Issue 4

CPATT NEWS

Message from the Director

Happy New Year to all, wishing everyone a wonderful 2012!

We are very pleased to be sending this, our fourth CPATT newsletter. We try our best to highlight some of the key on-going initiatives and keep you up-to-date on our activities. We are getting geared up to attend TRB and if you are coming we have a Waterloo Engineering/Transportation Group Hospitality Suite. Please join us at the Washington Marriott, Maryland C on Tuesday January 14th at 6pm

If you would like to learn more about anything we have presented in this newsletter, please do not hesitate to contact either Laura Bland at lbland@uwaterloo.ca or Susan Tighe at sltighe@uwaterloo.ca. We look forward to hearing from you!

Sincerely,

Susan L. Tighe, PhD., PEng.

Contents

Feature CPATT Faculty Member
Jean Andrey, PhD.
Professor

Education

Dr. Andrey is a Professor in the Department of Geography and Environmental Management at the University of Waterloo. She joined the Department in 1989 after completing her PhD at the University of Waterloo. Prior to doctoral studies, Jean worked for several years as a safety analyst with the Alberta Transportation Department. Her MSc degree was in physical geography (climatology) from the University of Calgary and her undergraduate degree in Geography from the Wilfrid Laurier University.

Jean Andrey, PhD. Professor, Department of Geography and Environmental Management, University of Waterloo.

Research Highlights

Jean's research focuses primarily on weather-transportation interactions including weather-related collisions, winter maintenance practices, and climate-change impact assessment.

- She has written extensively on weather-related collision risks in Canada as well as driver adjustments to hazards, often in collaboration with Brian Mills, a colleague from Environment Canada.
- Her work in road safety also deals with 'situational risk factors' beyond weather, e.g., her seminal work on young drivers' crash rates with passengers has influence graduated licensing programs around the world.
- Projects on snow and ice control have contributed to the development of winter weather indices.
- In terms of climate change, Jean contributed to Canada's national assessments of climate change impacts and adaptions (1996 and 2004), to the Intergovernmental Panel on Climate Change's AR4 Working Group on Impacts, Adaptions and Vulnerabilities (2007), and to the United Nations' Better Climate Information for a Better Future meeting (2009).

Professional Activity Highlights

- Working with students, colleagues and other professionals across the social, natural and engineering sciences in exploring transportation issues of importance to Canada.
- Currently Vice-President of the Canadian Association of Geographers.
- Recognized for outstanding contributions to teaching by the University of Waterloo (1995), the Canadian Association of Geographers (2000), and the Ontario Confederation of University Faculty Associations, Teaching Award (2004).

Research Focus – John J. Carrick Pavement Laboratory

Testing pervious concrete for the RMCAO 2011 correlation

Preparing CPATT equipment for the tour

Laboratory Updates

The CPATT laboratory has once again participated in the Pervious Concrete Correlation Program organized by the Ready Mixed Concrete Association of Ontario (RMCAO). Approximately 12 laboratories in Ontario take part in the correlation to determine the void index and void content of pervious concrete. Three different testing procedures are used within the correlation.

On December 9th, 2011, Yaprak Baltacioglu, Deputy Minister, Transport, Infrastructure and Communities visited the University of Waterloo Campus. One of the items on the agenda was a tour of the CPATT laboratory. Short presentations by graduate students included research topics: winter maintenance techniques of pervious concrete using CPATT's walk-in freezer, use of recycled concrete aggregate in structural concrete, skid resistance of materials used in solar road applications, perpetual pavement, recycled rubber tire in HMA, high RAP content in HMA and finally performance testing for pavement materials. It was a great tour and an honour to share the research projects in the group with the Deputy Minister.

Research Focus – Other CPATT Field Work

Collecting samples from Highway 7 (Night Paving)

Hopper (left) and Blending Unit (right) for blending rubber into the asphalt binder

Paving the rubber section on Highway 35

Field Work

The Ministry of Transportation Ontario, partnered with the Ontario Tire Stewardship, is investigating the use of recycled tire rubber made from scrap tires as a material. The crumb rubber is added to the asphalt cement binder to give asphalt the added benefit of the rubber, which includes reflection crack resistance, and added durability, which in turn elongates the life of the pavement.

Three highway sections have been paved with rubber modified asphalt binder; Highways 7, 35, and 115, in Ontario, to evaluate the performance of the tire rubber in the unique conditions presented in Ontario.

CPATT has been commissoned to carry out a study on the performance of the field blend rubber modified asphalt pavements against conventional pavements used in Ontario.

Research Focus – CPATT Test Track Relocation

The new location of the CPATT trailer and office. The area around the office and trailer will be paved in the months to come

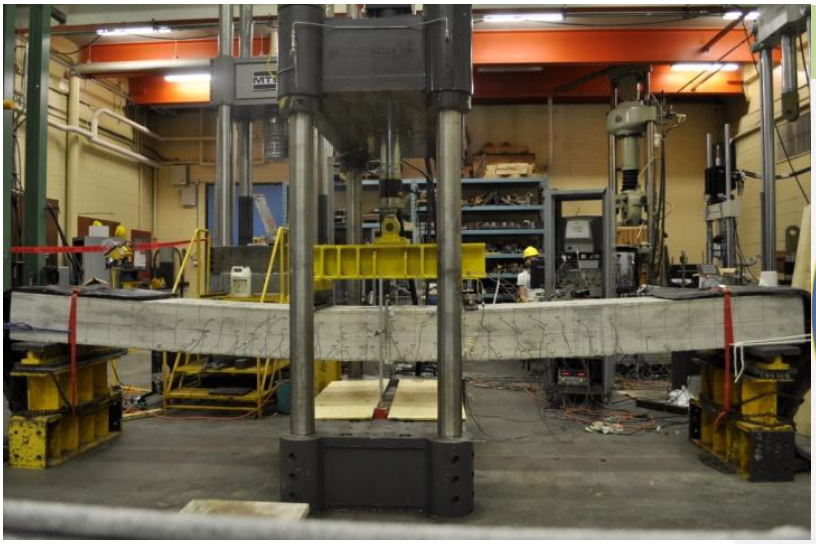
"Cold Weather Paving" Thank you to Steed and Evans Ltd. for their paving donation, especially so late in the season.

Test Track Updates

As discussed in the previous newsletter. The CPATT Office/Trailer at the Region of Waterloo's Waste Management Facility was undergoing relocation because the office/trailer was located within the footprint of waste cell NE-4. This waste cell will be developed in 2012. Therefore, the CPATT office/trailer had to relocate to another area within the Waste Management Facility.

We had a lot of help from the students to clean out the office and trailer ready for moving. This was a large undertaking by Jodi Norris who organized the clean-up and moving of the office and trailer.

We are very happy to say that researchers, the Department of Civil and Environmental Engineering, Faculty of Engineering, the University of Waterloo Central Administration, the Region of Waterloo and Steed and Evans, partnered to provide funding and in-kind support for this move. We especially appreciate the Region of Waterloo and Steed and Evans who donated significantly to this move.



Research Focus – Structures & Concrete Lab

Cracked CFRP-pretensioned beam being testing to failure

End of concrete beam showing prestressing anchor and tubes used for filling post-tensioning ducts with grout

Prestressing bed for pretensioned beams

Structures Laboratory Update

Research in the UW Structures Laboratory investigating the behaviour of Carbon Fibre-Reinforced Polymer (CFRP) tendons for pretensioned and post-tensioned concrete applications. A special wedge-type prestressing anchor developed at the University of Waterloo is used to grip the CFRP bars and apply the prestressing force; these anchors are now used by several concrete precast plants and in field applications throughout Canada.

One study is focused on investigating the bond between concrete and prestressed CFRP tendons with an exterior sand coating. In particular, the study aims to provide experimental data to verify or propose modifications to current design code equations for the transfer length and development length of CFRP tendons in concrete beams.

In a separate study, CFRP tendons are being used to improve the behaviour of Glass Fibre-Reinforced Polymer (GFRP) reinforced concrete slab bridges through post-tensioning. The prestressing force applied by the CFRP tendons counteracts the effects of applied loads to improve the structural performance of the slabs under service loads, as well as increasing the overall load-carrying capacity and extending the fatigue life of the structure.

Dr. Khaled Soudki can be contacted for further details on either project.

January 2012 Highlights
Feature Student – Liam Butler

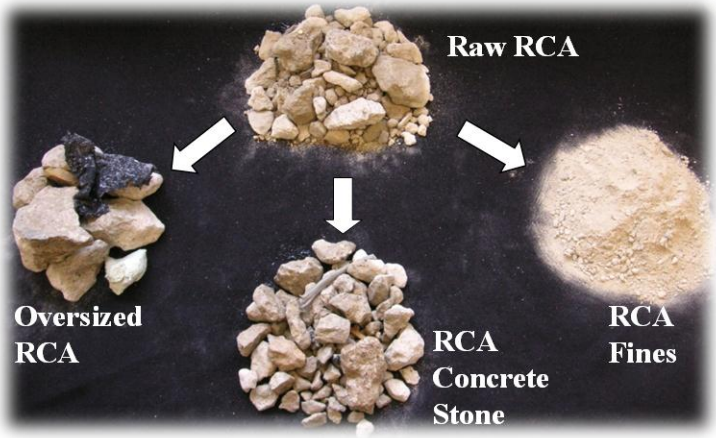
Liam Butler is a PhD. candidate under the supervision of Dr. Jeffrey West and Dr. Susan Tighe. He received his B.A.Sc. in May of 2007 from the University of Waterloo and began his M.A.Sc. in the fall of 2007. In the fall of 2009, Liam converted the work and results obtained from his M.A.Sc. into a PhD. and is currently in his final term of his PhD. studies.

Through his co-op work terms at the University of Waterloo, Liam has worked in several civil engineering sectors including construction management, concrete quality control and testing, and structural engineering consulting. In the academic sector, he has worked as a research assistant, teaching assistant and adjunct lecturer, all at the University of Waterloo. Liam's research focuses on the utilization of recycled concrete in new concrete for pavement, building, and bridge structures. He has published and presented several technical papers on this topic.

Feature Project – Structural Recycled Concrete

Through the demolition and crushing of decommissioned concrete structures, a new source of aggregate for usage in concrete can be produced. Using recycled concrete aggregates (RCAs) as a full or partial replacement for virgin quarried aggregate has the potential to divert a large portion of construction and demolition waste from landfill sites; reduce the demand on our natural aggregate resources; and, decrease greenhouse gas emissions associated with hauling natural aggregates from remote sites.

Due to the varied quality of the original concrete and the crushing process used to produce the RCA, its mechanical properties may be inferior to natural aggregate. As a result, the current usage of RCA has been limited to fill material under roadways, building and airport structures. A limited number of studies have investigated the use of RCA in structural concrete applications, whereas investigations of the effect of RCA on the bond strength with reinforcing steel are very limited. While it is widely accepted that bond strength is related to concrete compressive strength ($f'_c{}^{1/2}$), increasing coarse aggregate strength has been found to increase bond strength. Accordingly, the potentially inferior mechanical properties of RCA concrete raise concerns regarding the applicability of existing empirical design methods for bond in reinforced concrete made with these materials. The main objective of this study has been to obtain experimental relationships between the various RCA properties, RCA concrete properties, and the concrete-steel bond strength for the purpose of preparing best practice guidelines for use of these new sustainable materials.



January 2012 Highlights
Second Feature Project – Determining Quantity of Recycled Asphalt Pavement (RAP) in Hot Mix Asphalt (HMA)

Recycled Asphalt Pavement (RAP) has many benefits including: saves on dwindling aggregate resources, recovers non-renewable petrochemical resources, diverts large volumes of materials from overloaded landfills, reduces road building cost and contributes significantly to provincial and municipal recycling obligations.

This project will evaluate the impact that RAP has on two common Ontario mixes, SP12.5 and SP19, and provide some new guidelines on the usage of RAP. An extensive laboratory evaluation is planned that will involve evaluation of both basic properties and as well usage of performance tests such as dynamic modulus testing, Thermal Stress Restrained Specimen Test (TSRST) and fatigue beam.

The results expected from the project are: develop realistic measures for RAP usage in SP12.5 and SP19; understand how the addition of RAP to HMA alters the performance of the mix, and how HMA can be tested to determine the RAP content; determine if performance tests can be used to back-calculate performance grades for mixes containing RAP; consider application of RAP for both southern and northern Ontario roads.

This project is made possible by the partnership between CPATT, the Ontario Hot Mix Producers Association, DBA Engineering, and the Ministry of Transportation Ontario. The research involves the participation of Xiomara Sanchez, MASc Candidate and Jodi Norris, CET Research Technologist, under the leadership of Dr. Susan Tighe, PEng. Mr. Vince Aurilio, PEng, Manager, Pavement Engineering Services at DBA Engineering Ltd., will also be actively involved in the testing and evaluation of data.

On December 14th, 2011, students and staff from CPATT visited Capital Paving Ltd., in Aberfoyle, ON and sampled approximately 9 tonnes of material. This material consisted of stone, sand and RAP that will be used for developing mix designs and batching mix in the lab for performance tests. Once all the hard labour was complete, Mark Latyn provided a tour of the asphalt plant and answered questions. The opportunity was great! Special thanks to Mark Latyn and the folks at Capital Paving Ltd. for all their help!

Some pictures of the students gathering samples are shown on the next page.

January 2012 Highlights
Second Feature Project – Determining Quantity of Recycled Asphalt Pavement (RAP) in Hot Mix Asphalt (HMA) – Cont'd

Students gathering samples from Capital Paving Ltd.

CPATT students left to right: Amin Hamdi, Mehran Kafi Farashah, Mohab El-Hakim, Dom Hu, Aleks Kivi, Doubra Ambaiowei, Andrew Northmore

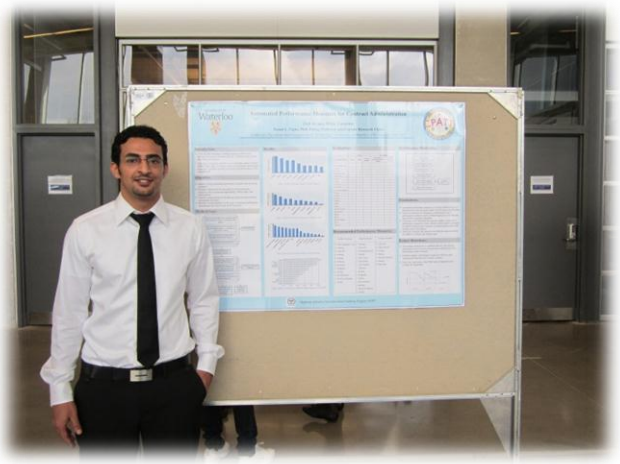
9 tonnes of asphalt samples

Students gathering samples from Capital Paving Ltd.

CPATT Graduate Student Poster Symposium

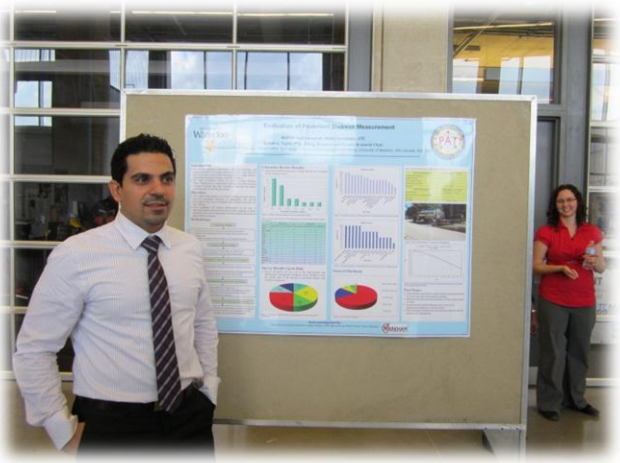
On October 28, 2011, CPATT hosted a Graduate Student Poster Symposium in the University of Waterloo E5 – Student Design Centre. This event was a great way for industry members and CPATT faculty members to see what the students have been researching. Student's prepared and displayed their posters showcasing their current research projects. Industry members and faculty members were encourage to mingle with the students and ask questions relating to their projects. It was a great success and we would like to thank all the industry and faculty members that attended this event. Your support for these projects is greatly appreciated. If you are interested in more information regarding the presentations, please contact Laura Bland.

Shirley Ddamba, MASc, Civil and Environmental Engineering (CEE) – **"Evaluation of the effect of recycled apshalt shingles on Ontario hot mix pavement"**



Zaid Alyami, MASc Candidate, CEE – **"Development of performance measures' LOS for pavement infrastructure under performance based contracts"**

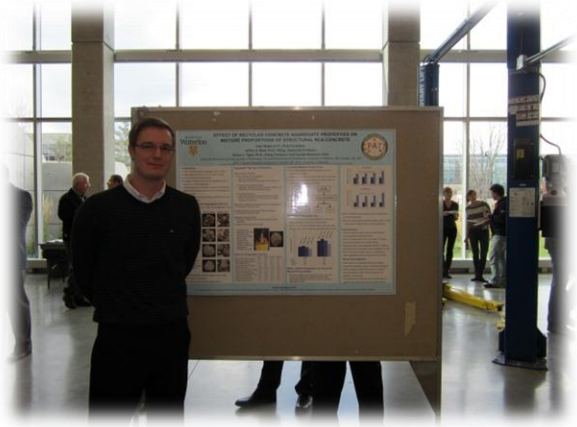
Richard Korczak, MASc Candidate, CEE - **"Review of the Canadian Long-Term Pavement Performance (C-LTPP) database"**



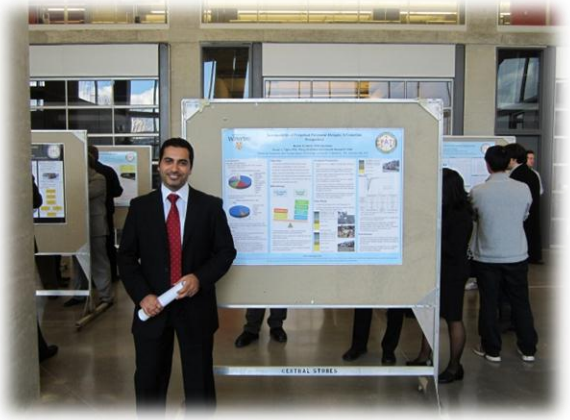
Mehran Kafi Farashah, MASc Candidate, CEE – **"Evaluation of pavement distress measurement"**

CPATT Graduate Poster Symposium Cont'd

Amin Hamdi, PhD Candidate, CEE – **"Improving Ontario pavement management through long term monitoring"**

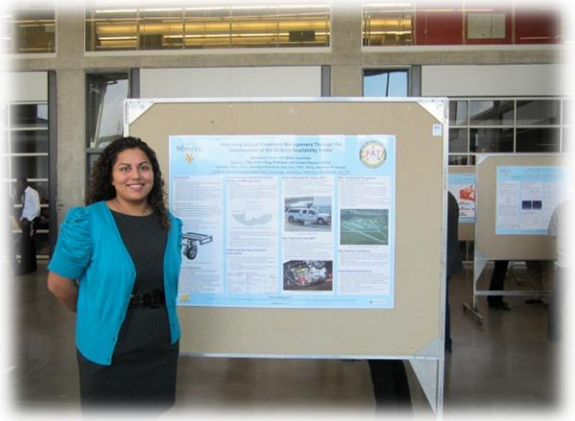


Liam Butler, PhD Candidate, CEE – **"Bond behaviour of reinforced recycled aggregate concrete members"**



Mohab El-Hakim, PhD Candidate, CEE – **"Evaluation of field strain in asphalt perpetual pavements using laboratory testing"**

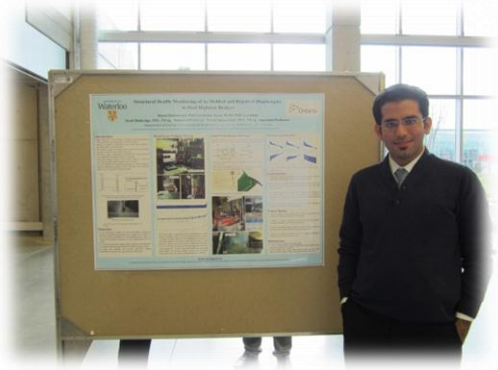
Doubra Ambaiowei, MASc Candidate and Rania Al-Hammoud, PhD Candidate, CEE – **"FRP rehabilitation for corrosion within wrapped structural elements"**



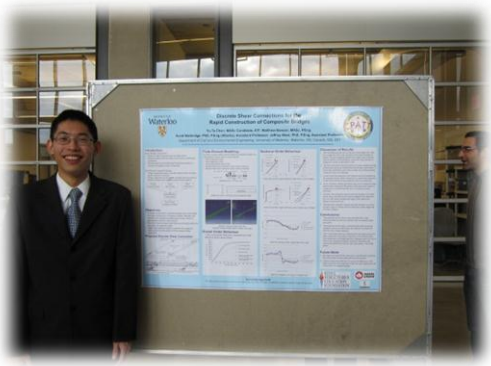
Samantha Pinto, MASc Candidate, CEE – **"Determining braking availability of aircrafts on contaminated runways"**

Attila Hertel, MASc Candidate, CEE – **"Quantifying pavement sustainability"**

CPATT Graduate Poster Symposium Cont'd

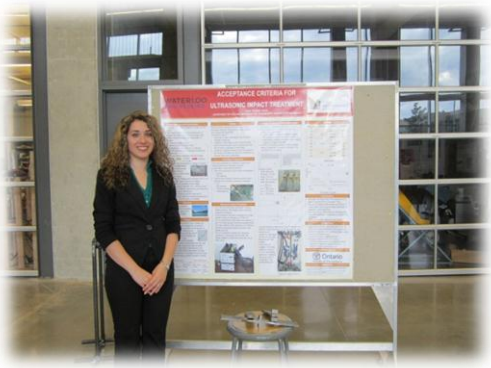


Kasra Ghahremani, PhD Candidate, CEE – **"Structural health monitoring of as-welded and repaired diaphragms in steel highway bridges"**

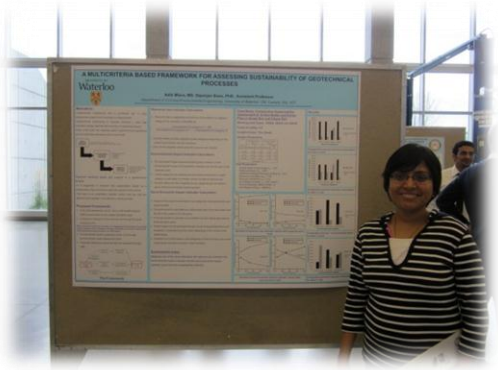


David Chen, MASc Candidate, CEE – **"Development of innovative shear connections for composite bridges"**

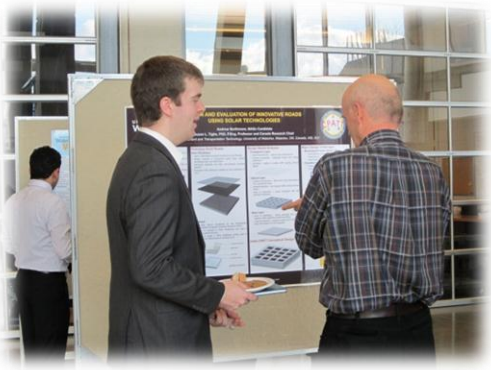
Lindsay Matthews, Geography and Environmental Management - **"Climate change and transportation in Prince George, BC"**



Rana Tehrani Yekta, MASc Candidate, CEE – **"Acceptance criteria for ultrasonic impact treatment"**



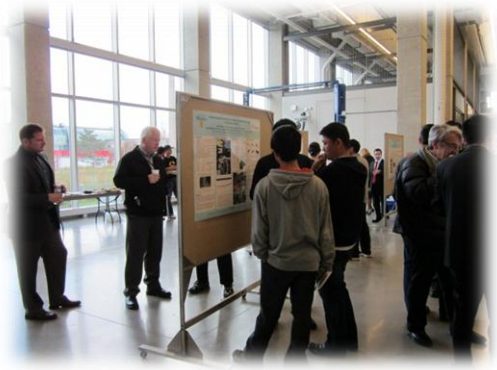
Aditi Misra, PhD Candidate, CEE – **"A multicriteria based framework for assessing sustainability of geotechnial processes"**



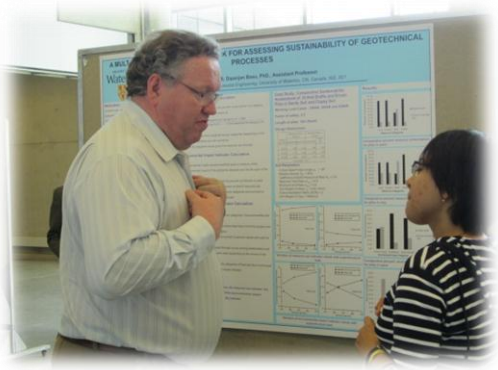
Andrew Northmore, MASc Candidate, CEE – **"Design and evaluation of innovative roads using solar technologies"**, and Ludomir Uzarowski (Golder Associates Ltd.)

CPATT Graduate Poster Symposium Cont'd

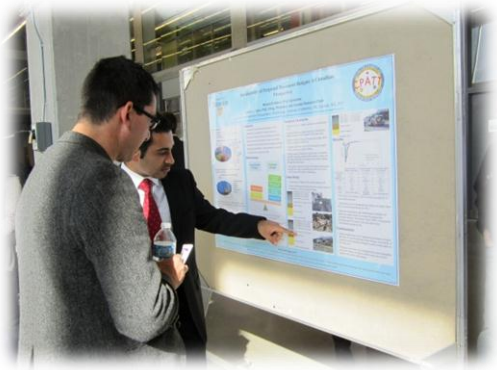
Kevin Snider, Zoe Atchinson and Chris Thompson (Roto-Mill Inc.), Malcolm Matheson (Steed and Evans), Susan Tighe (University of Waterloo)



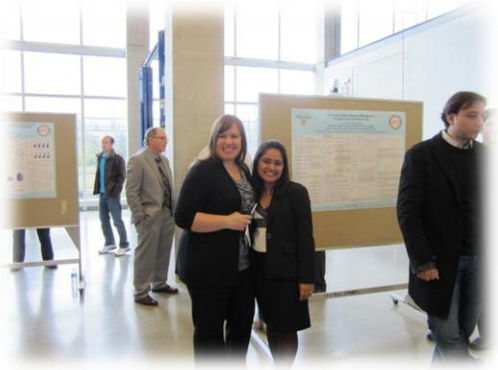
Guest Mingling at the event



Alexander (Sandy) Brown (OHMPA) and Aditi Misra



Mohab El-Hakim and Finlay Buchanan (MTO)



Jodi Norris, CET, CPATT Laboratory Technologist and Shila Khanal, MASc, Former Graduate Student

Group of students who participated in this event

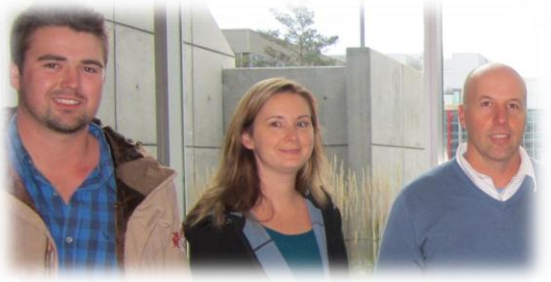
Speakers Corner

What did you learn or find most interesting about the CPATT Student Poster Symposium?

Gabe Cimini, Stantec Project Manager, Infrastructure Management and Pavement Engineering, Stantec Consutling Ltd.

"The Symposium was well organized and had many posters on display. The amount of unique research being done at the University and the high quality of students attending the University doing post graduate studies was very impressive. The most interesting item for me, as I am working on a large research project, was the perpetual pavement project being done near Woodstock. It was very comforting to see pavements being instrumented and monitored in Ontario. The poster was presented well. Prior to attending the Symposium, I assumed only a few posters would be presented and it was a pleasant surprise to see so many on display."

Chris Thompson, Construction Manager, Recycled Asphalt Construction Divison, Roto-Mill Inc.



In the photo: Kevin Snider, Zoe Atchison & Chris Thompson

"We were pleased to attend the CPATT Student Poster Symposium in October and what we (myself and other Roto-Mill staff) found most interesting was the enthusiasm shown by the students for their individual research projects and the diversity among the various projects. It was great to see both the lab and field research data being presented for improvements with existing technologies (Asset Management, Recycled Concrete) and the innovative research being done on emerging technologies such as the Solar road panels. The research being completed at CPATT is relevant and can be utilized to improve current practices or be implemented in the transportation industry in the near future.

We also enjoyed the opportunity to have a tour of both the Pavement and Structures Labs. Thanks Jodi.

Great Job to All!"

Speakers Corner – Cont'd

What did you learn or find most interesting about the CPATT Student Poster Symposium?

Marcos Kroker, Head, Transportation Rehabilitation, Design and Construction Division, Region of Waterloo

"The CPATT Student Poster Symposium was an excellent experience and forum for both the attendees and the students. The projects the students presented were comprised of a vast array of topics related to pavements from the macroscopic issues of climate change on transportation to very specific site issues. The students brought forth a fresh and enthusiastic approach to these real world problems facing the pavement industry today. The symposium was well received from industry leaders in government, contractors and consultants attending. There also seemed to be an underlying holistic theme to the symposium as there was significant emphasis on looking at the future of the industry by minimizing the resources required to sustain economincally and responsibly."

Upcoming Events

January 22-26th, 2012 – Transportation Research Board 91st Annual Meetings – Washington, D.C.

January 24, 2012 – Waterloo Engineering Networking Reception – Washington, D.C. (see page 17 for more details)

January 31, 2012 – Seminar hosted by CPATT/Norman W. McLeod Chair "An International Review and Evaluation of Public Private Partnerships" Speaker: Dr. Cesar Queiroz, Former World Bank Highway Advisor – University of Waterloo (See page 17 for more details)

March 23rd, 2012 – CPATT Board of Advisors Meeting – Location TBD

Welcome New Students

Aleli Lird Osorio, PhD. Candidate (Supervisor: Dr. Susan Tighe)

Peter Kelly, MASc Candidate (Part-time) (Supervisor: Dr. Susan Tighe)

Daniel Pickel, MASc Candidate (Supervisors: Dr. Susan Tighe and Dr. Jeff West)

TRB Papers, Posters and Presentations

- Improving Ontario Pavement Management Through Long-Term Monitoring – **A. Hamdi, Z. Alyami, T. Zhou, S. Tighe**
- Effect of RCA Properties on the Mixture Proportions of RCA Concrete Developed for Structural Applications – **L. Butler, J. West, S. Tighe**
- Influence of Ownership and Business Models on Achieving Transit Improvements – **A. Lopez Dodero, J. Casello, A.R. Molinero, D. Santiago Rodriguez**
- Automated System for Documenting the Evolution of As-Built Details During Construction – **M. Abdel-Monem, T. Hegazy, D.A. Saad**
- Using Probabilistic Models to Evaluate the Effectiveness of Steel Bridge Weld Fatigue Retrofitting by Peening – **S. Walbridge, D. Fernando, B. T. Adey**
- Analytical Method for Estimating Delays to Vehicles Traversing Single-Lane Roundabouts as a Function of Vehicle and Pedestrian Volumes – **B. Hellinga, A. Sindi**
- Multiobjective Calibration and Validation of Microscopic Simulation Platforms and Effect of Goodness-of-Fit Form on Calibration Results – **D. Duong, F. Saccomanno, B. Hellinga**
- Analysis of Injury Severity Outcomes of Highway Winter Crashes: Multilevel Modeling Approach – **T. Usman, L. F. Miranda-Moreno, L. Fu**
- Integrating Observational and Traffic Simulation Models for Priority Ranking of Unsafe Intersections – **U. E. Shahdah, F. Saccomanno, B. Persaud**
- Analysis of Empirical Evidence of Cyclists' Route Choice and Its Implications for Planning – **J. Cassello, K.C. Rewa, A. Nour**
- Discrete Shear Connection for Portable Composite Bridge – **M. Bowser, S. Walbridge, J.S. West**
- Investigation of Piezoelectric Weigh-in-Motion Sensor' Performance in Asphalt Concrete Pavements in Cold Temperatures of Southern Ontario – **S. Hashemi Vaziri, C. Haas, L. Rothenburg, R. Haas**
- Sustainable Pavement Maintenance and Preservation Practices: Review of Current Practices – **S. Tighe, D. Gransberg**
- Optimization of Headways for Bus Rapid Transit System with Stop-Skipping Control – **X. Chen, B. Hellinga, C. Chang, L. Fu**
- Use of Exogenously Defined Standard Deviation Versus Mean Travel Time Relationships for Estimating the Impact of Policy Measures on Reliability – **B. Hellinga, H. Van Lint, F. Hofman**
- Perpetual Pavement Designs and Sustainable Road Construction: Two Sides of the Same Coin – **M. El-Hakim**
- Tire-Pavement Noise Measurement: Case Study from Ontario, Canada – **S. Tighe**
- Selection of Automated Data Collection Technologies Using Multi Criteria Decision Making Approach for Pavement Management Systems – **Z. Alyami, M. Kafi Farashah, S. Tighe**
- Development of New 2011 Canadian Pavement Asset Design and Management Guide: Summary of Canadian State of the Practice – **S. Tighe, M. Juhasz**
- Pervious Concrete Pavement Condition Rating Using Fuzzy Sets – **A. Golroo, S. Tighe**

TRB Hospitality Suite

The Faculty of Engineering and the Transportation Group in the Department of Civil and Environmental Engineering at the University of Waterloo are pleased to invite you to a complimentary alumni and friends networking reception, during the 2012 TRB Annual Meeting.

Tuesday January 24th, 2012 | 6:00-7:30pm
Washington Marriott Wardman Park Hotel
Maryland C
2660 Woodley Road, NW
Washington, DC 20008

If you have any questions, please contact:
Gosia Brestovacki
Senior Alumni Officer, Faculty of Engineering
519-888-4567, ext. 36838
Gosia.brestovacki@uwaterloo.ca

Seminar

Seminar hosted by CPATT/Norman W. McLeod Chair

Tuesday January 31st, 2012
University of Waterloo, Davis Centre (DC) 1302
Parking Lot B or UWP ($5.00 in change)
Parking directions– http://uwaterloo.ca/map/index.php

"An International Review and Evaluation of Public Private Partnerships"

Speaker: Dr. Cesar Queiroz, Former World Bank Highway Advisor

Dr. Cesar Queiroz, is an international consultant on roads and transport infrastructure. His main expertise is in public-private-partnerships in infrastructure, road maintenance, financing, management and development, performance-based contracts, improving governance, quality assurance and evaluation, research, teaching and training. Between 1986 and 2006, he held several positions with the WB, including Lean Highway Engineer and Principal Highway Engineer. Prior to joining the WB, Cesar was a deputy director of the Brazilian Road Research Institute in Rio de Janeiro, Brazil.

CPATT

University of Waterloo
200 University Ave, W
Waterloo, ON N2L 3G1
www.civil.uwaterloo.ca/CPATT/

Numbers and Email:

Jodi Norris - Laboratory
519-888-4567 ext. 37731
j2norris@uwaterloo.ca

Laura Bland - Office
519-888-4567 ext. 32289
lbland@uwaterloo.ca

Dr. Susan Tighe, Director
519-888-4567 ext. 33152
sltighe@uwaterloo.ca

Dr. Jeff West, Associate Director
519-888-4567 ext. 33323
jswest@uwaterloo.ca