Norman W. McLeod Chair in Sustainable Pavement Engineering

2015-2016 Annual Report

This report provides an update of the activities of the Norman W McLeod Chair from January 2015 to January 2016 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 Inc.
- CRH Canada
- DBA Engineering Ltd.
- EnGlobe
- Golder Associates Ltd.
- McLeod Endowment
- McAsphalt Industries Limited
- Miller Paving Limited
- Ministry of Transportation Ontario
- Ontario Good Roads Association
- Ontario Hot Mix Producers Association
- Concrete 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: Anton Kucharek (McAsphalt Industries Ltd.), David Rhead (MTO), and Mick Prieur (RMCAO).

Graduate Poster Symposium

On Friday October 30th, we held the 5th annual Graduate Student Poster Symposium in the E5 Sedra Student Design Centre. There were a total of 16 student posters. Industry members, faculty, staff and students attended this event and were able to provide great feedback to the students. Congratulations to the three winners for the best posters and interesting research: Ben Dow for his research on development and study of UHPC as a closure strip material in prefabricated bridge applications, Magdy Shaheen for his research on the effect of high friction aggregate and PG plus on surface hot asphalt mixtures rutting: laboratory and image based characteristics, and Colin Van Niejenhuis for his research on stainless steel reinforcing alloys corrosion.

OUTREACH
Seminars

Prof. Ahmed Shalaby

In December 2015, the Norman W. McLeod Chair co-hosted a seminar for students on a large study that was conducted by the University of Manitoba on Culvert Performance Under Various Roads.

The invited speaker, Dr. Ahmed Shalaby is a professor of civil engineering and a professional engineer specializing in pavement design and highway materials. He has taught at the University of Manitoba since 1998, where he leads the Pavement Research Group. His research aims to improve the performance of road materials and pavement structures and to improve the maintenance and construction practices in Canada and around the world.

The presentation from this seminar can be found here: https://uwaterloo.ca/centre-pavement-transportation-technology/related-links

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

OUTREACH
International Collaboration

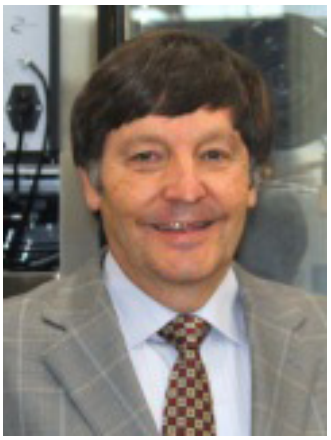
International Collaboration Initiatives

The Centre for Pavement and Transportation Technology has signed, in November 2015, a Letter of Intent with the Road and Traffic Engineering College at Yangzhou University and Jiangsu Tianlong Continuous Basalt Fiber C., Ltd. The cooperation between the three parties will focus on the use of engineering projects derived from the basalt rock in the road and infrastructure construction materials and rehabilitation techniques. The company, Jiangsu Tianlong, produces several products such as chopped basalt fiber, basalt FRP reinforcement bars, geogrids and geofabrics. Thanks to the exceptional tensile strength of the basalt fibers, the research teams believe that the use of these products in pavement materials (asphalt mixes and Portland cement concrete) and for the reinforcement and rehabilitation of infrastructure concrete elements would be very beneficial.

The cooperation will also allow graduate students and researchers from both universities to collaborate together through exchange opportunities between the two teams.

The signature of the collaboration agreement between Jiangsu Tianlong Continuous Basalt Fiber C., Ltd. and CPATT was part of the Ontario Business Mission to China of Ontario Primer, Hon. Kathleen O. Wynne.

OUTREACH
University of the Sunshine Coast



Mark Porter

John Yeaman

Greg White

Sabbatical in Australia

In 2015, Susan Tighe spent a 9-month sabbatical with the pavement engineering team at the University of the Sunshine Coast, near Brisbane, Australia. The small but enthusiastic team includes: Professor Mark Porter, Head of Discipline, Engineering, Professor John Yeaman, Construction Engineering, and Associate Professor Greg White, Airport and Pavement Engineering. The intention is that USC will continue to collaborate with the Norman W. McLeod Chair. We are expecting to work corroboratively on projects related to road and airport pavements.

The University of the Sunshine Coast is Australia's faster growing University and in 2016 celebrated its twenty year anniversary of its first lecture. The Pavement Engineering team may be small but it has grand vision and ambition. Research activities are broadly divided into road pavement and airport pavement streams, with significant overlap in the areas of material characterisation and pavement instrumentation. Recent and current undergraduate and postgraduate projects and activities include:

- Analysis of data from full in-pavement temperature, moisture and strain instruments
- The impact of crude oil and bitumen changes on asphalt performance
- Comparing near surface stresses and strains with finite element and layered elastic models
- Premium binders for airport asphalt production
- Asphalt shearing and shoving in heavy aircraft braking zones
- Causes of top down cracking in asphalt pavements
- Modification to the ACN-PCN for identification of surface distress in asphalt runways.

CURRENT PROJECTS 2015/2016

Title	Agency	Year	Status
Evaluation of Reclaimed Concrete Material as Aggregate for OPSS Granular B Type II	Ministry of Transportation Ontario	2015-2016	Active
Effect of Extraction and Recovery Method and Solvent Type on Properties of Recovered Binder	Ministry of Transportation Ontario	2016-2016	Active
Optimisation of the use of recycled glass-base artificial lightweight aggregates in the pavement structure	Ontario Centres of Excellence and Foamyna Canada	2015-2016	Active
Effect of Oxidation Products of Iron Sulphide Minerals in Aggregate on the Chemical/Rheological Properties of Asphalt Cement	Ministry of Transportation Ontario	2015-2017	Active
Development of High Modulus Asphalt mix design technology for use on Ontario's Highways	Ministry of Transportation Ontario	2015-2017	Active
Performance Evaluation of Pre-cast Concrete Panels over Asphalt	Ministry of Transportation	2015-2017	Active
Improvement Strategies for Upstream Heavy Oil Mining Pavements	Imperial Oil	2015-2017	Active
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 Tenstile Strength of Compacted Asphalt Mix	Ministry of Transportation Ontario	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
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
U-Fill Utilization of Recycled Materials	City of Toronto	2014-2016	Active

FUNDING

Total Effective Financial Resources

The initial investment was $1,500,000 and approximately $1,750,739 as of April 2015. 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.

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
- Ontario Centres of Excellence
- Chinese Scholarship Council
- 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

- Queensland Pavement Center, University of the Sunshine Coast - Susan Tighe
- Ontario Graduate Scholarship - Sina Varamini and Dan Pickel

Industry Hosted Events

- Participation in Ontario Good Roads Association Municipal Academy
- Ontario Hot Mix Producers Association - Fall 2015 Seminar

Completion of Students

- Janki Bhavsar, MASc., Operations Coordinator, Lafarge
- Sonia Rahman, MASc., Assistant Professor, PUC
- Alain Duclos, MASc., Principal Pavement Engineer, LVM Inc.
- Amr Ayed, PhD., Project Manager, Stantec Consulting Inc.
- Aleli Osorio, PhD., Research Associate, Pontificia Universidad Catholica de Chile
- Amin Hamdi, PhD., Assistant Professor, King Aziz University Saudi Arabia
- Magdy Shaheen, Assistant Professor, Alexandria University
- Prabir Das, Postdoctoral Candidate, Pavement Engineer, SNC Lavalin

Keynotes and Future Plans

Keynote Addresses

- 2015. "Incorporating Sustainability and Climate Change: Impacts into Transportation Asset Management: Engineering Long Term Infrastructure", 18th Conference on Pavement Technology and Management, Chinese Society of Pavement Engineering, Taichung, Taiwan, October
- 2015. "Overview of Research Activities at CPATT", 2015 Colloquium of the GRINCH (Groupe de Recherche en Ingénierie des Chaussées), Laval University, May 26, 2015
- 2015. "Sustainability and Pavement Management in Canada: Can They Be Combined?", RIMS Forum, Auckland, New Zealand, March

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

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