



CPATT NEWS

Message from the Director

We very much appreciated the positive feedback from our last CPATT Newsletter, where we featured the 10th Anniversary of our Test Track and the many alumni who commented on their experiences as students. We are proud of all of you and your many diverse achievements, keep up the good work! We also appreciate our many research partners and sponsors to the Norman W. McLeod Chair and CPATT who make it possible for us to carry out research.

The summer months have been very busy. The laboratory is busy with the various testing projects and the ongoing field research program continues to blossom. Our solar road research made the cover of the KW Record in July and our students also made the news with several best paper awards at recent national and international events. This is truly great news for all of us here at CPATT.

If you would like to learn more about anything we have presented in this newsletter, please do not hesitate to contact me at sltighe@uwaterloo.ca. We look forward to hearing from you!

Sincerely,

Susan L. Tighe, PhD., PEng.

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Feature CPATT Faculty Member Adil Al-Mayah, PhD., P.Eng. Assistant Professor



Education

Dr. Al-Mayah is an assistant professor in the department of Civil and Environmental Engineering and across appointed with the department of Mechanical and Mechatronics Engineering at the University of Waterloo. Before joining the department in 2011, he worked as a research associate at the Ontario Cancer Institute, Princess Margaret Hospital. Shortly after completing his PhD in 2004, he was a research assistant professor in the department of Civil Engineering/University of Waterloo. He completed his PhD and MASC from the University of Waterloo in the area of mechanics of composite materials. His undergraduate degree was from Basrah University, Iraq.

Adil Al-Mayah, PhD., PEng, Assistant Professor, Department of Civil and Environmental Engineering, University of Waterloo

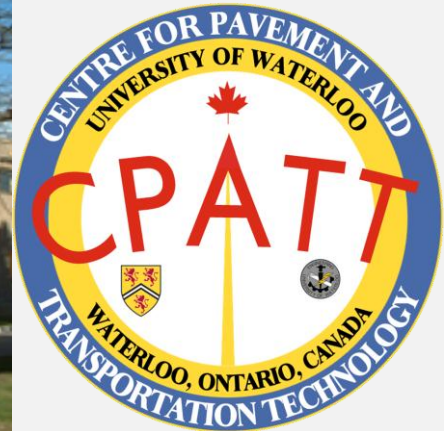
Research Highlights

Adil's research areas of interest include biomechanical properties of soft tissues, biomechanics for radiotherapy and surgery applications, integration of imaging and mechanics for material characterization, and mechanics of composite materials.

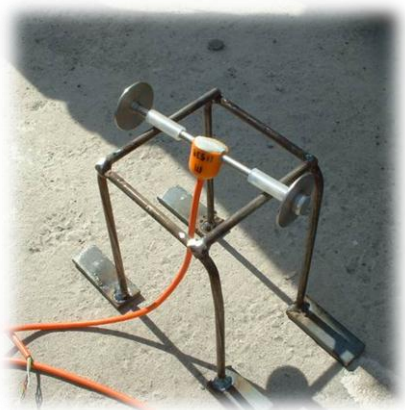
- Biomechanics for cancer treatment and assessment: He introduced the concept of interfacial mechanics to simulate the sliding between human organs to accurately locate the tumor of radiotherapy applications. The biomechanical modeling algorithm has been integrated into radiotherapy planning systems that have been used in cancer clinics. Similarly, he applied the biomechanical modeling to simulate the mammographic procedure to examine the properties of soft tissues for breast cancer risk assessment.
- Composite Materials: He developed an anchor system, known as FibreLok™, for fiber reinforced polymer (FRP) rods that has been used by a composite material/structural company in multiple structures. The system enables engineers to fully utilize the high tensile strength of CFRP, and GFRP rods for structural applications.

Professional Activity Highlights

- He is an associate editor for the Medical Physics Journal. He is a reviewer of a number of medical and engineering journals.
- He received a number of awards for his research contributions.
- Two of his publications have been selected as the "Editor Choice". One paper has been nominated for the best paper award and the highlight of the year.



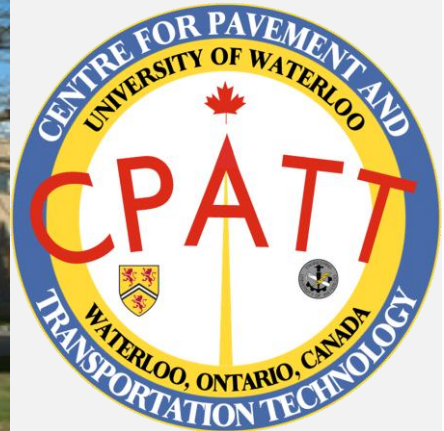
Research Focus – John J. Carrick Pavement Laboratory



Laboratory Updates

CPATT researchers have been recently reviewing the performance of concrete pavement rehabilitation treatments at an experimental pavement section in the City of Toronto. High volumes of heavy, slow moving bus traffic at the intersection of Bloor Street and Aukland Road, near Kipling subway station, were causing the rapid deterioration of the pavement at this busy intersection. In collaboration with the Cement Association of Canada and the University of Waterloo, the City of Toronto constructed its first unbonded concrete overlay on Bloor St. and reconstructed a short stretch of Aukland Rd. as a full depth concrete pavement in the summer of 2003. As part of the UW's involvement, instrumentation was installed in the new pavement layers to monitor the long-term performance of the rehabilitated pavements. The most recent condition survey shows that the experimental pavement sections remain in very good condition after nine years of service. Minor spalling has occurred at several joints, but the most significant distresses observed were some cracking in the vicinity of catchbasins and two cracked slabs near the crosswalks.

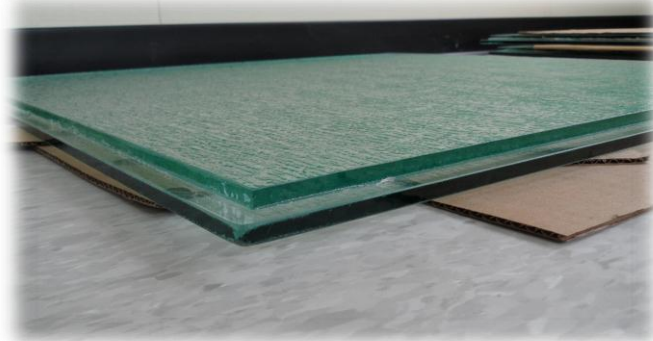
The results of this study show that an unbonded concrete overlay is a viable rehabilitation treatment for distressed concrete of composite pavements where heavy city traffic and cold climates are observed. It is estimated that the expected service life of 25+ years will be met and potentially exceeded, improving the return on investment and further confirming the suitability of this treatment. The performance of the Aukland Road pavement at nine years also shows that the use of concrete inlays, such as this short section of JPCP, can be effective. The section will continue to be monitored.



Research Focus – CPATT Test Track



Solar road panel materials, glass excluded



Solar road panel glass



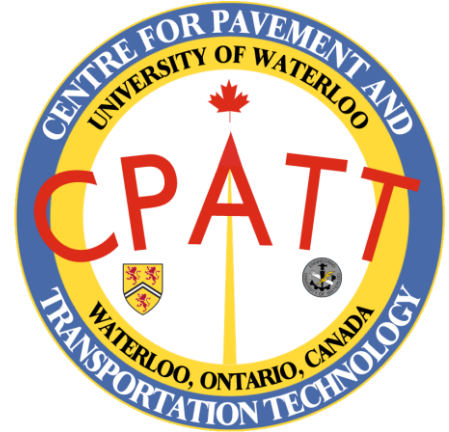
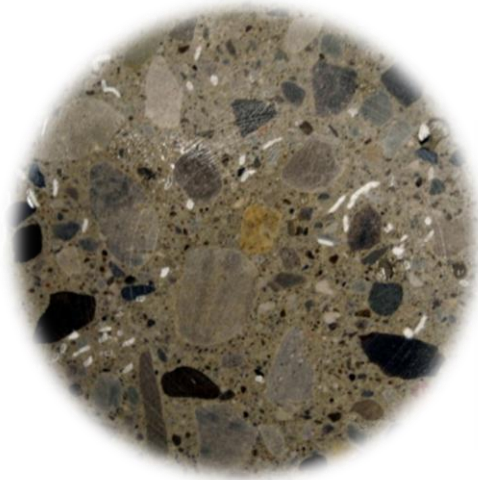
First fibreglass test piece

Test Track Updates

With the CPATT Office/Trailer at the Region of Waterloo's Waste Management Facility successfully relocated, it is able to regain its status as a research lab for CPATT. While most of the equipment is still waiting to be moved back in, space within the facility has been taken over by Solar Road Panel construction.

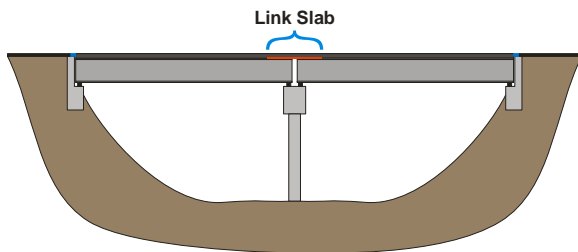
Solar road panels are solar modules that are being designed to operate as the top layer of road, sidewalk, and parking lot infrastructure. This allows the solar energy available on road surfaces to be converted to green electricity and diversifies the natural resource usage of pavement infrastructure. While it is not expected to replace asphalt and concrete anytime soon, it does have some potential.

Small-scale manufacturing trials have been completed, with full construction of the 1-metre square fibreglass and tempered glass panels to be completed by early August. Structural and environmental testing of the panels will be in September, and while this will be done back on the main campus it would not have been possible without the space available at the Test Track!



Research Focus – Structures & Concrete Lab

Structures/Concrete Update



Schematic of a two-span bridge with link slab (only the deck link slab is continuous at interior support)

A UW research project sponsored by the Ontario Ministry of Transportation is studying the use of a fibre-reinforced concrete (FRC) link slab as an alternative to bridge deck expansion joints. The link slab concept may be used in new bridge construction or as a retrofit, and gives the bridge a continuous deck surface while accommodating strains due to loading, thermal cycles and shrinkage.



Fresh concrete mix with synthetic macro fibres

The FRC for link slabs uses a high dosage of fibres to provide post-cracking tensile strength. The UW research is focusing on FRC mixture proportioning to provide the increased flexural and tensile strength and toughness requirements while maintaining desired compressive strength, workability and durability characteristics. The basic mechanical and fresh properties of FRC mixes with a range of compositional variables are currently being examined in a parametric study. In addition, the long-term internal strains in three mixtures are being monitored in outdoor exposure conditions with and without salt ponding.



Outdoor exposure specimens with embedded strain and temperature sensors

The next stages of the research will study the FRC flexural properties and toughness (ASTM C1609 flexural test), FRC shrinkage characteristics, and effects of repeated loading. The overall goal is the develop FRC mixtures with optimal mechanical and long-term properties for use in bridge deck link slabs.

Contact Dr. Carolyn Hansson and Dr. Jeff West for further details.

August 2012 Highlights

Feature Student – Mehran Kafi Farashah



Mehran Kafi Farashah is a M.A.Sc. candidate under the supervision of Dr. Susan Tighe. He received his B.A.Sc. in May of 2010 in Civil and Environmental Engineering from the University of Waterloo and began his M.A.Sc. in the fall of 2010. Mehran is an engineering intern (EIT) since June 2010. He also completed the Leadership Certificate from the Organization and Human Development Student Leadership Program at the University of Waterloo.

During his co-op terms, Mehran was involved in different infrastructure and construction projects as a site inspector, junior structural engineer, project coordinator, engineering technologist, and research assistant.

Mehran's research interests lie in the area of asset management, construction, and performance modeling.

Feature Project – Evaluation of Pavement Distress Measurement

This research is carried out in partnership between the City of Markham and the Centre for Pavement and Transportation Technology (CPATT). The focus of this research was to review existing pavement distress practices and rationalize distressed as appropriate for the City of Markham. This research included determination of the type of distresses, density and severity levels and weightings of these distresses to be used in conjunction with the Distress Manifestation Index (DMI) calculation. Thus, in 2011 a survey was developed as part of this research and was distributed to cities and municipalities across Canada to study the current state-of-the-practice in pavement distress and condition evaluations. This research also included developing the performance prediction models for various rehabilitation and maintenance strategies were developed for different road classifications for the City of Markham.

Below are pictures from Mehran's research project

August 2012 Highlights Feature Project Cont'd



Microsurfacing – Placing Emulsion Mix



Microsurfacing



Paving – Placing 50mm Asphalt



SAMI – Placing GeMat on Emulsion for SAMI application



SAMI – Placing emulsion on GeMat for SAMI application



Shave and Pave – Preparation for Lowering Manholes

August 2012 Highlights

Feature Project 2 – Recycled Asphalt Pavement

At a time when the concept of sustainability is being promoted through waste minimization, recycling of recycled asphalt pavement (RAP) for production of new asphalt mixtures has demonstrated to be of interesting prospects. Through the use of RAP in hot mix asphalt (HMA) with very well established asphalt recycling technologies have highlighted such benefits as reduction in the amount of used energy, greenhouse gas emissions, landfill bound wastes, and overall cost savings; there is still substantial need for further validation of performance information of SuperPave mix design procedures for mixes containing RAP, particularly with regard to creep (rutting resistance), fatigue endurance and pavement durability.

This project is a collaboration between CPATT, MTO, OHMPA and DBA Engineering. In addition, we gratefully appreciate the in-kind material donations from Capital Paving Ltd., McAsphalt Industries, Canadian Asphalt, Coco Paving, and Bitumar.

The research evaluates and compares performance and asphalt cement testing results for the following Ontario SuperPave mixtures:

- ***SP12.5mm/0%RAP/AC-PG 58-28;***
- ***SP12.5mm/0%RAP/AC-PG 52-34;***
- ***SP12.5mm/40%RAP/AC-PG 58-28;***
- ***SP12.5mm/20%RAP/AC-PG 58-34;***
- ***SP12.5mm/20%RAP/AC-PG 52-40; and***
- ***SP12.5mm/40%RAP/AC-PG 52-40***

The mixes will be evaluated in accordance with the: Dynamic Modulus Test (AASHTO TP 62007), the Thermal Stress Restrained test (TSRT- AASHTO TP 10-93) and the Flexural Fatigue Beam Test (AASHTO T321).

Currently, all preliminary activities with regard to aggregate sieving, batching, mix design and mix preparation, and determination of maximum relative densities (Gmm) for the respective mixtures have been completed. Fabrication of cores and beam specimens necessary to facilitate actual performance tests are now in progress.

August 2012 Highlights Feature Project 2 – RAP



Placing batched virgin aggregate for mixing



Placing batched 40% RAP aggregate for mixing



Adding AC-PG 52-40 to the mix



Mixing in progress



SP12.5mm/40% RAP/AC-PG 52-40 all boxed up

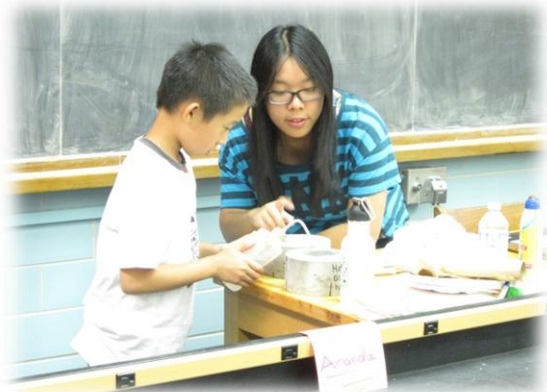


Determination of maximum relative density for conditioned mix in progress

ESQ Presentations Summer 2012

Engineering Science Quest (ESQ) was formed by the Faculties of Engineering and Science at the University of Waterloo in the fall of 1990 when two Waterloo Undergraduate students saw a similar program at another Canadian University. They ran their first camps for grades 5 and 6 students in 1991 with an attendance of 200 students. Since then, ESQ has grown to be recognized as a leader in Science and Engineering camps in Canada and now offers multiple summer camps for children entering grades 1 to 9. Annually, ESQ fill over 2,000 spots in the summer camps, and run camps in various rural and aboriginal locations in Ontario. ESQ camps are run out of the Waterloo Engineering outreach office, WE-Connect, and are jointly supported by the Waterloo Faculties of Engineering and Science. More information is available at: <http://esq.uwaterloo.ca/>.

This summer, Jingwen Cao, an undergraduate co-op student working in the CPATT laboratory, gave a presentation about pavement to ESQ children weekly during the summer camps. She talked about a research project underway by Marcelo Gonzalez, a PhD student. This project discussed the utilization of nano-materials in pavement. The presentation included pictures of: the laboratory work, sample preparation, finished specimens, compression tests, sound absorption tests and friction tests to explain the important properties of pavement. The presentation was based on the use of the nano-lotus leaf and explained the lotus leaf by nature has a super hydrophobic surface; hence, lotus leaf product can be applied on a surface as a coating to drain out the water very quickly from the surface. This presentation was very interesting and the children enjoyed passing around samples. In the past, CPATT has also hosted similar sessions on the use of RAP in asphalt pavements. Below are some pictures from the presentation.



Speakers Corner

How does your organization use research to improve practice?

Dave Hein, P.Eng. - Principal Engineer, Vice-President Transportation – Applied Research Associates Inc.



Applied Research Associates Inc. (ARA) uses research to improve practice in many ways. Some examples of a few projects are below:

[January 25, 2012 – Helping Rebuild America’s Transportation System](#)

“The Highways for Life Program within FHWA is not so much core research but research implementation. The products and ideas that are developed by agencies and industry are fostered within this program and demonstrated to show their value in the design, evaluation and management of our critical infrastructure.”

[October 25, 2011 – ARA Making Road Construction Safer through Engineering Research](#)

“This research in making road construction safer was a direct result of an unfortunate incident that resulted in the death of one of our young staff while out working on data collection for a roadway rehabilitation project. The product of the research is improved safety for roadway workers and the travelling public.”

[July 13, 2011 – Cutting-Edge Tri-Max Saves Lives, Stops Fires](#)

“This research resulted in better technology to keep the world safer by improved firefighting systems.”

Paul Cudmore – General Manager/COO – Team Eagle Ltd.



“From my perspective, we use research to improve practices in several ways”

- **Learning** – what works and what does not. This helps us understand and define expectations as we try and help our customers with their challenges.
- **Product Development** – research helps us understand if we can create a product/service to meet a demand with a reasonable expectation of return on our investment.
- **Proof** – longer term research/evidence that a process, procedure, or practice has a specific benefit and/or outcome is helpful to our ability to make decisions on which project/products to focus on.
- **Partnerships** – research also creates valuable partnerships and networks that are important and beneficial for the future of our business.

We are committed to supporting research as a core component to our approach to business at Team Eagle.”

Speakers Corner – Cont'd

How does your organization use research to improve practice?

Tom Kazmierowski, P.Eng – Manager, Materials Engineering and Research Office – Ontario Ministry of Transportation (MTO)



The Ontario Ministry of Transportation (MTO) has a long history of pursuing and funding transportation research through partnership arrangements. This strategy has allowed the ministry to tailor research to priority areas while leveraging research and development dollars through combining funding resources with others.

Highway Infrastructure Innovation Funding Program (HIIFP)

The HIIFP was established in 2003 to encourage and assist Ontario universities and colleges to pursue basic and applied undergraduate and graduate research in transportation infrastructure, with possible subject topics including: Engineering Materials, Environment, Highway Design, Structures, Construction, Traffic Operations, Intelligent Transportation Systems, Geomatics, and Maintenance. HIIFP is explicitly intended to solicit innovative approaches, methodologies and outcomes to address ministry business needs, while focusing and leveraging research dollars. Any ensuing

research reports are made available on the ministry's public website, through the MTO Library at: <http://www.mto.gov.on.ca/english/transrd/index.shtml>

To date, 123 individual projects have been funded at 13 Ontario institutions. A little less than one-third of the projects are multi-year. MTO has disbursed \$5.4 million and leveraged additional funding of \$3.5 million for a total research value of almost \$9.0 million. Funding levels have averaged \$579,000 annually, with an average funding amount of \$33,000/project/year.

HIIFP is the ministry's formal highway research funding program that, with its current budget, typically funds about 20 projects annually. Additional research needs are supported through other arrangements, such as bi-lateral partnerships with universities, programs or researchers; pooled funding opportunities with the Transportation Association of Canada (TAC) and Federal Highways Administration (FHWA); specific in-house projects; or other internal / external partnerships. For instance, in 2011/12, MTO special projects research included: eleven university research projects; 8 pooled funding projects with TAC and FHWA; and two internal/external partnerships. Over the 21 projects, MTO funding of just over \$700,000 leveraged other funding of over \$1.4 million.

In terms of research dollar leverage, the HIIFP has performed well. For every \$1.00 MTO has invested another \$0.65 has been invested by another party. The projects themselves have yielded good return on investment to MTO.

Implementing Research into Practice

MTO carries out research in partnership with Ontario universities, and also carries out internal research projects incorporating field sites on provincial highways where we are able to utilize the input of our engineering and technical staff as well as our specialized materials testing laboratory. The results of the research are used as the basis for development of technical policies, standards, specifications and test methods that are used in our contracts.

Speakers Corner – Cont'd

How does your organization use research to improve practice?

Tom Kazmierowski, P.Eng – Manager, Materials Engineering and Research Office – Ontario Ministry of Transportation (MTO) – Cont'd

Typically, academic research is triggered by a research need identified through ministry operations or by the recognition of the need to fill a 'gap' in our technical knowledge and understanding. With a strong theoretical component, such research typically focuses on longer-term needs. This work is often the first step in transferring innovative concepts and new technologies from the "idea" stage to the practical. As well as supporting significant advancements in ministry and industry practice, academic research contributes to the training of post graduate students who will be the future leaders in the field. Examples of research projects currently underway include a study on application of scanner technology to automate the current labour intensive and operator-dependent test method for analyzing the air void system of concrete, a critical factor in the durability of concretes in cold climates. If successful, this will result in a new test method providing greater reliability and confidences for MTO and contractors, and a new area of opportunity and growth for Ontario testing laboratories.

Where products or technologies have a record of success in the laboratory or with other agencies, research may take the form of field trials where the products are utilized under typical Ontario conditions. This means typical contracting methods and industry practices, as well as the environmental exposures that can be expected for an Ontario highway. In such cases, the intent is to verify that the reported performance obtained elsewhere, can be obtained under our local conditions. Field trials are monitored closely to assess success or alternatively to identify the factors critical to performance. With this information, specifications to incorporate the technology into MTO work can be developed and implementation facilitated in the most effective manner.

Results of MTO research are shared with stakeholders and with other highway agencies through publications and presentations, with through contribution to development of technical standards not only internally but at the provincial, national and international levels through participation in standards-setting committees such as Ontario Provincial Standards (OPS) Canadian Standards Associations (CSA), American Society of Testing and Materials (ASTM) and American Association of State Highway and Transportation Officials (AASHTO). Through dissemination of technical information, benefits can be shared across the broader technical community. Input from peers is critical to moving forward, and the sharing of technical information avoids duplication of efforts and ensures new research is targeted where it will have the greatest impact.

How does research improve practice? – greater cost effectiveness for MTO through the development of leading edge standards for construction and maintenance of Ontario's highway infrastructure, creation of more opportunities and options for Ontario industry who are supported by academic partners with a growing reputation for excellence in materials and transportation related research.

Submitted by: Tom Kazmierowski with thanks to Finlay Buchanan and Hannah Schell.

Upcoming Events and Announcements

Upcoming Events

September 17-21, 2012 – [Summer Winter Integrated Field Technologies \(SWIFT\) 2012 Conference and Trade Show](#). This conference is being held at the Fairmont Banff Springs Hotel, Banff, Alberta, Canada.

September 21, 2012 12:30pm – 3:00pm – [Norman W. McLeod Chair and CPATT Graduate Student Poster Symposium](#). This event is being held at the University of Waterloo, Waterloo, Ontario, Canada. Please follow the link which will take you to the CPATT website. From there, you can find more information under events.

October 14-17, 2012 – [2012 Transportation Association of Canada \(TAC\) Conference and Exhibition](#). This conference is being held in Fredericton, New Brunswick, Canada.

November 17-21, 2012 – [57th Annual Canadian Technical Asphalt Association \(CTAA\) Conference](#). This conference will be held at the Westin Bayshore Hotel in Vancouver, British Columbia, Canada.

Welcome New Students and Congratulations

Alain Duclos, MSc Candidate

Cheng Zhang, MSc Candidate

Magdey Shaheen, PhD Candidate

Congratulations to Xiomara Sanchez and Oscar Pernando Lopez Mejia on the arrival of their baby girl, Luciana Lopez Sanchez. Luciana was born at Grand River Hospital on April 20th, 2012 at 4:24am, she weighed 6lbs 14oz and measured 52cm. The meaning of the name Luciana is Spanish and relates to light. As it is used in Colombia and Latin America, her last name is the union of both father and mother family names. We wish Xiomara and family all the best!

News and Awards

- Vale Masters Scholarship – **Rana Tehrani Yekta** – Canadian Engineering Memorial Foundation (Supervisor – Scott Walbridge)
- [Sustainability of Perpetual Pavement Designs: A Canadian perspective](#) - **Best Paper Award** – Annual Inter-University Symposium on Infrastructure Management (AISIM) – **Mohab El-Hakim** (Supervisor – Susan Tighe)
- [Developing Innovative Roads Using Solar Technology](#) – **3rd place in the Graduate Student Paper Competition** - Canadian Society of Civil Engineers – **Andrew Northmore** (Supervisor - Susan Tighe)

Chair/CPATT Symposium

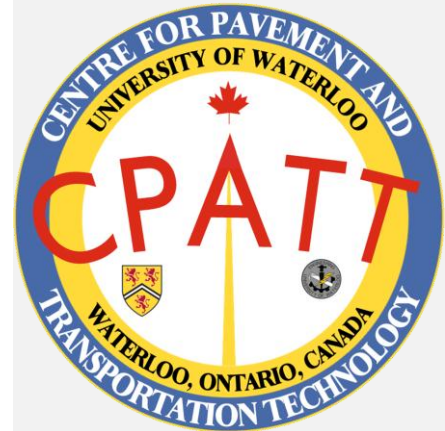
Friday September 21, 2012 12:30 – 3:00pm
E5 – Student Design Centre Area

Contact person for RSVP

Aleli Osorio – aosorio@uwaterloo.ca or
Susan Tighe – sltighe@uwaterloo.ca

Join industry members and CPATT faculty members for a graduate student poster symposium, where students will be showcasing their current research projects. This is a great event to mingle with industry partners and learn about current research projects.

Parking Lots: B, UWP or N – www.uwaterloo.ca/map



CPATT

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