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| **NSERC Create Heritage Engineering Forum**OCTOBER 15,2015 DISCOVERY CENTRE, MCODRUM LIBRARY, CARLETON UNIVERSTIY |
| ***Conference Proceedings*** |
| Prepared by: |
| Justin Berquist, Joshua Dalphy, Zeynep Ekim,  |
| Carly Farmer, Alex Federman, Natalie Miller |

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| AGENDA |
| Agenda Item | Speaker | Time slot |
| 1. Welcome from VP Research
 | **Nimal Rajapakse**, Vice-President (Research & International), Carleton University | 9:00am-9:10am |
| 1. Remarks from Dean of Engineering
 | **Rafik Goubran**, Dean of Engineering, Carleton University | 9:10am-9:20am |
| 1. Remarks from ICOMOS Canada
 | **Christophe Rivet**, President, ICOMOS Canada | 9:20-9:30am |
| 1. Introduction to the Program
 | **Mario Santana**, Program Director, NSERC CREATE Heritage Engineering | 9:30-10:00am |
| 1. Panel #1A: Building Rehabilitation
 | **Moderator: Mario Santana****Mark Brandt**, MTBA Architects**Tom Morrison**, Heritage Standing**John Cooke**, John G. Cooke & Associates**Doug Stephenson**, Heritage Conservation Directorate, PWGSC | 10:00 – 11:15am |
| 1. Short break
 |  | 11:15 – 11:30am |
| 1. Panel#1B: Building Rehabilitation continued

  | **Moderator: Stephen Fai****Victoria Angel**, ERA Architects**James Maddigan**, Robertson Martin Architects**Jim Mountain**, The National Trust for Canada | 11:30 - 12:30pm |
| 1. Lunch break
 | Lunch catered by Aramark | 12:30 – 1:30pm |
| 1. Learning Outcomes & cuPortfolio
 | **Educational Development Centre, Carleton University** (Andrew Barrett, Morgan Rooney, Allie Davidson)**Office of the Vice-Provost** (Andrea Thompson) | 1:30 – 2:00pm |
| 1. Panel #2: Building Digitalization
 | **Moderator: Mario Santana****Stephen Fai**, Carleton Immersive Media Studio, Carleton University**Christian Ouimet**, Heritage Conservation Directorate, PWGSC | 2:00-2:45pm |
| 1. Short break
 | Coffee & tea | 2:45 – 3:00pm |
| 1. Panel #3: Building Sustainability Simulation
 | **Moderator: Stephen Fai****Jeffrey Erochko**, Carleton University**Susan Ross**, Carleton University**Liam O’Brien**, Carleton University | 3:00 – 4:00pm |
| 1. Closing remarks & upcoming events
 |  | 4:00 – 5:00pm |

# **FORUM ATTENDEES:**

***Co-applicants (7):***

Mario Santana Quintero, Program Director

Jeffrey Erochko, Dept of Civil and Environmental Engineering, Carleton

Stephen Fai, Carleton Immersive Media Studio and Azrieli School of Architecture

Jeremy Laliberte, Engineering, Carleton

Liam O’Brien, Dept. of Civil and Environmental Engineering, Carleton

Susan Ross, School of Canadian Studies, Carleton

Mariana Esponda, Azrieli School of Architecture

***Students (9):***

Justin Berquist (CREATE)

Joshua Dalphy (CREATE)

Zeynep Ekim (CREATE)

Carly Farmer (CREATE)

Alex Federman (CREATE)

Natalie Miller (CREATE)

James Hayes

Davide Mezzino

Golnaz Karimi

***Collaborators (10):***

Victoria Angel, ERA Architects

Jean Angelo Beraldin, NRC

Mark Brandt, MTBA Architects

John Cooke, John B. Cooke & Assoc.

James Maddigan, Robertson Martin Architects

Tom Morrison, Heritage Standing

Jim Mountain, The National Trust for Canada

Christian Ouimet, Heritage Conservation Directorate, PWGSC

Jack Vandenberg, Heritage Conservation Directorate, PWGSC

Doug Stephenson, Heritage Conservation Directorate, PWGSC

***Guests (10):***

Nimal Rajapakse, VP Research, Carleton

Rafik Goubran (dean of engineering)

Christophe Rivet, VP Scientific, ICOMOS

Erica Nocerino, FBK

Peter Coffman, Canadian Studies, Carleton

Myles McDevitt

Allie Davidson, EDC

Andrew Barrett, EDC

Andrea Thompson (OVP)

Laurie Smith, Program Coordinator, NSERC CREATE

**CONFERENCE PROCEEDINGS:**

# **INTRODUCTION:**

On October 15, 2015, Carleton University held the inaugural NSERC CREATE Heritage Engineering Forum. This forum brought together individuals from a wide assortment of backgrounds in order to facilitate a discussion on what the future holds for the field of heritage conservation. The participants were members of both the private and public sector, along with the NSERC CREATE Grant students themselves. The panelists who spoke identified key research gaps that need to be solved in their respective specialty. These gaps will be the focal point of the thesis research that will be conducted by the CREATE students over the course of their Masters. Another integral part of the CREATE program is to allow the students to gain the necessary skills for future employment. This task will be accomplished through the participation of two internships with partner organizations for the CREATE grant.

The following pages of this document detail the proceedings of the forum, and represent a detailed summary of the conference proceedings.

**PANEL #1A: BUILDING REHABILITATION:**

In the first panel, Mark Brandt (MTBA Architects), Tom Morrison (Heritage Standing), John Cooke (John G. Cooke & Associates), and Doug Stephenson (Heritage Conservation Directorate- PWGSC) spoke about the concept of building rehabilitation. The Building Rehabilitation track focuses on manners in which buildings can be restored. This can be done through building condition assessments (building envelope, materials deterioration and structural integrity), various monitoring strategies and the implementation of effective rehabilitation mitigation strategies. This track also includes developing approaches for the identification of decay and deterioration to help prevent major damage to these historical structures. The common themes that the panelists iterated were the need for collaboration, the methodology of the repairs that are conducted, and the implementation of monitoring systems to be able to fully understand how deterioration manifests in these historic structures.

**Mark Brandt:**

Senior conservation architect, Mark Brandt, and his firm (MTBA Associates Inc.) work at the “nexus” of natural and cultural conservation. He stated that these are one and the same in the sense that they both seek to preserve that which we value. In the same context, professionals must look at the broader picture when it comes to heritage conservation, instead of focusing so intensely on the specifics.

There is also a need to collaborate to develop mitigation strategies for adaptive reuse and repair of heritage structures in ways beyond energy efficiency. There are two new tools that his firm is working on that can help to solve these issues:

* *Building Resilience: Practical Guidelines & Technologies for Sustainable Rehabilitation* (a federal provincial and territorial collaboration), to be published November 2015 <<http://sustainableconservation.ca/sustainable-conservation/building-resilience-guidelines-sneak-previews-at-recent-conferences/>>
* *OSCAR: Online Sustainable Conservation Assistance Resource* initial prototype launched at APTI Kansas City conference (November 1-5, 2015) <[www.oscar-apti.org](http://www.oscar-apti.org)>

Mark concluded with a brief overview of the Bank of Montreal/Sir John A. MacDonald Building in Ottawa and the Printing Bureau in Gatineau.

Mark identified the following research gaps during the course of his presentation:

* How to better collaborate with the research community
* The interaction between building systems and building envelope (to be explored in APTI San Antonio conference 2016);
* The development of new tools and strategies for modern era heritage
* Projects operating at the neighbourhood and district scale

**Tom Morrison:**

Tom Morrison is a structural engineer at Heritage Standing in New Brunswick. His interest in old buildings have led him to work on many historic buildings, including his rehabilitation work with ICOMOS after the Haiti earthquake.

Tom brought up the topic of structural health monitoring, and how it is used to gain a better understand of a building by observing it through these monitoring techniques. However, he also said that more research would be beneficial to determine what data is needed and how it can be effectively used. An abundance of data can be collected from both high and low tech monitoring, but how to best manage this information is still unclear. Although there are a wide range of investigation techniques, there is limited knowledge on how to best use them. One example is of this lack of knowledge is ground penetrating radar.

Tom also spoke about structural rehabilitation and how buildings with seismic retrofits were the ones that failed during Italy’s earthquakes in 1977 and 1997. This example illustrates the need for reversible repairs and better understanding of what does and does not work and why. There are many revived ideas and innovative solutions concerning structural rehabilitation, such as using a tensioned rope to support an old truss, thereby improving the lateral resistance of a building. The use of alternative compliance paths to meet the building code is another major area of research.  A shift from a prescriptive code to a performance code allows designer to be more creative in their solutions.

Tom identified the following research gaps during his presentation:

* Data required for effective analysis of a building’s structural health
* How to make effective reversible repairs to existing buildings
* How to identify the most appropriate method of investigation
* Code compliance, alternative path

**John Cooke:**

John Cooke, a structural engineer with over 25 years of experience in the field, brought up the key point that in order to do any rehabilitation work to historic structures, we need to understand how they work and operate.

He went on to explain that in the 1900’s, the wrong interventions took place, and the solutions implemented by the structural engineers were vastly incorrect. One such example was mortar repointing, and the fact that stronger mortars were used instead of weaker ones. The weaker mortar accounts for the flexibility of the masonry in order to absorb blast forces. Monitoring buildings during blasting revealed that blast forces at grade versus chimney height were reduced by 30% because the forces were absorbed by the softer mortar.

When working on heritage projects, John stated that it is paramount to understand the building itself. This means identifying characteristics such as the date of construction, the skill set of the workers during that time period, and the materials that were available. It is also integral to understand the compatibility of materials, specifically older technologies used in conjunction with modern materials. Building off of this topic, John used the example that when brick masonry is being restored, instinct is to replace the older bricks with newer ones. This then presents a problem with moisture migration, as the two different bricks have different porosities.

The specific research gaps that John identified during his presentation are:

* A means of establishing material properties during time when these historic structures were constructed
* Understanding the flow of moisture through masonry walls
* Understanding how new materials react with existing heritage ones
* Establishing a methodology for recording interventions

**Doug Stephenson**

Doug Stephenson is a member of the Heritage Conservation Directorate and PWGSC. In his presentation he spoke about hybrid construction. This deals with how materials like steel, wood, stone, brick are connected with one another in historic buildings. Doug brought up the point that determining the extent of deterioration is important for determining an appropriate method of intervention. This could be effectively done through the use of non-destructive techniques. In hybrid construction in particular, it is important to understand how the materials are interacting with each other, and as changes are made, knowing how new materials will affect the behavior of an element or building is a very important piece of information.

Doug identified the following research gaps during the course of his presentation:

* Hybrid construction and behavior under seismic loads
* Monitoring systems to understand behavior before, during and after interventions
* Emerging technologies in detection of material deterioration

**PANEL #1B: BUILDING REHABILITATION:**

In the second panel, Victoria Angel (ERA Architects), James Maddigan (RMA) and Jim Mountain (National Trust for Canada) continued the discussion on building rehabilitation. Collaboration with communities and non-for-profit organizations, development of cultural landscapes, sustainability, and the use of BIM for heritage practices were the major topics that were brought up by the panelists.

**Victoria Angel**

Victoria Angel, a senior heritage planner from E.R.A. Architects in Toronto, started her panel by introducing some of the projects that her firm is involved with. These include the Tower Renewal project, Culture of Outports, and Concrete Toronto.

Victoria mentioned that heritage itself has quite a broad definition, and that it is not only about the preservation of buildings and artifacts. The projects she identified are representative of social heritage and the connection between people and the places that they deem important.

She further discussed that new tools such as developed inventories and mapping with GIS might be a way to document and incorporate the importance of this connection into conservation management plans of both individual structures and cultural landscapes.

The following research gaps were identified during Victoria’s presentation:

* Shift in heritage integration- cultural landscapes (ideas/approaches)
* Heritage as a role player in the broader scope- relationship between things
* Still focused on heritage in isolation- need tools/programs/principles/charters
* Need for mapping/inventories
* Energy modelling/building science

**James Maddigan**

James Maddigan, from Robertson Martin Architects, focused his speech on finding ways in which technologies can be best adapted for heritage projects. He discussed research gaps and limitations of off-the-shelf software when used for assessing sustainability of heritage structures.  Some software lacks the necessary databases or ability to specify properties of heritage materials. He indicated the need for further research on analyzing the compatibility of new assemblies and materials for rehabilitation of heritage structures. He raised further issues such as finding a balance between energy savings and heritage significance and how to adapt green approaches to heritage buildings.

James identified the following research gaps during the course of his presentation:

* Adaptation of software for heritage
* New assemblies and materials for heritage
* How to balance energy savings with heritage significance
* Access to documents and information

**Jim Mountain**

Jim Mountain, from the National Trust for Canada, presented examples from his previous projects that showcase ways to encourage participation in communities for saving heritage. Some examples included the Ross River Suspension Bridge in Yukon, the Main Street Pilot Project in Alberta, and the Lighthouse campaign. Though the National Trust identifies a list of Endangered Places in Canada, this is only the first step in preserving some of our nation’s important historical landmarks. Jim stressed the importance of interdisciplinary work in heritage.

Jim also spoke about issues that developers associate with heritage, as these projects can have low or delayed return on investment (ROI) or in limited development potential. However, there can also be economic benefits of saving heritage structures, and building rehabilitation can also help foster pride within a community.

Jim identified the following research gaps:

* Converting records from physical to digital copies to ensure longevity
* Management of projects, and creating positive relationships with developers

**PANEL #2: BUILDING DIGITIZATION:**

In the third discussion, Steven Fai (Carleton Immersive Media Studio and Azrieli School of Architecture) and Christian Ouimet (Heritage Conservation Directorate, PWGSC) discussed the topic of building digitalization as it relates to heritage conservation.

**Steven Fai and Christian Ouimet**

Stephen Fai, from Carleton Immersive Media Studio and Azrieli School of Architecture, and Christian Ouimet, from Heritage Conservation Directorate, PWGSC, both brought up the topic of accuracy in relation to building modeling.  A challenge that is present when modeling a building is obtaining a high degree of accuracy when going from point cloud data to the 3D model.  Furthermore, another important point that was mentioned was deciding on how much detail should be included when modeling in order to obtain a clear picture of what is being modeled. Both Stephen and Christian mentioned that providing a combination of modeling and other information could be used to reduce the amount of modeling required while still having a sufficient amount of data to obtain a clear picture of the building being modeled.  Furthermore, the panelists touched on the topic of deciding when is there to much or too little detail in a model.

The panelists also discussed a new approach to obtain images and video of buildings.  The former is using unmanned aerial vehicles (UAVs) equipped with digital cameras in order to produce photogrammetric models.  Christian discussed that to date, a fixed wing UAV with a single digital camera was used to obtain data with an accuracy of 50mm.  The main challenges present when using UAVs is obtaining flight permits to fly over the intended buildings.  The advantages are that using UAVs can reduce the cost and improve safety in the workplace when it’s compared to the alternative, using people to measure/obtain the data.

To conclude the panel, both panelists discussed gaps relating to building digitalization that would benefit from further research. These areas are listed below:

* Tools to assist work on site as condition assessments.
* Monitoring.
* Building diagnostic tools.
* Archiving and maintenance of data.
* Information management system.
* Publication permission

**PANEL #3: BUILDING SUSTAINABILITY SIMULATION:**

In the final panel, Jeffrey Erochko (Dept. of Civil and Environmental Engineering, Carleton), Susan Ross (School of Canadian Studies, Carleton), and Liam O’Brien (Dept. of Civil and Environmental Engineering, Carleton) began the discussion on Building Sustainability Simulation.  Building Sustainability Simulation is a tool in which computer aided simulation assess the impact of rehabilitation and various design options.  The three panelists emphasized the importance of properly utilizing data to obtain efficient designs both from an energy and structural standpoint. They believed that through collaborative design, solutions can be developed that will assist in the preservation of heritage buildings.

**Jeffrey Erochko**

Jeffrey has a background in Earthquake Analysis and Design.  He works in the design of damping structures and also brings structures which have been affected by earthquakes back to zero displacement. Jeffrey discussed the necessity for the analysis of historic timber structures and seismic retrofit of historic timber/masonry, along with the requirement of innovative solutions in order to preserve multiple historic structures.  He identified the following research gaps:

* Seismic retrofit strategies for historic timber structures
* Design of damping systems for heavy timber systems

**Susan Ross**

Susan Ross is particularly interested in the conservation of urban landscapes, modern/industrial heritage, and sustainability. She believes that standards/guidelines and smaller scaled retrofits must be addressed in our research. She discussed the importance of obtaining and storing data, but also stressed the importance of knowing when this information should be used to model a corresponding system. Susan provided the following research gaps:

* How to address standards/guidelines/policies for heritage practices
* How to address smaller scale retrofits
* How to address the topic of modern heritage

**Liam O’Brien**

Liam began his presentation by emphasizing his interest in Building Performance Simulation (BPS) and discussed the related categories that are important to this topic. He discussed the various applications that BPS could be used for. The ones which are relevant to existing buildings are as follows: comparing design concepts, retrofit analysis, automatic conversion process and to optimize existing buildings. However, BPS can also be used for new buildings, new building code compliance, developing a comparison to the baseline design and evaluating new design strategies which will assist in the preservation of future heritage buildings.  The gaps that Liam presented are:

* Accurate model input & efficient work flow methodology
* Utilizing existing BPS tools for heritage conservation techniques
* How should the data/results be interpreted and used
* What are the opportunities and trade-offs between BPS & heritage

**LEARNING OUTCOMES AND CONCLUSIONS:**

At the forum, a series of learning outcomes were presented, which represent the overall goals of the grant:

**At the completion of the NSERC CREATE Heritage Engineering Program, students of the program should be able to:**

1. **Discuss and explain the decision-making process in heritage conservation and sustainability;**
2. **Identify gaps in knowledge in heritage conservation and sustainability and use research to extend knowledge in that particular area;**
3. **Present their research to audiences at conferences and meetings;**
4. **Produce academic articles about their research in scientific journals and international conferences that are peer reviewed;**
5. **Use the vocabulary of heritage conservation and sustainability;**
6. **Apply and improve existing or emerging approaches in heritage conservation;**
7. **Describe the roles of the different disciplines within the practice of heritage conservation;**
8. **Explain the working context of partner organizations in specific heritage conservation sectors as a result of their internships.**

The proceedings of the first annual NSERC CREATE Heritage Engineering Forum the forum can be deemed as a huge success. The event not only allowed students to network with industry professionals, but also gave them a vast amount of knowledge of potential research topics for their upcoming Master’s thesis. The forum presented students with a unique opportunity to understand exactly what is occurring in the field of heritage conservation today. This valuable information will allow them to plan for the future in regards to how they will make a positive difference in the heritage community.

Thank you to everyone who made this a success!