
3. The results were documented and plotted for the various WFTs. The following charts were generated as a result of this field study:





Retro-reflectivity

Retro-reflectivity is the scientific term that describes the ability of a surface to return light back to its source.

Nighttime visibility is greatly enhanced by the application of glass beads to the paint surface. The glass beads that protrude above the surface of the traffic markings reflect light from headlight beams back to the driver. The returned light is referred to as retro-reflectivity. The retention of retro-reflectivity is a key determinant of traffic marking performance and ability to hold glass beads.

Millicandelas is the term used for measuring the light radiating capacity of the of the light source (head lights), in candelas per square metre (mcd/Lux/m^2).

Conclusion

The 15mil WFT traffic paint lines exhibited better durability than the thinner lines (13 & 12mil). However, when you closely examine the weighted "R" values for both the white and yellow 13mil WFT paint lines, it is evident that the 13mil WFT "R" rating is acceptable. The thinner paint lines (13 & 12mil) exhibit a more rapid bead loss than the thicker 15mil WFT white and yellow paint lines. Initial retro-reflectivity readings at 38 days exhibited considerable higher readings for the 15mil WFT lines. The 15mil WFT paint lines provided better bead retention throughout the study period of 209 days.

Waterborne traffic paint lines will provide acceptable performance at thinner (14 or 13mil) WFT applications. However, on highways with higher traffic volumes (ex: Hwy 2) the 15mil WFT application should be used to optimize paint line performance.

A thinner paint application rate will allow rapid loss of the large and intermediate sized glass beads due to less of the glass bead being embedded into the paint film.

Photographs taken after one year of wear:

White paint, line #9 – 15mil, line #10 – 13mil and line #11 – 12mil
The 12mil line (#11) is almost completely worn. The 13mil line (#10) is performing well.

Yellow paint, line #9 – 15mil, line #10 – 12mil and line #11 – 13mil
The 12mil line (#10) is almost transparent. The 13mil line (#11) is performing better.

Recommendations

Selection of the most effective wet film thickness application for pavement marking systems is dependent on three main factors; retro-reflectivity (bead loss), durability (appearance) and cost (not taken into consideration in this study).

The recommended wet film thickness application rate to optimize durability and retro-reflectivity performance is 15mil's WFT, as proven in this study. The 15mil WFT traffic paint exhibited higher retro-reflectivity throughout the 209 day evaluation period.

The following table shows the number of days the various wet film thicknesses retro-reflectivity values stayed above the 100 mcd/m^2/lux for white and yellow paint:

Retro-reflectivity above 100 mcd/m^2/lux

	White			Yellow		
	15mil	13mil	12mil	15mil	13mil	12mil
Days	160	115	38	90	45	<38

The recommended application rates to optimize durability and retro-reflectivity performance are:

Minimum Application Rate: WFT – ℓ/km
15mil - 38 ℓ/km, high volume roads
13mil to 14mil 33 ℓ/km to 35.6 ℓ/km, low volume roads

Note: Traffic volume on the highway 16 test deck is approximately 11,000 AADT.

The completed WFT's study can be found at http://www.infratrans.gov.ab.ca/INFTRA_Content/docType241/Production/TM0405.pdf

For additional information please contact
Joe Filice Phone 780 415 1022
Email joe.filice@gov.ab.ca

Technical Training

Ron Stoski
Geotechnical and Materials

Technical training and upgrading has been identified as an important way to improve job skills of new and old employees and to update employees.

The following courses and seminars were arranged for and/or delivered by TSB during the 2005/06 fiscal year:

Sixteen employees completed the Pavement Materials and Evaluation (PPS1), Pavement Management (PPS2), and Pavement Treatment and Preservation Designs (PPS3) Modules.

Eighteen people attended the BIM Class B Bridge Inspection in September and the follow up BIM Field Training Program in October.

Seventy people participated in the Bio-engineering and Bio-technical Stream Bank and Stabilization Techniques Workshop in Hinton in September.

Thirty participants attended the Traffic Noise Seminar in Edmonton.

More than 130 people attended the one day BIM Inspection Seminars which were held in Edmonton, Red Deer, Airdrie, Barrhead, Peace River and Lethbridge.

Twenty-one people attended the February Pavement Preservation Course in Peace River and 28 attended the March Pavement Preservation Course in Airdrie.

Similarly, presentations to update maintenance contractors and department employees on the Automatic Vehicle Location System (123 attendees) and Road Weather Information System (170 people) were well received in Peace River, Grande Prairie, Edson, Edmonton, Athabasca, Red Deer, and Calgary.

TSB Training Courses
Calendar of Events for April to June - 2006

TSB will be delivering and/or arranging for delivery of the following technical training courses:

Pavement Preservation**:** April 10-12

Highway Design Guideline Overview - May 10-11

BIM Class B Inspection Course April 24-28
BIM Class A Inspection Course June 5-9

The technical training course calendar is updated every two months and posted under Technical Resources, Technology Transfer, Courses Seminars and Events: http://www.infratrans.gov.ab.ca/INFTRA_Content/docType256/Production/courses.pdf

Center for Transportation Engineering and Planning (CTEP) Courses

Ron Stoski
Geotechnical and Materials

CTEP has delivered and/or made arrangements for the delivery of the following courses:

Bridge Construction Inspection for Project Managers
Edmonton March 6 - 8

Urban Geometric Design for Canadian Roads
Joint Venture by TAC/CTEP –
Edmonton March 13 - 15
Calgary March 15 - 17

Grading, Base Course & Paving for Project Managers
Calgary April 5 - 7

The C-TEP website is at:
http://www.eng.ucalgary.ca/Civil/C-TEP/courses.htm

For additional information and/or suggestions and/or comments on training needs and events please contact:

Peter Ing Phone: 780 415 1009
email: peter.ing@gov.ab.ca

or Ron Stoski Phone 780 415 1020
email: ron.stoski@gov.ab.ca