CPATT
CENTRE FOR PAVEMENT AND TRANSPORTATION TECHNOLOGY

CPATT NEWS

Issue 11 - Spring 2014

Message from the Director

Welcome to our summer addition of CPATT News!

In this addition of our newsletter, we include research highlights, one of our feature faculty members and we celebrate various awards. We also invite you to attend our colleague, Professor Frank Saccomanno's retirement - see details on page 14. We also recently were delighted to have Dr. Theuns Henning from The University of Auckland visit us during his sabbatical. Included are some highlights from his visit.

Should you have any questions related to our activities please do not hesitate to contact us

Sincerely,

Susan L. Tighe, PhD., P.Eng
Professor and Canada Research Chair
Norman W. McLeod Professor in Sustainable Pavement Engineering
Director of CPATT

Contents:

UNIVERSITY OF WATERLOO

Feature Faculty - Professor Liping Fu

Dr. Liping Fu, PhD., P.Eng.

Dr. Fu is a Professor in the Department of Civil and Environmental Engineering at the University of Waterloo and Director of the Innovation Transportation Solutions Lab. He holds a B.Sc. and a M.Sc. degree in Road and Traffic Engineering from the Tongji University, P.R. China and a Ph.D in Transportation Engineering from the University of Alberta. Dr. Fu is the past Chair of the Transportation Division of the Canadian Society for Civil Engineering. Dr. Fu is the winner of the 2011 Award of Academic Merit of the Transportation Association of Canada for his long time contribution to the advancement of the transportation field.

Research Highlights

Dr. Fu's research interest specifically focuses on evaluation and optimization of large, complex traffic and transportation service systems where uncertainty and dynamics play a major role, and on the development of decision support tools for use in managing these systems. Dr. Fu has a long track record of research contributions to the areas of intelligent transportation systems, public transit, road safety, and winter road maintenance. Dr. Fu has authored more than 150 publications in refereed journals and technical conferences.

Dr. Fu holds two international patents and several software copyrights including a routing and scheduling system, a pickup and delivery simulation system, a web application currently being used by Transport Canada for screening highway-railway grade crossings and developing safety improvement programs. He has provided technical services to many transportation agencies, including Transport Canada, the Ministry of Transportation Ontario, and several municipalities in Canada. Dr. Fu is supervising a large group of PhD and MASc students working on a number of research projects funded by NSERC, Transport Canada, MTO, AURORA and many industrial partners.

Professional Activity Highlights

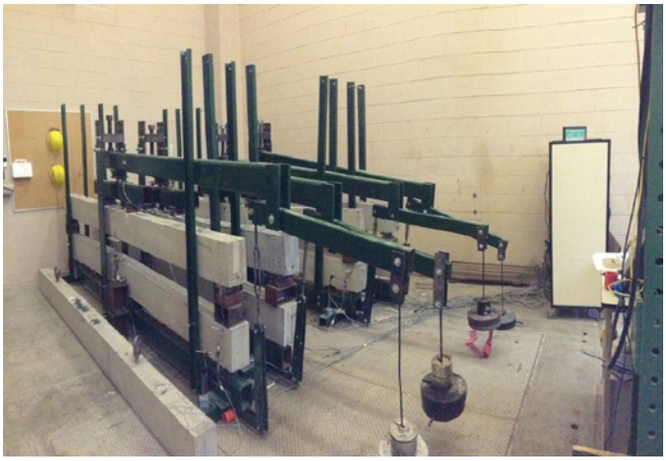
- Past Chair, Transportation Division, Canadian Society for Civil Engineering
- Member, Institute of Transportation Engineers
- Member, technical committees for the Transportation Research Board
- Member, Canadian Transportation Research Forum (CTRF), Canadian Urban Transit Association (CUTA) and Intelligent Transportation Systems Canada (C-ITS)
- Past Member, editorial advisory board of the Journal of Transportation Research, Intelligent Transportation Systems Society of Canada, and Canadian Urban Transit Association

Research Focus - Concrete Laboratory

The University of Waterloo research project sponsored by Schoeck Canada Inc., and the Natural Sciences and Engineering Research Council of Canada (NSERC) is currently underway to investigate the long-term behaviour of concrete beams prestressed with a new generation of Glass Fibre-Reinforced Polymer (GFRP) bars.

Among the types of FRP's used in civil engineering applications, carbon FRP is commonly used in prestressed applications due to its high strength and stiffness and good long term properties. GFRP bars have primarily been used in non-prestressed applications like bridge decks and barrier walls where their lower cost (relative to CRFP) makes them competitive with other types of corrosion resistant reinforcement. The use of GFRP bars for prestressing has been limited due to their susceptibility to creep rupture and their relaxation properties.

A new generation of GFRP bars has been recently developed and is reported to have mechanical properties that make the bars suitable for prestressed applications. The ongoing research at the UW will provide useful data on the long-term flexural behaviour of concrete beams prestressed with these GFRP bars under sustained loads.



GRFP prestressed concrete beams subjected to sustained loads in mechanical loading frames

The concrete beam specimens have dimensions of 150 mm wide x 250 mm depth x 3600 mm long, and are pretensioned with one prestressed high-strength GFRP bar. Variables investigated include GFRP bar size, prestress level and concrete strength. The beams are subjected to sustained loading (up to 300 days) using mechanical loading frames.

Formwork placed inside the prestressing bed

The UW research will provide information on the transfer length of the pretensioned GFRP bars, along with the long-term behaviour of GFRP prestressed concrete beams including the relaxation characteristics of the GFRP bars. The findings will create opportunities for prestressing applications with the new generation GFRP bars, and may lead to design solutions for bridge infrastructure that have decreased maintenance costs compared to steel prestressed concrete and lower initial cost compared to CFRP prestressed concrete.

Mohamed Zawam is the UW PhD candidate working on this project in collaboration with the late Prof. Khaled Soudki (deceased in Sep. 2013) and Prof. Jeffrey West.

Research Focus - Pavement Laboratory

Improving Runway Pavement Braking Prediction Through Innovative Methods

Runway overrun remains one of the most frequent air transportation accidents/incidents in the past few years and has become a major concern for airport and airline safety. This research aims to improve airport runway pavement braking performance prediction through innovation methods to mitigate the risk of runway overrun. This research includes a mechanistic-empirical aircraft landing distance prediction method and the development of the braking availability tester (BAT).

Cheng Zhang is the CPATT graduate student currently working on this research project under the supervision of Prof. Susan Tighe. This research is being conducted in partnership with Team Eagle Ltd., WestJet Airlines, Waterloo International Airport, and the Ontario Centres of Excellence. This research also collaborates with two professors, Prof. Soo Jeon and Prof. HJ Kwon, and a previous graduate student, from the mechanical and mechatronics engineering department at the University of Waterloo.

A mechanistic-empirical aircraft landing distance prediction method, which integrates pilot configurations, aircraft operational characteristics, accurate amounts of reverse thrust, aircraft braking system characteristics, and runway friction conditions, has been built. The method is based on the mechanistic analysis (Figure 1) and calibrated with digital flight data. A programme has been developed based on the mechanistic-empirical aircraft landing distance prediction method. Figure 2 demonstrates the user interface of the programme. A Boeing 737-700 case study was conducted and the results indicate that this method has similar results as the *Boeing 737 Quick Reference Handbook,* and can provide an accurate prediction of aircraft landing performance and its landing distance. This programme can be applied to calculate required landing distance before the aircraft lands to mitigate the risk of runway overrun, It can also be used to optimize quick exit taxiway design and airport operations, as well as help airlines control and reduce fuel consumption.

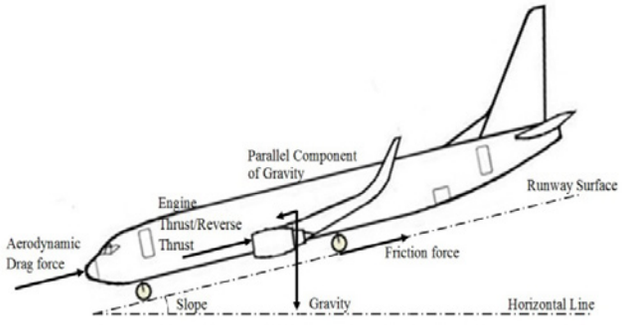


Figure 1. Mechanistic analysis

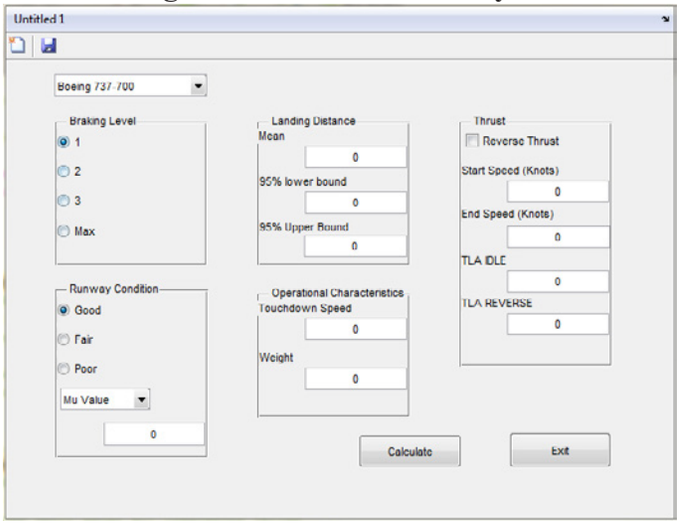


Figure 2. Mechanistic-empirical aircraft landing distance prediction programme

Research Focus - Pavement Laboratory

The BAT was developed in partnership with Team Eagle Ltd. The objective of the BAT project is to design a runway pavement measurement device that can provide pilots with real time runway braking availability, especially for landing at airports with wet or contaminated runways. The provided braking availability information can help pilots make better landing decisions.

Figure 3. BAT Aircraft Landing Gear Wheel (MME, UW)

The distinguishing feature of the BAT is that it simulates an aircraft's real braking performance. This is done by installing an aircraft landing gear wheel and brake with an Antiskid Braking System (ABS) algorithm controlling them in the back of a F350 (Figure 4). Several sensors are embedded and measure torque load, speed, braking pressure, wheel speed, drag force, temperature, etc. This allows the BAT to monitor all aspects of braking performance of the landing gear wheel.

By combining the mechanistic-empirical aircraft landing distance prediction method and the BAT, this project is able to give us the opportunity to provide the aviation industry a better understanding of the effects of contaminated runways on aircraft braking performance as well as an accurate prediction of aircraft braking performance and its required landing distance. The research team is grateful for the support of Team Eagle Ltd., in particular, Steve McKeown, Paul Cudmore, and Rick Thibodeau. Also, thank you to Dave Rodger from WestJet. Without their continued support, this project would not have been possible.

Figure 4. Braking Availability Tester (MME, UW)

Student Feature - Doubra Charles Ambaiowei

MEET DOUBRA AMBAIOWEI

Doubra, a gentleman with a rare spirit. Born in Port-Harcourt, Nigeria, he completed a Bachelor of Engineering (B.Eng.) degree in Civil Engineering in 2008. Thereafter, he worked as an administrative and construction intern with Moreno D. C West Africa Plc and Setraco Nigeria Ltd., respectively. During this time, he was involved with general supervision and holistic management of the technical operations in pavement, bridge and building construction work packages in accordance with specifications and craft standards.

These experiences motivated him to consider graduate school where he earned a Master of Science (MSc.) degree in Construction Management for the University of Birmingham, United Kingdom in 2010. As part of his lifelong desire to acquire the necessary theoretical and practical knowledge to contribute towards tackling the demands and challenges of road construction; especially those peculiar to Nigeria, Doubra is currently working on achieving his doctoral degree in Civil and Environmental Engineering under the supervision of Prof. Susan Tighe at the University of Waterloo. His research topic is **"Recycling and Testing Recycled Asphalt Pavements"**. His leadership qualities got him elected Senate President of the Engineering Student's Departmental Representative Council during his undergraduate days. He has been a graduate member of the Nigerian Society of Engineers since 2009, and has presented papers related to his PhD. research at the Canadian Technical Asphalt Association (CTAA) and Transportation Association of Canada (TAC) Conferences. He enjoys travelling, swimming, playing football and tennis, and is very keen on continuous improvement.

Feature Project - Recycling and Testing Recycled Asphalt Pavements

Doubra's research is carved out of two separate studies aimed at fostering innovation for greener roads in Ontario, Canada. It is anchored on the fact that utilizing reclaimed asphalt pavement (RAP) and crumb rubber modifier (CRM) in Hot Mix Asphalt (HMA) are consistent with the concept of sustainability, and a more cost-effective alternative to traditional road paving.

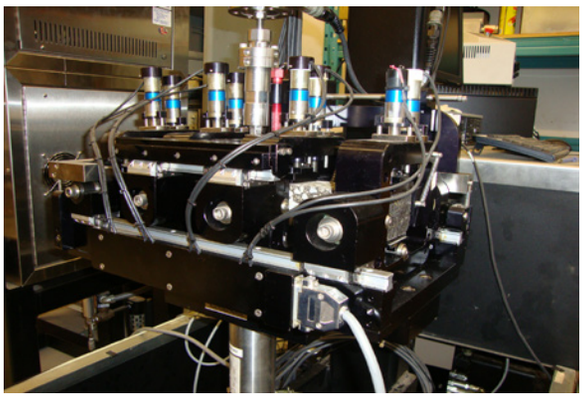
CRM and RAP Aggregates

Student Feature and Project Cont'd

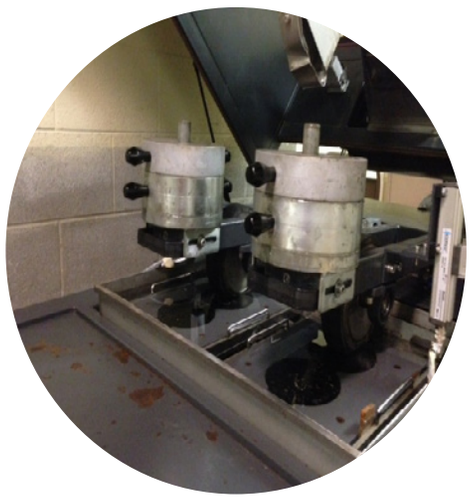
The projects in his study (Determining Quantity of RAP in Ontario HMA, and Evaluation of Rubber Modified Asphalt: Past, Present, Future) are a collaborative effort between the Centre for Pavement and Transportation Technology (CPATT), the Ministry of Transportation Ontario (MTO), the Ontario Tire Stewardship (OTS), the Ontario Hot Mix Producers Association (OHMPA), and the Natural Science and Engineering Research Council of Canada (NSERC).

The studies are expected to evaluate the feasibility of "wet-process" - field and terminal blend rubber modified asphalt (RMA) as well as stimulate higher RAP usage in typical Ontario Superpave mixtures. A comprehensive laboratory and field evaluation approach is adopted to investigate, understand and compare the mechanistic properties, behaviour and overall performance of typical Superpave rubberized-RAP HMA mixtures.

The Thermal Stress Restrained Specimen Test (TSRST), Hamburg Wheel Tracking test device (HWTD), Dynamic Modulus and Flexural Fatigue beam test procedures are employed to characterize the resistance to low temperature cracking, rut susceptibility, elastic property evaluation and fatigue life of dense and gap-graded HMA mixtures incorporating 0%, 15%, 20%, and 40% RAP and 20% CRM with performance graded asphalt concrete binders (PGAC) typically used in southern and northern Ontario.

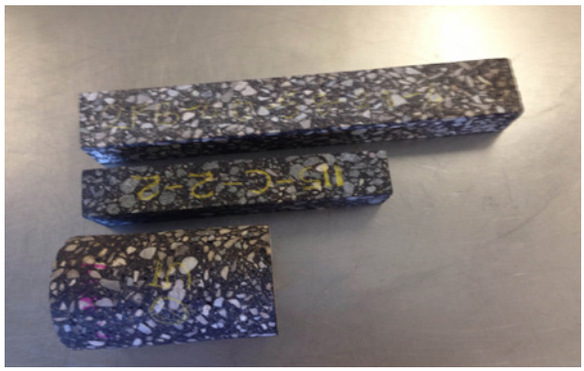


Fatigue Testing



Rut Testing

Sample Splitting



Test Samples

Student Feature - Kamal Hossain

MEET KAMAL HOSSAIN

Kamal Hossain is a PhD candidate working under the supervision of Dr. Liping Fu at the University of Waterloo's iTSS Lab. Born in Bangladesh, he earned his B.Eng. in Civil Engineering from the Bangladesh University of Engineering and Technology (BUET) and his MBA from the University of Dhaka, both among Bangladesh's most prestigious institutes. Before joining the University of Waterloo in 2011, Kamal worked in the construction industry for more than seven years, where he gained substantial real-world experience with high volume construction projects, project evaluations and project management. In the iTSS Lab, Kamal has been leading a multi-year research project entitled "Snow and Ice Control for Parking Lots and Sidewalks" for the last three year.

Feature Project - Snow and Ice Control for Parking Lots and Sidewalks (SICOPS)

Winter maintenance contractors, responsible for parking lot and sidewalk safety, have few guidelines on the right snow and ice control methods, materials or amounts of material that should be applied under specific winter weather conditions. To address these needs, the University of Waterloo's iTSS lab, in partnership with NSERC, Landscape Ontario, GO Transit, Toronto Region Conservation Authority (TRCA), Ontario Ministry of Transportation (MTO), Snow and Ice Management Association (SIMA) USA, and a number of private organizations, is conducting a multi-year research project entitled "Snow and Ice Control for Parking Lots and Sidewalks (SICOPS)".

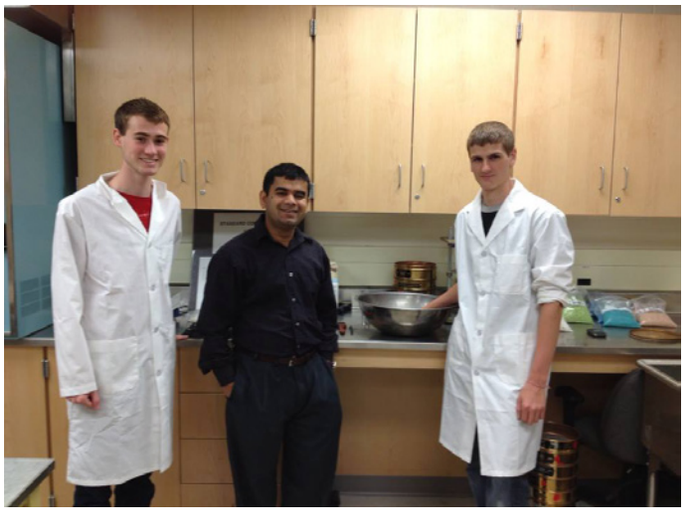
To achieve this goal, the project has been designed to include a number of field tests in parking lots and sidewalks under the combination of treatment options. The tests explore the effect of choosing a different maintenance strategy (e.g., de-icing vs. anti-icing), material (e.g., regular salt vs. magnesium chloride vs. organic), or application rate. Data from these tests will help develop a quantitative understanding of the conditions that influence the effectiveness of these treatment options, and will generate practical guidelines and decision support tools that can be adopted by all maintenance contractors across Ontario. Ultimately, the aim of the project is to improve professionalism and environmental stewardship in the industry while simultaneously reducing over-salting and operational costs.

The project's field experiments started in the winter season of 2011-12. Over the last three winter seasons, the research team has managed to conduct a range of field tests that focus on the de-icing and anti-icing performance of regular solid salts and other alternative salts.

Student Feature and Project Cont'd

The test results revealed many interesting findings, some of which have been published in technical papers including seven papers presented at the Annual General Meeting of the Transportation Research Board.

Under the supervision of Dr. Liping Fu, the project has been successfully led by Kamal for the last three years. To date, over 20 co-op undergraduate students have been actively involved in this project. The details of this project can be found at www.sicops.ca.



The Weather and Society Study Group

The Weather and Society study group initially formed in the fall of 2010 as an unofficial gathering of undergraduate and graduate students, academics, and researchers. The goal of the group was to share and discuss research articles that specifically explored the relationship between weather and society, a topic that had received comparatively little attention on campus. As membership in the study group grew, the meetings became slightly more formal, and included research presentations, guest lectures, and discussions on conference and scholarship opportunities. At present, the Weather and Society study group meets several times per term to discuss significant weather events, current and future research projects, and upcoming opportunities for members.

In the summer of 2011, the Weather and Society study group launched the Canadian Weather & Society Advisor - a newsletter intended to share ideas, questions, opinions, stories, research, and experiences with a broader Canadian audience. The Advisor aims to create an open environment for contributions and to build a sense of community around weather and society in order to advance our understanding and application of knowledge. As of early 2014, the study group became affiliated with the Interdisciplinary Centre on Climate Change (IC3) at the University of Waterloo. Most recently, the Weather and Society study group was pleased to announce an undergraduate travel grant competition for students to attend the World Weather Open Science Conference. This conference is an international gathering of academics, practitioners, and researchers involved in the study of both the physical and human dimensions of meteorology.

For more information on the Weather and Society study group, please contact Amber Silver at:
a2silver@uwaterloo.ca

One-year monument to the F3 Goderich tornado

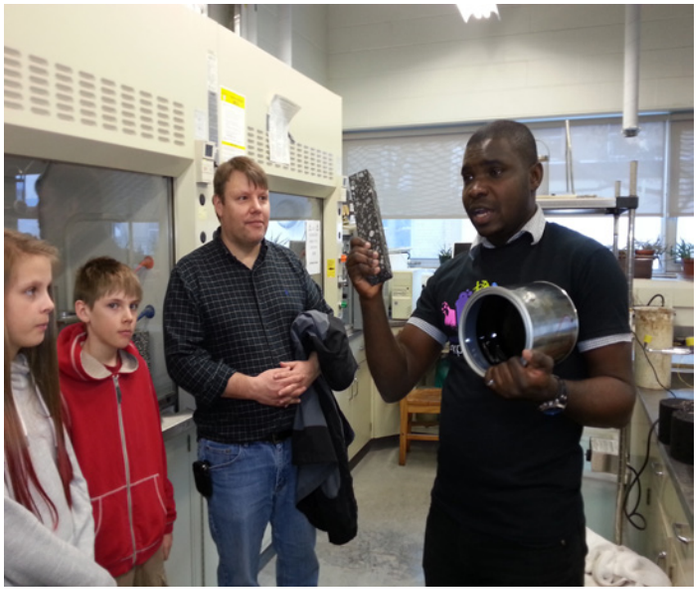
Ice storm in Waterloo region winter 2014

ESQ Girls Club

The Engineering Science Quest offers weekend programs during the school year. The Girls Club engages participants through activities designed to dispel stereotypes about engineers and scientists and inspire girls to pursue these studies in high school and post-secondary education. During January - March 2014 many of our graduate students participated in this event.

Explorations

On Monday March 10, 2014, CPATT participated in Explorations by giving lab tours and teaching the students about the research being done at CPATT. Explorations is an event for grade 6-8 students and their parents to experience the faculty by viewing a mix of displays in a tour of various departments. The Faculty of Engineering hope to excite students about engineering in hopes of sparking an interest in continuing their math and science studies throughout high school.



Transportation Research Board Alumni Reception 2014

On Tuesday January 14, 2014, the Faculty of Engineering and the Transportation Group in the Department of Civil and Environmental Engineering at the University of Waterloo were pleased to host a complimentary alumni and friends networking reception, during the 2014 Transportation Research Board Annual Meetings. This event was held at the Washington Marriott Wardman Park Hotel at the Stone's Throw Restaurant and Bar. We hope to see you all again next year at the new location!

Awards and Upcoming Events

Awards and Recognition

2014 Amit & Meena Chakma Award - Rania Al-Hammoud was one of the recipients of the 2014 Amit & Meena Chakma Award for Exceptional Teaching by a Student. Rania was a sessional lecturer and TA for several undergraduate courses in the Department of Civil and Environmental Engineering at the University of Waterloo. This nomination is very competitive and was initiated by the department undergraduate students.

Queen Elizabeth II Scholarship - Gulfam Jannat and Dan Pickel - This scholarship is designed to recognize students who have shown academic excellence in the graduate program.

Ontario Graduate Scholarship - Sina Varamini - This scholarship recognizes academic excellence at the graduate level.

Upcoming Events

June 16, 2014, 3:00 - 5:00pm - Frank Saccomanno Retirement Celebration - please join the Civil and Environmental Engineering Department in honouring our esteemed colleague and friend, Frank Saccomanno, after more than 35 years of dedicated teaching and research. The celebration will be held at the University of Waterloo University Club. Please R.S.V.P to Shirley Springall at shirley@uwaterloo.ca by Friday June 6, 2014.

2014 - Ontario Good Roads Association - Asset Management courses - see website for details.

September 15 - 18, 2014 - Summer Winter Integrated Field Technologies (SWIFT) - this event will be held at the Sheraton Vancouver Wall Centre Hotel and Vancouver Airport Authority, in Vancouver, BC.

September 28 - October 1, 2014 - Transportation Association of Canada (TAC) Conference and Exhibition - This event will be held at the Palais des congres in Montréal, Québec.

November 16 - 19, 2014 - Canadian Technical Asphalt Association Conference - this event will be held at the Fairmont Winnipeg Hotel in Winnipeg, MB.

Norman W. McLeod Chair in Sustainable Pavement Engineering

We are very pleased to announce that the Canadian Asphalt Industries Inc. has become a member of the Norman W. Mcleod Chair. We are very pleased to have them become a members of the Chair and look forward to working with them.

We have interviewed for the Norman W. McLeod Junior chair and hope to announce the successful candidate shortly. In this newsletter we highlight Dr. Theuns Henning's visit tot he University of Waterloo which was made possible by the Norman W. McLeod Professorship. During his visit he participated in various activities. The highlight of his visit was a seminar he presented.

"Understanding Road Network Needs Through Performance Measurement and Monitoring"

Since ancient Egyptian times, the engineering sophistication of any man-made creation has been directly related to the ability of society to monitor and quantify units of measure. One can only marvel at the unsophisticated yet extremely accurate measurements that made the construction of the pyramids a reality. Likewise, the importance of accurate measurement and reporting of network status is an integral part of today's modern asset management plans. Performance reporting not only gives an agency the planning context of past performance as a function of historical investment; it also quantifies users' expectations of the Level of Service for a network.

The presentation summarized valuable lessons from a number of performance management research and implementation projects completed in New Zealand and Canada. The presentation covered the important business positioning of performance management as part of the overall asset management process. It looked at the techniques of aligning performance management frameworks to corporate objectives that have been defined by an agency and, lastly, it assessed performance measures as the means of conveying the performance message in the asset management plan itself.

The seminar was held at the University of Waterloo on May 15, 2014. The presentation and video of the seminar can be found here.

News

Other News

Memorial for Dr. Khaled Soudki

A memorial service was held for Dr. Khaled Soudki, PhD., P.Eng., FACI, on March 14, 2014 at the University of Waterloo's Mike & Ophelia Lazaridis Quantum-Nano Centre. The service included talks and presentations from Dr. Khaled's colleagues, graduate student, and friends. The department celebrated the life and career of Dr. Soudki through stories from his technical career, mentoring students, and reflections from personal relationships.

A 2500 kN structural testing actuator and frame was named in memory of Prof. Khaled Soudki, on behalf of his students and colleagues at the University of Waterloo, in commemoration of his dedication to excellence in research, teaching, and mentorship in the field of structural engineering. Also, in memory of Khaled, the Department has renamed the CivE 205 bridge design competition the "Professor Khaled Soudki Bridge Design Competition Award". The winning design team in the competition will receive a $250 cash award and have their names engraved on the plaque which will be mounted in the E2 corridor outside of the CEE Undergraduate Computer Lab where it will be seen by many.

Articles and Announcements

The Region of Waterloo Article - **Susan Tighe** was interviewed on March 20, 2014 by Chris Herhalt from the Waterloo Record on the severe winter and the resulting number of potholes in the region.

Congratulations to **Dan Pickel** and **Andrew Northmore** on completing their MASc. Also, congratulations to Andrew on accepting the position of Transportation Specialist at Forensic Engineering Inc. Dan is working as a Research Engineer at CPATT for the next several months.

Congratulations to **Karolina Konarski**, MASc candidate under the supervision of Prof. Susan Tighe, and her partner Carmen Caputo on the birth of their beautiful baby girl, Suzanna. Suzanna was born on March 6, 2014 at 6:50am, weighing 4lbs 14oz.

Contact Us

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

Numbers and Email:

CPATT - Laboratory
519-888-4567 ext. 37731

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

CPATT Board Members