CPATT
CENTRE FOR PAVEMENT AND TRANSPORTATION TECHNOLOGY

CPATT NEWS

Issue 14 - Summer 2015

NORMAN W. McLEOD
CHAIR IN SUSTAINABLE PAVEMENT ENGINEERING

Message from the Director

Welcome to our Summer 2015 addition of CPATT News!

We hope all your projects have been successful to date and wish you all continued success as the construction season progresses.

In this newsletter we highlight some of the various projects underway at CPATT. Also, we highlight some events and special features.

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 Norman W. McLeod Professor in Sustainable Pavement Engineering
Director of CPATT

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CSCE Chapter Field Visit to Pearson International Airport

UNIVERSITY OF WATERLOO

Faculty Feature

Dr. Carolyn Hansson, Ph.D., P.Eng.

Dr. Carolyn Hansson is a Professor in both the Mechanical and Mechatronics Engineering and the Civil and Environmental Engineering Departments at the University of Waterloo and a faculty member of the Centre for Pavement and Transportation Technology. She received her B.Sc., A.R.S.M, D.I.C and Ph.D in Metallurgical Engineering from Imperial College, London University. She has lived and worked in the UK, USA, Denmark, and Canada and has been employed in private sector research (Martin Marietta Research Laboratories and AT&T Bell Laboratories - now Lucent Technologies), a not-for-profit consulting company (the Danish Corrosion Centre) and in academia (Columbia University, the State University of New York at Stony Brook, Queen's University and the University of Waterloo).

She was Vice-President University Research at Waterloo, and was responsible for facilitating the research activities of faculty members across all disciplines of the university. After this, she reverted to her favourite roles as research engineer and instructor and mentor for students.

Her research has covered many aspects of environmental degradation of materials, particularly the corrosion and erosion of metals and alloys. Over the last 20 years, her major focus has been the durability of infrastructure materials, particularly the chloride-induced corrosion of reinforcing bar and those properties of the concrete which affect this process. Dr. Hansson has published over 160 papers and reports and has conducted over 50 research projects on time and within budget. In addition, she has worked with consulting companies and the Ministry of Transportation Ontario in corrosion monitoring of bridge structures, with Alberta Transportation in evaluating rebar corrosion problems and in the design, installation and monitoring of corrosion probes in several bridge structures in B.C., one in Nova Scotia and in the Confederation Bridge (although the probes in the latter were not monitored). Her current research is focused on the application of corrosion-resistant alloys as reinforcing materials with a view to understanding the influence of the metallurgy on the corrosion resistance and prediction of the relative life-cycle costs of the different alloys.

She has served on a number of professional boards and committees including the Natural Sciences and Engineering Council of Canada, the Minister's National Advisory Council for CANMET, the US National Materials Advisory Board as well as the boards of a number of not-for-profit technical and professional organizations. She is a licensed Professional Engineer in Ontario and a Chartered Engineer in the UK. She is a Fellow of the Royal Society of Canada, the Canadian Academy of Engineering, the Danish Academy of Technical Sciences, the US Minerals, Metals and Materials Society, the UK Institution of Materials, Minerals and Mining and the American Concrete Institute and is the recipient of a number of professional awards.

In July 2015, Carolyn was named a Member of the Order of Canada for her many contributions. Congratulations Carolyn!

Research Focus - Structures Lab

Fatigue Resistance of Shear Stud Connectors on Steel Girders

The fatigue resistance of bridges is a key topic related to transportation infrastructure durability. It is especially important for bridge components that cannot be inspected for signs of fatigue. In 2014, two research projects on the fatigue resistance of stud shear connectors were initiated at UW, sponsored by the Ontario Ministry of Transportation and the Steel Structures Education Foundation (with additional support from NSERC). An in-depth literature review defined the gaps that the experimental and analytical research would address. Specifically, these gaps include the inconsistent practice of using push-test data as a safe guide to designing shear studs in composite beams, and the question of the consequence of failure of individual shear studs on the capacity of a bridge. The latter question is especially important as bridges become older and their replacement is delayed in jurisdictions with aging infrastructure and limited maintenance budgets.

The research is investigating the fatigue performance of the shear studs in composite bridge girders with two configurations. The first considers a standard cast-in-place concrete deck construction with distributed shear studs. The second considers full-depth precast concrete decks that utilize grouped shear studs coinciding with pockets in the deck panels. The latter system is used when accelerated bridge construction is desired. The experiment design was undertaken to ensure that the planned fatigue tests could be completed in a timely manner, and that key behaviour could be observed by the placing of instrumentation. The experimental design included connector spacing, cyclic loading locations and magnitudes, and construction materials. Beam fabrication is now underway, and twelve composite beams including six cast-in place beams and six precast beams have been cast to date.

Photos of the specimens are shown.

Fatigue testing will be initiated this summer.

The task of finite element analysis has been ongoing since the experiment design stage. One model has been developed of the experiment specimen, and another is being developed of a full bridge. These models will be used to assess the experimental results and a reliability analysis will be carried out to quantify the consequence of shear connector failure. The test program will significantly add to the existing data of shear connector fatigue beams. The next steps include testing of the first six beams specimens, fabrication of six more beams (the forms will be reused), and continuing analytical work. Contact Dr. Scott Walbridge, Dr. Jeff West, Matthew Sjaarda, or Taylor Porter for further details.

Cast-In-Place Slab Specimen (note girder)

Specimens after casting (precast with stud pockets)

Student Feature - Sonia Rahman

Meet Sonia Rahman

Sonia is a MASc. Candidate in the department of Civil and Environmental Engineering at the University of Waterloo, under the supervision of Dr. Susan Tighe. Sonia was born and brought up in Bangladesh. She completed her undergraduate studies in 2012 at the University of Engineering and Technology, the best engineering university in Bangladesh. She started her career working at a construction company in her home country. Sonia always had a desire to continue her education, so she started her Masters degree in the CPATT group in Winter 2013.

In addition to her studies, she has also been serving as the Vice President Internal for the Graduate Student Association (GSA) at the University of Waterloo from May 2014.

Sonia completed her Masters Degree in Winter 2015.

Development of Durability Performance related Test Methods for Pervious Concrete Pavement

This research is being funded by the Ministry of Transportation Ontario (MTO) under the Highway Infrastructure Innovation Funding Program (HIIFP). Other funding provided for this project is from the Cement Association of Canada (CAC) and the Natural Science and Engineering Research Council of Canada (NSERC).

The introduction of pervious concrete into pavements in cold weather climatic regions, specifically Canada, was driven by their sustainable benefits. However, there has been caution in the pavement industry to the use of pervious concrete in climates that experience freeze-thaw cycles.

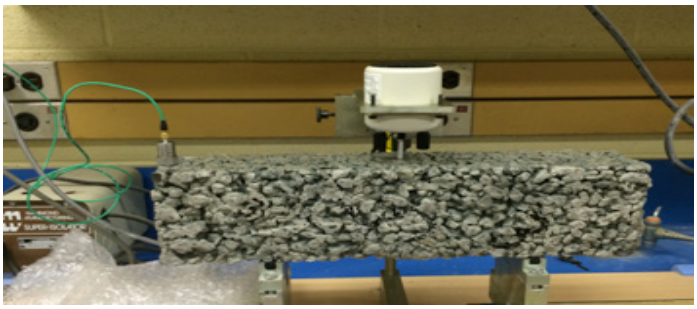
This research was intended to examine which test methods should be used to ensure a high quality pervious concrete pavement is achieved. Another objective of this research was to evaluate the performance criteria for pervious concrete pavement tested for flexural strength, ravelling, abrasion, permeability, scaling resistance, and freeze-thaw resistance.

The major outcome of this research is to define the draft test methods for pervious concrete pavement. Also, field samples were collected from selected field sites and the draft methods were performed to evaluate the applicability of the developed test methods and determined the probable reason of observed field distresses.

Student Feature and Project Cont'd

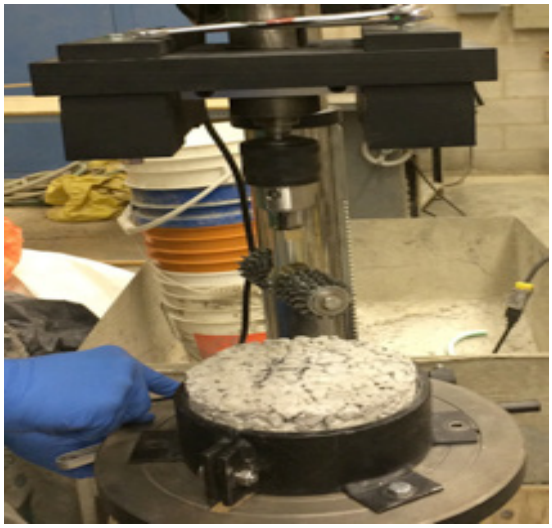
A framework was also developed to identify how pervious concrete can be integrated into low volume infrastructure with detailed functional and structural design considerations, which can help the designers at implementing the technology.

Pervious concrete

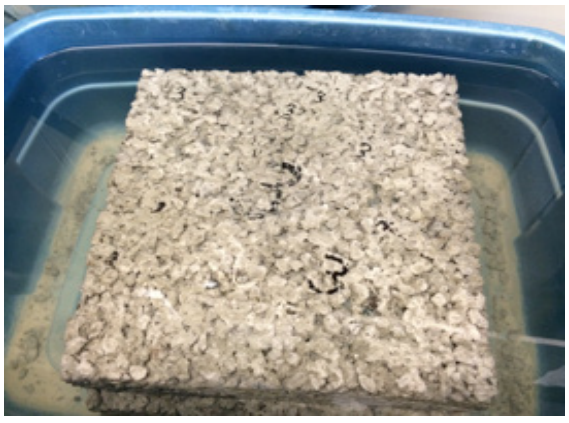


Frequency Testing for Freeze Thaw Resistance

Hamburg Wheel Rutting Testing



Abrasion Testing



Scaling Resistance Testing

Student Feature - Yassaman Yousefi

Meet Yassaman Yousefi

Yassaman Yousefi is a Ph.D Candidate in the civil and environmental department at the University of Waterloo. Yassaman completed her BSc in computer engineering in Iran and her MSc in IT management at Lancaster University in England. After finishing her master's degree in England, she has been involved with projects relating to material processing and planning as well as management for the last ten years. In June 2012, Yassaman became a research member in a project group for research and analysis of a new innovative insulation material based on recycled glass. Following this research, Yassaman joined the Centre for Pavement and Transportation Technology and the department of civil and environmental engineering to work on her Phd in the area of foam glass aggregate.

Glass is ideal for recycling and can be recycled multiple times. Currently, the usage of glass is increasing especially in the food and beverage industry due to health concerns. Therefore, recycling of glasses is becoming a big dilemma in Canada. Different glasses such as container mixed glasses, float glass, windshield glass and contaminated glass are being vigorously collected but poorly recycled. Less than 30% of the 400,000 tonnes of waste glass in Ontario is currently recycled and a big part of this is fine powder waste which goes to landfills.

One solution is foam glass aggregate. Foam glass is normally made from 97% recycled glass. It is an innovative lightweight material for applications in road construction and building industries. The recycled glass used in the present formulation can be taken from clear and mixed coloured industrial wastes.

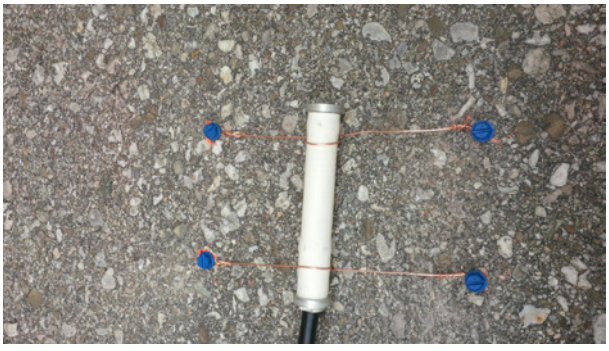
The innovative properties of the material such as anti-bacterial, catalytic and hydrophobic are considered for surface treatment of the materials. Using this material in subbase will prevent frost heave and cracking during spring time as the unique drainage characteristic of this material does not allow the water to be trapped and absorbed in the aggregate layers.

Field Work Focus

A project currently being studied at CPATT is the concrete overlay rehabilitation of Sprague Road in the Region of Waterloo. The initial study involved monitoring the traffic management strategies at the site to produce a case study for effective management of a 2 lane rural highway overlay. The study investigated the effectiveness of signage, maintaining resident access to properties, construction staging strategies, and modifications to all of these aspects which were made to facilitate the process.

During concrete placement, strain gauges were installed at the interface between the concrete and the asphalt separation layer. These gauges will provide insight into the strain behaviour at the bottom of the unbonded overlay. The strains observed will be both static and dynamic in nature.

Concrete overlay being placed at Sprague Road, Region of Waterloo



Strain gauge affixed to asphalt separation layer

Another on-going project at CPATT is studying the potential of using recycled asphalt and concrete in the production of unshrinkable fill. U-fill, as it is known, is a flowable material which does not require compaction or vibration. This makes it ideal for backfilling applications which have traditionally used granular fill, such backfilling sewer and utility trenches and retaining walls. U-fill has low strength in comparison to typical concrete in order to facilitate hand excavation at later points in time. As a result, it could potentially be an ideal application for the use of recycled materials.

Test sections of U-fill with varying proportions and types of recycled materials have been placed as part of a study involving the City of Toronto, The Miller Group, LVM, and the Cement Association of Canada. Currently lab work is on-going to determine the ideal mixture proportions of U-fill to limit mix water bleeding while maintaining sufficient bearing capacity.

U-fill sample during bleeding test

Highlights

An ongoing research at CPATT is to identify effective future maintenance and rehabilitation practices to maintain the structural, colour, and functional performance of the coloured asphalt design for Bus Rapid Transit (BRT) lanes located along the three most heavily travelled roads in York Region, Ontario; Yonge Street, Highway 7, and Davis Drive.

Currently, plant and laboratory produced coloured asphalt mixtures are being tested at CPATT to evaluate the current performance and predict the future performance. These results will be then integrated with field observations and automated distresses survey of existing road sections to provide a greater understanding of the material. Also, CPATT is working closely with the York Region and the construction contractor planning to install sensors that are capable of capturing pavement responses under heavy articulated bus loadings, as well as climatic conditions. Pavement responses can be then used to develop deterioration models to provide accurate measure of long-term behaviour of coloured asphalt pavement.

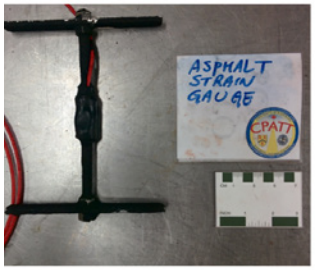
Highway 7 BRT-Lane, York Region, Ontario, May 2015

Paving mixture piling

Highlights Cont'd

Red Asphalt paving on a section of Hwy 7
BRT Lane, York Region, August 2014

Sampling of the material



Types of sensors for a section of York Region
BRT Lane

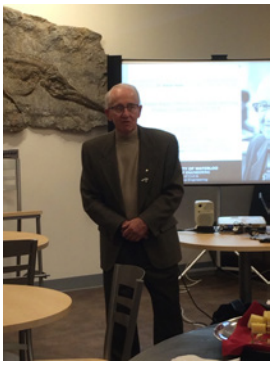
Awards and Recognition

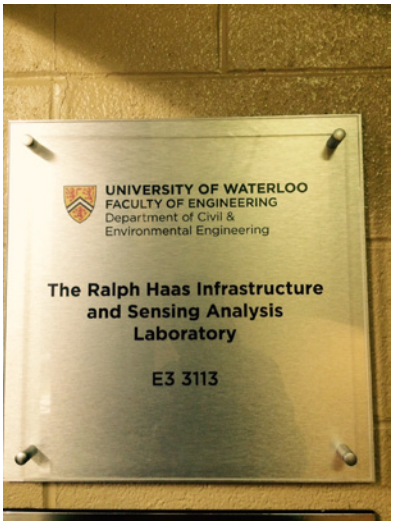
2015 President's Graduate Scholarship - Dan Pickel- Awarded to recognize the outstanding achievements and potential.

2015 Ontario Graduate Scholarship - Sina Varamini - Awarded for excellence in a graduate program

2015 Order of Canada - Dr. Carolyn Hansson - awarded for her contributions as a materials engineer whose efforts have reduced corrosion and improved the performance of reinforced concrete structures.

2015 Engineering 3 Laboratory named in honour of Ralph Haas - the Infrastructure and Sensing Analysis Laboratory for his many contributions to UW. More information can be found here.





New Baby

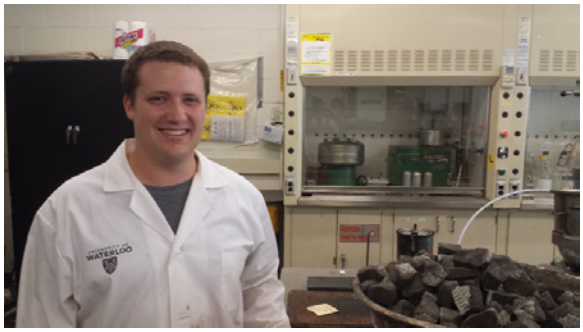
Congratulations to Hanaa Al-Bayat and her husband Waleed Aziz on the arrival of their new beautiful baby girl, Anas Waleed Aziz. She was born on January 22, 2015 at 5:45pm.

Congratulations to Marcelo Gonzalez and his wife Gloria Stephens on the arrival of their beautiful baby girl, Sofia Gonzalez Stephens. She was born in Santiago, Chile on July 6, 2015 and weighed 3.2 kg.

Norman W. McLeod Chair in Sustainable Pavement Engineering - New Students

Hawraa Kadhim is a Ph.D. student in the Civil and Environmental Engineering Department at the University of Waterloo. She received her M.Sc. degree in Transport Engineering and Planning from London South Bank, England in 2013-2014 and a B.Sc. degree from Almustansria University, Iraq in 2012.
Hawraa joined the CPATT team in Winter 2015. Her Ph.D. research focuses on the investigation of the use of some "magic" additive to the asphalt to help self-heal after fatigue or thermal cracking or mitigate the initiation and the propagation of these cracks. She currently investigates the impact of using Phase-Change Materials to generate local heat at cold temperatures in the asphalt binder which would help asphalt to dissipate thermal stresses. She also started investigating the use of Self-Healing Materials that would repair the cracks in the mix but also the use of anti-oxidants to delay binder ageing and then delay cracking.

Hawraa is fan of history and cultures. She loves reading and travelling to discover new places and meet with people.



Adam Schneider is a MASc student in the Department of Civil and Environmental Engineering at the University of Waterloo. He completed his BASc in Geological Engineering at Waterloo in 2011. He subsequently worked at Thurber Engineering in Oakville and at Capital Paving in Guelph before joining CPATT in May 2015. His research is composed of two projects with a common theme which is the use of sustainable alternative materials in the unbound layers of the pavement structure. The first project is supported by MTO and Aggregates Recycling Ontario (ARO) on the expanded use of recycled concrete in "Granular B" type materials. The second project evaluate the potential of the use of foamed glass lightweight aggregate (LWA) in unbound granular layers. This project is supported by the private sector and the Ontario Centre of Excellence (OCE).

Adam is an Alumni Representative on the Board of Directors of the Waterloo Engineering Endowment Foundation (WEEF). He also is a member of the UW A Cappella Club (UWACC) and he volunteers with the Knights of Columbus.

Norman W. McLeod Chair in Sustainable Pavement Engineering - Cont'd

Taher is a PhD student in the Department of Civil and Environmental Engineering at the University of Waterloo. In 2009, he received his Bachelor Degree in Civil Engineering form Azad University/Mashhad, Iran. Thereafter, in 2010, he started his Master study in the field of Highway and Transportation at the University of Malaya, Malaysia. During his master's study he has conducted some research in evaluating road pavement performance, pavement materials as well as road safety. In 2011, he started working as a research assistant in the Department of Civil Engineering, University of Malaya. Upon graduation from this program, his interest in emerging and innovative technologies led him to pursue a Doctoral degree in civil engineering with the Centre for Pavement and Transportation Technology (CPATT). Taher's PhD research focuses on the development of the technology of High Modulus Asphalt Mixes in Ontario as a part of a project supported by the Ontario Ministry of Transportation (MTO) through the Highway Infrastructure Innovation Funding Program (HIIFP).

In his spare time, Taher enjoys reading, playing soccer, working out, travelling, and spending time with family and friends.

Outreach - GRINCH Colloquium at Laval University

The Pavement research teams at Laval University and the Ecole de Technology Superieure have several years of collaboration and form together a research group called "GRINCH: Groupe de Recherche en Ingénierie des Chaussées" or Research Group on Pavement Engineering. This year, Laval University hosted the Grinch colloquium on May 26th, 2015 and invited the CPATT team to participate. Professor Hassan Baaj represented CPATT in the colloquium and gave a presentation on our ongoing research projects and future plans. More than 50 participants from private and public sectors attended this conference where students and researchers from the participating institutions presented the findings of their research projects. The colloquium was a great occasion to strengthen the ties within the research teams and to identify several potential topics for future interdisciplinary collaborations.

Contact Us and Upcoming Events

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CPATT Board Members

Upcoming Events

September 14-17, 2015 - SWIFT World's Premier Airfield Operations Conference - Montreal, Canada

September 27-30, 2015 - Transportation Association of Canada Conference and Exhibition - Prince Edward Island.

January 10-14, 2016 - Transportation Research Board 95th Annual Meeting - Washington, D.C.

June 1-4, 2016 - CSCE Annual Conference - London, Ontario