



# Norman W. McLeod Chair in Sustainable Pavement Engineering

2014-2015 Annual Report

This report provides an update of the activities of the Norman W McLeod Chair from January 2014 to January 2015 inclusive.

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UNIVERSITY OF  
**WATERLOO**

**NORMAN W. MCLEOD**

CHAIR IN SUSTAINABLE PAVEMENT ENGINEERING

# Scope and Objective of the Chair

The scope of the Chair focuses on emerging and innovative pavement technology, state-of-the-art research infrastructure in areas of design, materials, construction, preservation, safety, and management for tackling specific problems, developing new technologies and training skilled people.

The objective of the Chair is to:

- Provide cutting-edge sustainable pavement engineering research
- Develop sustainable and cost-effective materials, designs, construction and management tools
- Collaborate with government, industry and academia
- Teach and supervise students
- Disseminate findings through seminars, newsletters, papers and reports

One main objective of the Chair is to provide specialized training needed to meet the challenges of transportation engineering in the 21st century. The research and teaching program is designed to develop future leaders and to advance critical partnerships between universities, government, and the private sector.

The Norman W. McLeod Chair in Sustainable Pavement Engineering is in support of the Centre for Pavement and Transportation Technology (CPATT). CPATT has been at the forefront of exceptional research, training and professional activities. This success is rooted in both the experienced and skilled faculty members, as well as the state-of-the-art facilities such as the John J. Carrick Pavement Laboratory at the University of Waterloo, the CPATT Test Track at Waterloo Region's Waste Management Facility and several satellite test sites located across Canada. All of these facilities support the state-of-the-art research program. The current and future research will continue to advance key research needs but will also provide strategic training for the industrial partners and the broader community at large. Development of national and international partnerships will also facilitate technology transfer.

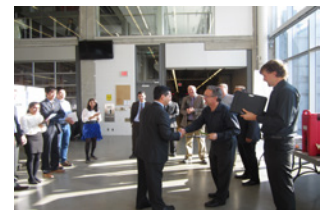
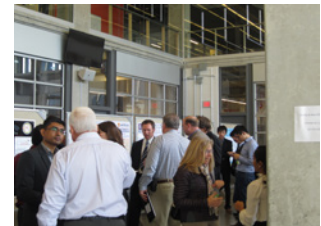
# Partners



We greatly appreciate the continued support of our partners in the Norman W. McLeod Chair in Sustainable Pavement Engineering. Our industry partners are key industry stakeholders and are knowledgeable in the areas of research in which the Chair will pursue. The resources and expertise they provide is extremely beneficial as we move forward on various research initiatives. Below is a list of our partners:

- Canadian Asphalt Industries Ltd.
- Capital Paving Limited
- DBA Engineering Ltd.
- Golder Associates Ltd.
- Holcim Canada Inc.
- LVM-Jegel
- McLeod Endowment
- McAsphalt Industries Limited
- Miller Paving Limited
- Ministry of Transportation Ontario
- Ontario Good Roads Association
- Ontario Hot Mix Producers Association
- Ready Mixed Concrete Association of Ontario
- Roto-Mill Inc.
- Shiloh CanConstruct
- Stantec Consulting Limited
- Steed and Evans Limited

# OUTREACH Symposiums



## Acknowledgements

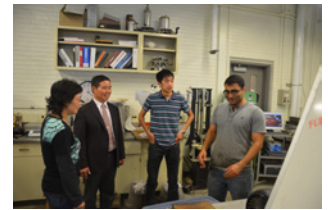
Thank you to all the students that participated in this event, the industry members who attended and our three judges: Bart Kaners (RMCAO), Sandy Brown (OHMPA), and David Rhead (MTO)

## Graduate Poster Symposium

On Friday October 24th, we held 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 Sina Varamini for his research on the evaluation of modified mixtures for use in pavement applications.



# OUTREACH Seminars



## Xuan-cang Wang

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. Professor Wang holds a BSc and a MSc degree in pavement engineering from Xi’an Highway Institute, and a PhD in civil engineering from the Tongji University. Professor Wang has authored over 200 technical publications in pavement and infrastructure, among which 33 articles are indexed by EI, and he is the author of seven published books. Professor Wang has been involved with over 100 research projects in the area of transportation, including the Ministry of Transportation of China’s Western Highway Development Projects, review and development of a series of highway pavement design, construction and maintenance technical specification projects sponsored by Chinese national and/or provincial special research funding. His key research interests are pavement structure and material, subgrade engineering, and highway economy and engineering management.

The complete presentation can be found at: <https://uwaterloo.ca/centre-pavement-transportation-technology/related-links>

We greatly appreciate Prof. Wang for taking the time to visit the University of Waterloo.

# OUTREACH Seminars



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## Rebecca McDaniel

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, presented on her experience with sustainable pavements. Dr. McDaniel is the Technical Director of the North Central Superpave Center at Purdue University, a position she has held 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.

The complete presentation can be found at: <https://uwaterloo.ca/centre-pavement-transportation-technology/related-links>

We greatly appreciate Dr. McDaniel for taking the time to visit the University of Waterloo.

# OUTREACH Seminars



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## A.O. Abd El Halim

On January 5, 2014, the Norman W. McLeod Chair co-hosted a seminar on “The AMIR Compactor: From Conception to Construction”. The invited speaker, Dr. Halim, Professor, Carleton University, presented on the AMIR Compactor. Dr. Halim is a tenured professor and has completed his second term as the Chair of the Civil and Environmental Engineering Department in July 2010, Carleton University. He was also the first Director of the newly established Master Program in Infrastructure Protection and International Security. He has also been the Director of the Centre for Geosynthetic Research Information and Development, C-GRID since 1987.

The presentation reviewed the AMIR Compactor. Since the design and construction of the laboratory Asphalt Multi Integrated Roller, AMIR, in 1987, two versions and/or prototypes were built and tested in the field in several continents. The results of these field tests showed the potential benefits and advantages of this promising new technology. This presentation dealt with the steps that led to the design and manufacturing of the AMIR. It discussed the theoretical, laboratory and field phases which were completed to reach a working prototype.

The complete presentation can be found at: <https://uwaterloo.ca/centre-pavement-transportation-technology/related-links>

We greatly appreciate Dr. Halim for taking the time to visit the University of Waterloo.

# OUTREACH

## Dave Anderson



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### Using Work Tech to Manage Municipal Assets

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



# OUTREACH Showcases



## International Research Showcase

The Norman W. McLeod Chair and the Centre for Pavement and Transportation Engineering (CPATT) participated in the International Research Showcase hosted by the Waterloo International Office on November 20th, 2014. This event was part of the International Education Week (IEW). Many hosted international themed events were hosted throughout the week. The hope of this event was to promote mobility of programs and further the internationalization goals of the university.

## WE Innovate

The Norman W. McLeod Chair and CPATT participated in WE Innovate hosted by the Faculty of Engineering on November 19th, 2014. This years theme was “The Connected Age”. Research topics related to the Internet of Things, wearable technology, smart grid, connected/autonomous vehicles, advanced manufacturing, nanotechnology, operations management and more were included in this event.

# Welcome Prabir Das



Prabir has joined as a Post-doctoral Fellow in the Department of Civil and Environmental Engineering at the University of Waterloo from October 2014. Prior to this, he obtained his doctorate degree in Pavement Engineering from KTH Royal Institute of Technology-Sweden, which is one of the top ranked technical universities in Europe. Prabir also has two years of research engineer experience from the same institute. He is an expert on aging and low temperature fracture of asphalt mixture, warm mix asphalt, rheology and micromechanical properties of asphalt binder.

## Research Interests

- Low temperature cracking performance of asphalt mixture
- Investigation on age hardening or durability of asphalt mixture
- Micro-mechanical analysis on bitumen and connect it with fundamental understanding of material behaviour
- Innovative materials for better performing pavements
- Asphalt pavement recycling with reclaimed asphalt pavement (RAP)

## RECENT PROJECTS

Title	Agency	Year	Status
Performance Evaluation of Coloured Asphalt Pavements and Surface Treatments for BRT Lanes in York Region	York Region	2014-2016	Active
Upgrade of U of Waterloo's primary confocal microscope for 37 users with state-of-the-art correlative microscopy	NSERC- Research Tools and Instruments - Category 1 (Co-PI), PI - David Spafford (UW)	2014-2014	Applied For
NSERC Strategic Network for Cement and Concrete Innovation	NSERC Strategic Network (Co-PI), PI - Doug Hooton (UofT)	2014-2019	Applied For
Effect of Warm Mix Additives on Tensile Strength of Compacted Asphalt Mix	Ministry of Transportation Ontario	2014-2015	Active
Improvement Strategies for Upstream Heavy Oil Mining Roadways	Imperial Oil	2014-2015	Active
Comparing Cold In-place Recycling (CIR) and Cold In-place Recycling with Expanded Asphalt Mixture (CIREAM)	NSERC - CRD and McAsphalt Industries	2013-2015	Active
Engineering Criteria and Standards for Key Pavement Performance Indicators Used in Pavement Management	Ministry of Transportation Ontario	2013-2014	Active
Development of Acceptance Test Methods Related to Performance and Durability of Pervious Concrete	Ministry of Transportation Ontario	2013-2015	Active
Sustainable Long Life Concrete Pavements	NSERC-CRD, and the Cement Association of Canada	2013-2016	Active
Improving the Fatigue Performance of Hot Mix Asphalt	Ministry of Transportation Ontario	2012-2014	Completed
Determination of Dynamic Modulus for Hot Mix Asphalt (HMA) required for MEPDG Implementation	Ministry of Transportation Ontario	2012-2014	Completed
Evaluation of Rubber Modified Asphalt: Past, Present, Future	Ontario Tire Stewardship	2012-2014	Completed
Determining Quantity of Recycled Asphalt Pavement (RAP) in HMA Research	NSERC- CRD, Ontario Hot Mix Producers Association, MTO	2012-2014	Completed

# FUNDING

## **Total Effective Financial Resources**

Initial investment of \$1,500,000 and renewals of \$375,000 has resulted in approximately \$1,575,000 research funds and \$300,000 funding towards students. Some of the funding for students comes from research projects but also funding comes from scholarships and assistance as described below. In addition, it has enabled for open houses, symposiums and seminars to be hosted. The Chair program is fully utilizing the original \$10 million CPATT laboratory.

## **Faculty and Personnel Salary**

The salaries for faculty and personnel are approximately \$300,000/per year. These salaries include: Susan Tighe, Laura Bland (Administrative Assistant), Prabir Das (Research Associate), part salary to support Chair for Anca Constantinescu (Faculty Financial Officer), and part salary to support the Chair for Heidi Mussar (Assistant Director, Graduate Financial Aid & Awards). These salaries are provided by the Canada Research Chair program and the University Operating Budget with the exception of Laura Bland and Prabir Das, whose salaries are from the CPATT Operating Budget and research funds.

## **Student Salary Assistance**

Total annual funding from student assistance programs is approximately \$120,000/year. The following is a list of student assistant programs that are included in this amount.

- NSERC USRA
- Ontario Graduate Scholarships, Civil and Environmental Engineering Scholarships, President's Graduate Scholarships, Dean's Incentive Program
- Saudi Arabian Scholarship Funds
- Transportation Association of Canada Scholarships
- Canadian Technical Asphalt Association Scholarships
- Queen Elizabeth Scholarships
- Scholarship for Ministry of Higher Education and Scientific Research/Scholarship & Cultural Relations Directorate - Republic of Iraq
- Becas-Chile Scholarship - Chilean National Scholarship Program for Graduate Students
- Part-time students - part-time students salaries are covered by industry

# FUNDING

## **Awards**

- J. Alan George Student Leadership Award - Gulfam Jannat
- Bleeds Black Award (OHMPA) - Susan Tighe
- Queen Elizabeth II Scholarship - Gulfam Jannat and Dan Pickel
- Ontario Graduate Scholarship - Sina Varamini
- 2014 Irene Marguerite McLeod Postgraduate Scholarship - Doubra Ambaiowei
- 2014 Canadian Technical Asphalt Association Graduate Scholarship - Gulfam Jannat
- 2014 TAC Award of Academic Merit - Susan Tighe
- 2014 TAC Foundation Scholarship - Sina Varamini, Adam Felinczak, Edward Lau
- 2014 The College of New Scholars, Artists and Scientists, induction into the Inaugural Cohort of the Royal Society of Canada - Susan Tighe

## **Industry Hosted Events**

- Participation in Ontario Good Roads Association Municipal Academy
- Ontario Hot Mix Producers Association - Fall 2014 Seminar

## **Completion of Students**

- Cheng Zhang, MAsC , Research Engineer, CPATT
- Marcelo Gonzalez, PhD., Assistant Professor, PUC
- Doubra Ambaiowei, PhD, Research Engineer, CPATT
- Xiomara Sanchez, PhD., Assistant Professor, University of New Brunswick
- Dan Pickel, MAsC, PhD Candidate
- Karolina Konarski, MAsC., Pavement Engineer, LVM Inc.
- Mohammed Hegazi, MAsC., Pavement Engineer, Stantec
- Andrew Northmore, MAsC., Transportation Specialist, Forensic Engineering Inc.



# Keynotes and Future Plans

## Keynote Addresses

- 2014. “Recycling: Why Not? What are you waiting for?”, National Quarry New Zealand Conference, Auckland, New Zealand, July
- 2014. “Sustainable Asset Management”, International Seminar on Advanced Methodologies for Managing Construction Projects, Santiago, Chile, September
- 2014. “Performance Based Contracts for Infrastructure Projects”, International Seminar on Advanced Methodologies for Managing Construction Projects, Santiago, Chile, September
- 2014. “Effective Asset Management for Transportation Engineering”, Intelligent Transportation Research Centre, Chang’an University, Xi’an, China, November
- 2014. “Usage of Key Performance Indicators to Manage Road Networks”, National Conference hosted by China Communications Construction Association, Xi’an, China, November
- 2014. “Best Practices in Pavement Design and Management: A Canadian Case Study”, Shanxi Provincial Research Institute of Communications, Taiyuan, China, November.

## Future Plans

The Research Road Map of the Norman W. McLeod Chair in Sustainable Pavement Engineering, prepared in September 2012, has provided a global and clear vision to research orientation of the Chair in the future. The Road Map stated that the Chair will work towards improving knowledge and conduction leading edge research under three pillars: Technical/Economic, Environmental and Social. Several potential research topics were then identified and some projects have already been launched within the framework of the vision. New research projects will be launched in the near future in order to achieve the objective of the Chair as stated earlier in this document. The following are some of these potential topics:

- Mechanistic eco-design of rigid and flexible pavement structures
- Integration of Life Cycle Analysis approach in pavement design
- Intelligent pavement infrastructures
- Use of Nanomaterial to improve the performance of pavement infrastructure
- Alternative artificial aggregates in pavement materials
- Use of Self-healing materials in asphalt mixes
- Ageing and rejuvenation of bituminous binders and optimisation of the use of recycled materials
- Hydraulic Road Binders for soil stabilisation
- Durable and sustainable solutions of rigid and flexible pavement preservation and rehabilitation

## Contact Us



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