



# CPATT NEWS

Issue 13 - Winter 2015

**NORMAN W. MCLEOD**

CHAIR IN SUSTAINABLE PAVEMENT ENGINEERING

## Message from the Director

Welcome to our Winter 2015 addition of CPATT News!

Happy New Year to All! We hope everyone had a safe and festive holiday.

In this newsletter we highlight some of the various projects underway at CPATT. Also, we highlight some events and seminars that have been hosted over the past few months.

We look forward to a busy 2015. If you are attending TRB, please see below information on the Waterloo Engineering Suite.

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

## WATERLOO ENGINEERING ALUMNI RECEPTION - TRB

Join fellow alumni and friends of the University of Waterloo Faculty of Engineering community at a special networking reception at the Transportation Research Board Meetings in Washington D.C.

**When:** Tuesday January 13, 2014 from 5:30pm - 7:30pm

**Where:** Chef Geoff's Downtown - 1301 Pennsylvania Ave NW, Washington D.C.

**Cost:** Complimentary

**Registration:** Please visit our [UW page](#) for more information

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## Faculty Feature



### **Dr. Bruce Hellinga, PhD., P.Eng.**

Bruce Hellinga is a Professor in the Department of Civil and Environmental Engineering at the University of Waterloo, Ontario Canada and is currently the Associate Dean for Graduate Studies in the Faculty of Engineering and the Associate Director, ITS in the Waterloo Centre for Automotive Research (WatCAR). He is co-founder of the Waterloo Public Transportation Initiative (WPTI) and is the founder of WatTRIPS (Waterloo Transportation Research for Improving Performance and Safety). Dr. Hellinga has over 20 years of experience in the profession and has authored or coauthored more than 170 technical papers and reports reflecting his research interests which include traffic engineering and control, public transportation, traffic and transit modeling, active transportation, safety and ITS. He currently supervises a team of 11 MAsc and PhD students working to improve performance and safety of transportation systems.

In addition to spending time working with his graduate students, teaching, and conducting research, Dr. Hellinga enjoys hiking, cycling, canoeing, hockey, camping, running (well he does run, but saying he enjoys it may be an overstatement!) and travelling.



## Faculty Feature Cont'd



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### Sample of Current and Recent Research Projects Includes:

- Bill 173, before the Ontario legislature, includes an amendment to the Highway Traffic Act to introduce a rule called “1 meter rule” in which motorists will be required to provide a minimum of 1m lateral clearance when overtaking cyclists. Dr. Hellinga and one of his MASc students, Kushal Mehta, developed a custom sensor array which can be mounted on a bicycle and measure the lateral distance between overtaking vehicles and the bicyclist. They used this array to collect actual lateral distances of over 5,000 overtaking maneuvers on two and four lane urban roads with and without bike lanes. The results indicate that 12% of passing maneuvers had a lateral separation distance of less than 1m on two-lane roadways without bike lanes, and 0.2% on two-lane roadways with bike lanes. On four-lane roadways without bike lanes, they observed that 5.9% of passing maneuvers had a lateral separation distance of less than 1m and only 0.5% on four-lane roadways with bike lanes.
- Road traffic conditions are commonly defined in terms of travel time. Technologies, including Bluetooth detectors, are available to measure travel times of a sample of the vehicle stream in real time. However, these measurements are obtained only after the vehicle has reached the downstream detector and therefore, measurements reflect the recent past. What is needed is the travel time that motorists can expect to experience if they enter the roadway section now or in the near future. The research team has examined a variety of ways of predicting these near-future travel times for both arterial roadways and freeways. It is expected that proactive traffic control strategies can be implemented on the basis of these predictions, which will result in better network performance.
- The reliability of performance provided by the road transportation network is receiving increasing attention. Reliability is typically measured on the basis of the variations in travel times. Studies show that travellers value reliability; however, most existing methods for performing benefit/cost evaluations of candidate road improvement initiatives do not consider the benefits that are associated with improved reliability. In this project, the research team is working to develop a method by which traffic engineers can use existing traffic simulation models to estimate the benefits associated with improved travel time reliability.

Dr. Hellinga and his research team has conducted applied research in these areas for and in partnership with a wide range of public and private sector agencies.

### Websites

WatCAR - <https://uwaterloo.ca/centre-automotive-research/>

WPTI - <http://www.civil.uwaterloo.ca/wpti/>

WatTRIPS - <https://uwaterloo.ca/transportation-research/>

## Research Focus - Structures Lab

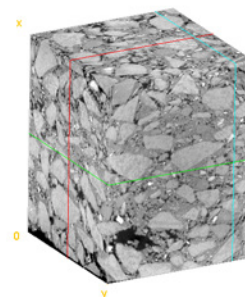


### Image-Mechanics Integration in Material Research

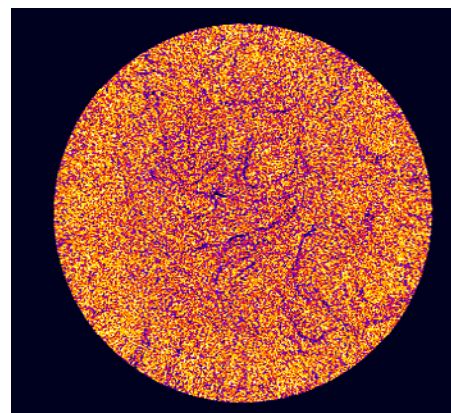
The role of material research has been crucial in the advancement of a wide range of applications including structures, pavement, automotive and emerging biomedical technologies. Engineers have been applying the principles of mechanics to estimate the overall performance of materials. On the other hand, medical professionals have been relying on the image information provided by different imaging techniques to make critical treatment decisions. Integrating imaging into mechanics has emerged as a promising technique to characterize materials performance based on the response of internal components response of materials before failure. In medicine, this innovative technique has shown a great potential in solving a number of challenges associated with tissues deformation in different medical applications such as radiotherapy.

A comprehensive research program has been established to implement the emerging paradigm of material investigations that merges imaging, mechanics, and numerical modeling. This innovative research theme will shift the focus in material characterization from the conventional “overall” performance to a “components-based” investigation. It will also transfer conventional visual image inspection to a detailed image-based mechanical analysis with stress distribution and a deformation map through the development of image-based and “sample specific” finite element (FE) models.

A state-of-the-art computed tomography (CT) imaging system has been used. The system is equipped with a unique combination of high resolution and power making it optimal for a wide range of applications, including hard materials, such as steel, concrete, fiber reinforced polymer (FRP) materials, and asphalt. As well as soft biological tissues. The acquired 3D images provide detailed analysis of cracks, deformation, and void analysis.



**3D image of asphalt illustrates voids, aggregates and mastics**



**3D image of basalt FRP bar shows fiber distribution inside a matrix**

Contact Dr. Adil Al-Mayah for more details

## Student Feature - Magdy Shaheen



### Meet Magdy Shaheen

Magdy Shaheen is a Doctor of Philosophy Candidate (PhD) in the Civil and Environmental Engineering Department at the University of Waterloo. He received his BSc and MSc in 2002 and 2008, respectively from Alexandria University, Alexandria, Egypt. He assisted in teaching four courses at the undergraduate level from 2002 to 2011 at Alexandria University. His research interests include hot mix asphalt characterization and modelling, modified asphalt mixes, pavement design and management systems.

Magdy has over 10 years engineering work experience in the field of pavement engineering. This includes structure and geometric design, and construction of road networks. In 2011, he joined the House of Engineering and Development (HED) for Stantec's Infrastructure Management and Pavement Engineering (IMPE) group at the Kitchener office.

Then in September 2011, he joined the CPATT group to complete his PhD.

### Featured MTO Projects

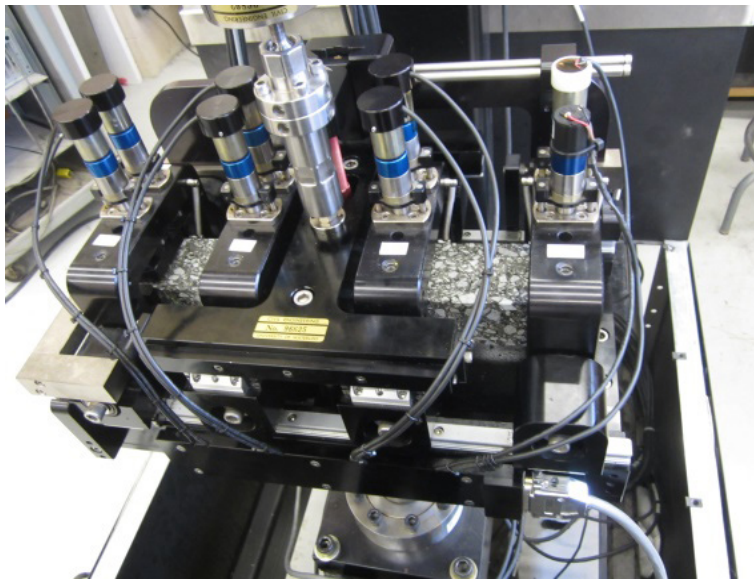
The Ministry of Transportation Ontario (MTO) is funding research projects through the Highway Infrastructure Innovations Funding Program (HIIFP), conducted by the Centre for Pavement and Transportation Technology (CPATT) at the University of Waterloo, Ontario. The first project objective is to improve the fatigue life of Hot Mix Asphalt (HMA) without compromising rutting resistance. The fatigue resistance, stiffness and rutting of asphalt mixes has been investigated by the four point bending test, dynamic modulus ( $|E^*|$ ) and Hamburg Wheel Rut Tester (HWRT). The X-ray Computed Tomography (CT) is being used to characterize the internal structure of asphalt mixes. This project finding is expected to provide a better understanding of the HMA fatigue performance with traditional and advanced methods. The second project involves the development of a database for the dynamic modulus ( $|E^*|$ ) for a wide range of typical Ontario HMA mixtures. The overall research findings of the second project are expected

to support MTO to move towards usage of the AASHTOWare.

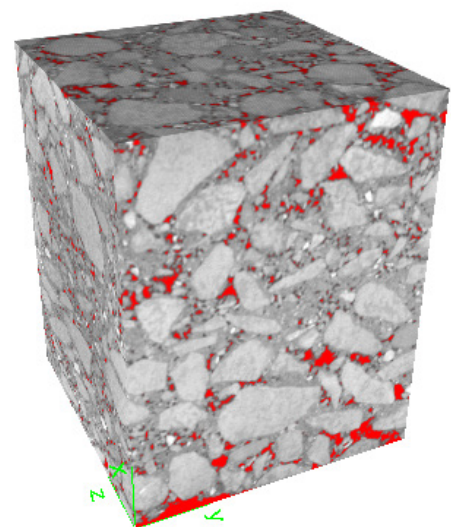


**Saw cutting of HMA Beams and Preparation**

# Student Feature and Project Cont'd



Four Point Bending Test Setup



X-Ray CT Scan



Dynamic Modulus of HMA mixes

## Laboratory Focus



### Warm Mix Asphalt

Sina Varamini is a PhD Candidate in the department of Civil and Environmental Engineering at the University of Waterloo under the Supervision of Dr. Susan Tighe. Sina's research is directed at evaluating the laboratory performance of mixtures containing warm mix asphalt (WMA) additives for usage in Ontario with particular interest on provincial and municipal roads. Warm mix asphalt is defined as a group of technologies that allow for a reduction in the production and placement temperatures of conventional hot mix asphalt (HMA). Despite the potential environmental, and safety benefits of WMA, changes in the production process have raised concerns in regards to the long-term performance of WMA, particularly moisture susceptibility and rutting resistance. In an effort to address these concerns, Sina will conduct comprehensive laboratory testing to systematically evaluate different types of WMA additives on the strength of compacted asphalt mixtures for usage in pavements in Ontario.

Selection of constituent material will be based on the Ministry of Transportation Ontario's Designated Sources for Material (DSM), covering a spectrum of materials suitable for typical Ontario conditions. Such materials are then used to prepare mixtures by using different types of dosages of WMA additives

in combination with different anti-stripping agents and aggregate types. Samples will then be used to evaluate structural performance by performing laboratory testing including freeze-thaw resistance, dynamic modulus, Thermal Stress Restrained Specimen Test, Hamburg Wheel rut testing, Indirect Tensile Strength, and resilient modulus.

One of the main focuses of this project will be to evaluate freeze-thaw durability of WMA. For this purpose, a walk-in freeze-thaw apparatus located in the CPATT laboratory will be used to subject samples to multiple freeze-thaw cycles. Freeze-thaw durability will then be evaluated by performing a number of tests such as dynamic and resilient modulus, and Indirect Tensile Strength.

Dynamic and resilient modulus will be used to evaluate the structural adequacy of asphalt mixtures at testing conditions simulating varying seasonal temperatures and vehicle speed. Thermal Stress Restrained Specimen Test will be used to evaluate the resistance of samples to thermal cracking. The resistance of compacted asphalt mixtures to rutting will be evaluated by using a Hamburg Wheel Tracking Device (HWTM). The HWTM will be used to measure rutting potential as well as moisture sensitivity of Superpave gyratory compacted specimens that are immersed in hot water. The rutting potential is measured as a function of a number of steel wheel passes across the surface of specimens, which can also be used to evaluate moisture sensitivity. All these laboratory test methods will help to better understand the effects of WMA additives on the material properties of the conventional HMA, and can be further linked to long term performance.

## Field Work Focus - Dan Pickel



Dan Pickel is a PhD Student beginning his studies as a member of CPATT. The focus of his research involves the repair of high-traffic asphalt road sections and pre-cast concrete slabs. As part of the information gathering portion of his research, Dan visited the Fort Miller Company precasting

plant in Schuylerville, NY as well as several other sites where precast concrete is a novel process. Observing the traditional usage of precast concrete is invaluable to Dan's research.

The first site visited was the rehabilitation project for a section of Highway I-95 in New York State. The section being repaired had a concrete cross-section approximately 250 mm in depth and was being repaired by removing failed sections and replacing them with Fort Miller's proprietary Super-Slabs. The surface of the roadway had surface texturing created by diamond grinding. The estimated average annual daily traffic of this section of highway in 2011 was approximately 110,000



**Precise technique for placing levelling material**

Repairs to high-traffic roadways involve significant scheduling challenges to ensure that day-time traffic is not unduly affected by the construction. As such, sections of concrete pavement to be replaced are marked and cut the night before removal. On the evening of October 29th, the two right lanes were closed incrementally with the right-most lane closing at 10 pm and the centre lane closing at 11 pm. Once the lanes were closed the following night, the construction procedure was as follows:

- Removal of existing concrete to be hauled off site
- Removal of any extra sub-base material which affects the final elevation of the new slab
- Drilling of dowel holes into the existing pavement using a pneumatic drill
- Placement and compaction of bedding material to tight elevation restrictions
- Insertion and epoxying of smooth dowels into previously drilled holes
- Placement of Super-Slab specific to each measured area
- Placement of bedding grout to ensure full bearing on sub-base material
- Placement of dowel grout to ensure high load transfer between Super-Slab and adjacent pavement (often done the following night to ensure sufficient curing time for grout)



**Repair area ready for placement of Super-Slab**



## Field Work Focus - Dan Pickel - Cont'd



The Yonkers Contracting Company crew kept a pace of approximately 20 slab repairs per night.

The following night, the on-going construction project on the Brooklyn Bridge was visited. Part of the bridge resurfacing project includes the milling of existing approach slabs in order to replace the material with Super-Slabs. Prior to arrival onsite, the asphalt surface layer of the approach had been removed and the milling of the underlying cinder concrete was underway. The milling portion of this operation was relevant to Dan's research as the preparation of asphalt sections for repair with precast concrete will include a similar milling operation.



### Milling of cinder concrete from bridge approach slab

Due to the unique nature of this project, a small milling machine with a width of 4.5 feet was used. This machine allowed for more manoeuvrability on

the irregularly shaped approach slab and also met the weight requirements of the project.

Similar to a highway project, daytime traffic was required to be maintained unimpeded throughout the course of the bridge deck rehabilitation. In order to meet this requirement, large steel plates were used to construct a temporary driving surface to replace the existing driving surface which was milled. Custom wooden supports were made each night to maintain the required surface elevation of the steel plates.

While observing the milling operation, several factors which will be considered in Dan's research became evident, including: a procedure for the removal of excess water left after milling, the milling rate which will determine the length of repair performed in one night, the contour shape at the beginning of a milled section, the surface roughness of the exposed material after milling, and the straightness of a milled edge.

Dan would like to thank the Fort Miller Co. and particularly Peter Smith, Fort Miller's VP of Market Development and Product Engineering, for providing access to all of the sites which were visited as well as knowledge of the state-of-the-practice.

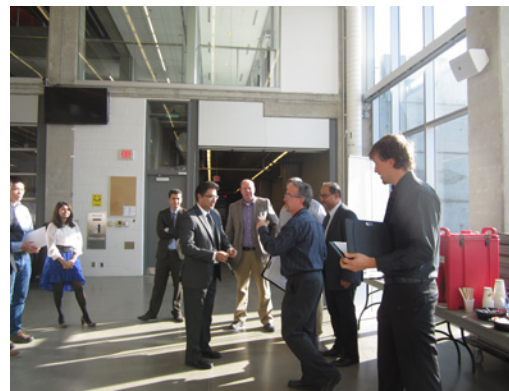


Surface texture of milled surface

## 2014 Graduate Student Poster Symposium



On Friday October 24th, CPATT and the Norman W. McLeod Chair hosted the 4th annual Graduate Student Poster Symposium in the E5 Sedra Student Design Centre. There were a total of 17 student posters. Industry members, faculty, staff and students attended this event and were able to provide great feedback to the students. Congratulations to the winners for the best posters and interesting research. First place went to Tim Bandura for his research on the evaluation of the proposed European rapid screening test for stainless steel rebar. The two runners up were Marcelo Gonzalez for his research on nanotechnology applied in the design of the next generation of concrete pavement surface, and to Sina Varamini for his research on the evaluation of modified mixtures for use in pavement applications. A special thank you to our judges Sandy Brown (OHMPA), Bart Kanters (RMCAO), and David Rhead (MTO).





# CPATT Test Track Aggregate Clean-up



Thank you to all the students that assisted with the aggregate cleanup at the CPATT Test Track in the Fall. We appreciate the team work and everyone who volunteered to help with this.



## Alex Strutzke - Visiting Scholar



Alex Strutzke is a PhD Candidate at Philipps-University Marburg in Germany. Alex visited CPATT from July 2014 to December 2014 to learn more about the research underway at CPATT. His thesis is “The Interdependency of Resource Mining, Transportation and Infrastructure with Natural Conditions and the Society in the Canadian North and Alaska. Chances and Risks of a Changing Climate”. Alex did a short presentation on his work on December 3rd to wrap up his time spent at CPATT. Alex’s presentation can be found [here](#).



## Using Work Tech to Manage Municipal Assets

### Dave Anderson - Short Course



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On December 18, 2014, Dave Anderson, CET, President, 4 Roads Management Services Inc., presented a short course on “How to Use Work Tech to Manage Your Municipal Assets”. Managing a road system is far more complex than simply managing by pavement condition; it is only one factor in the final decision. Managing a road system presents risks from a number of perspectives: financial, performance and liability. WorkTech Asset Manager Foundation provides a robust database that is easily configured to adapt to any attribute set desires, but is pre-configured for the Inventory Manual for Municipal Roads, 1991 and all of the inherent calculations that are defined by the manual.

The presentation focused on the Inventory Manual and its usage and configuration in WorkTech Asset Manager Foundation. Presentation contents included:

- Asset identification
- Existing road condition
- Traffic volume, type and projected growth
- Point rating of road elements
- Type and timing of required improvements
- Improvement costs
- Interpretation of rating, and recognition of the implications of defects found within the road allowance with respect to liability exposure and performance
- The inter-relationship of the data fields and the calculations in the Manual
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Dave Anderson is an Asset Management Specialist with over 30 years of experience as a municipal employee, and approximately 7 years as a consultant. Dave’s municipal career began in surveys and inspection and advanced to spend the last 20 years of his municipal career at the senior manager or department head level. Dave’s municipal experience includes municipalities at the upper-tier, lower-tier, and single-tier levels. His responsibilities have included all infrastructure types and road systems of up to 1,425 centreline-kilometers.

His range of experience includes public works engineering and operations, engineering studies for all types of infrastructure, including Class Environmental Assessments, Master Plans, Road Needs Studies, and capital planning and program implementation. Notably, Dave became the first Manager of Engineering and Infrastructure for the newly formed Haldimand County in the fall of 2000 and was tasked with creating an engineering department for a single-tier municipality, responsible for capital planning and implementation for all assets.

During his municipal career, and then as a consultant, Dave has completed a combined total of over 70 Road Needs/State of the Infrastructure studies or data collection exercises, following the MTO *Inventory Manual* methodology.

## Awards and Recognition



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## Awards and Recognition

**2014 Queen Elizabeth II Graduate Scholarship in Science and Technology - Janki Bhavsar-** Awarded for overall academic excellence.

### **Congratulations to Dr. Adel Sedra**

Dr. Adel Sedra received the designation Distinguished Professor Emeritus on Saturday October 25, 2014 at the University of Waterloo's 109th Convocation. Dr. Sedra retired in 2013 following a long and distinguished record of university leadership, including ten years (2003 - 2012) as the Dean of Waterloo's Faculty of Engineering and a total of 43 years spent in academia.



Dr. Sedra received his BSc Degree from Cairo University in 1964 and MSc and PhD degrees from the University of Toronto in 1968 and 1969, respectively, all in electrical engineering. He joined the University of Toronto in 1969 and served as chair of its electrical engineering department from 1986-1993, when he became vice-president, provost and chief academic officer.

He started at the University of Waterloo in 2003 as the Dean of Engineering. Dr. Sedra holds a number of patents, and is the author of textbooks used at hundreds of universities worldwide.

**Welcome** Prabir Das, PDF; Jennifer Yang, Visiting Professor; and Ye Yu, visiting student funded by the China Scholarship Council.

## New Baby

Congratulations to Amin Hamdi and his wife Duaa on the arrival of their new beautiful baby girl, Youmna. She was born on November 24, 2014 and weighed 3.07kg.



## Norman W. McLeod Chair in Sustainable Pavement Engineering



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### Xuan-cang Wang Seminar

On September 25th, the Norman W. McLeod Chair co-hosted a seminar for students on “Introduction of China’s over 100,000 KM Freeway Network Planning, Design, Construction and Maintenance Management”. The invited speaker, Dr. Wang, Director of Pavement Structure and Material Laboratory, Highway Engineering Institute, Chang’an University, China, presented on his experience with pavement networks in China.

### Rebecca McDaniel Seminar

On November 19th, 2014, the Norman W. McLeod chair co-hosted a seminar for students on “Sustainability in Asphalt Pavements and Materials: Putting Research into Practice”. The invited speaker, Dr. McDaniel, Technical Director North Central Superpave Center Purdue University, presented on her experience with sustainable pavements. Dr. McDaniel has been the Technical Director of Purdue University since 1995. In that position, she is responsible for research into various aspects of asphalt materials, mixtures and pavements, including use of recycled materials, tire-pavement noise, friction and surface characteristics, and more. McDaniel holds Bachelors, Masters and PhD degrees in Civil Engineering from Purdue University and a Bachelor’s degree in English from Indiana University. She is a registered professional engineer in Indiana.

The presentation reviewed recent advances in sustainable practices for building asphalt pavements. The potential benefits and challenges of implementation of these practices were also outlined. The main focus was on the use of reclaimed asphalt pavement (RAP), but other sustainable practices such as use of recycled asphalt shingles, other reclaimed or by-product materials, warm mix asphalt and perpetual pavement were also addressed.

Both Dr. Wang’s and Dr. McDaniel’s presentations can be found at: <https://uwaterloo.ca/centre-pavement-transportation-technology/related-links>



## Contact Us and Upcoming Events



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Dr. Jeff West, Associate Director  
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Dr. Hassan Baaj, Associate Professor  
519-888-4494  
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## Upcoming Events

January 11-15, 2015 - [Transportation Research Board 94th Annual Meeting](#) - Washington, D.C.

May 27-30, 2015 - [Canadian Society of Civil Engineering](#) - Regina, SK.

September 27-30, 2015 - [Transportation Association of Canada Conference and Exhibition](#) - Prince Edward Island.

## CPATT Board Members

Susan Tighe (Director) University of Waterloo  
Jeff West (Associate Director) University of Waterloo  
Rico Fung (Chair) Cement Association of Canada  
John Carrick Jr., McAsphalt Industries Ltd.  
Sandy Brown, Ontario Hot Mix Producers Association  
Becca Lane, Ministry of Transportation Ontario  
Matt Karan, Former Stantec Consulting Ltd.  
Carl Clayton, Stantec Consulting Ltd.  
Gary MacDonald, Regional Municipality of Waterloo  
Murray Ritchie, The Murray Group Ltd.  
Neil Thomson, University of Waterloo  
Ralph Haas, University of Waterloo  
Gerhard Kennepohl, University of Waterloo  
Hassan Baaj, University of Waterloo