Instructor: **Dr. Mario Santana Quintero**  
e-mail: [Mario_santana@carleton.ca](mailto:Mario_santana@carleton.ca)  
ph. +1 (613) 520-2600 x 3093, Canal Building, Office 5207 (5th floor)  
Recurring Zoom link: [https://carleton-ca.zoom.us/j/81743062844](https://carleton-ca.zoom.us/j/81743062844)  
Meeting ID: 817 4306 2844 - Passcode: 484968

Lecture class: Thursday 8:35 am to 11:25 am.

Labs:

<table>
<thead>
<tr>
<th>Sctn</th>
<th>Day</th>
<th>Times</th>
<th>Field</th>
<th>Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>B2</td>
<td>Fri</td>
<td>2:35 pm – 5:25 pm</td>
<td>SITE</td>
<td>SA404</td>
</tr>
<tr>
<td>A1</td>
<td>Fri</td>
<td>11:35 am – 2:25 pm</td>
<td>SITE</td>
<td>Online</td>
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</table>

Teaching Assistants:

Definitions: **Building Pathology** is a term "used to define a holistic approach to understanding buildings. Such an approach requires detailed knowledge of how buildings are constructed, used, occupied, and maintained. The various mechanisms by which their structural, material, and environmental conditions can be affected. It is, by necessity, an interdisciplinary approach and requires a wider recognition of how buildings and people respond and react to each other." David Watt, *Building Pathology, Principles and Practice*, 1999

**Rehabilitation** is the "action or process of making possible a continuing or compatible contemporary use of a historic place, or an individual component while protecting its heritage value." Parks Canada, *The Standards and Guidelines for the Conservation of Historic Places in Canada*, 2011.

Description: **Building Pathology and Rehabilitation** is a core course of the Bachelor of Engineering (BEng) and Architectural Studies (BAS) with a Major in Architectural Conservation and Sustainability. It is taught in the 4th year of the programme after students have been introduced to basic conservation and sustainability principles and fundamentals of
building materials, assemblies and structures. Building on the Architectural Technology courses taught throughout the BAS and BEng and using basic documentation techniques learned in the Historic Sites Recording course, students will become familiar with the skills required to investigate and address the conservation and sustainability issues of historic and modern buildings. While focused on Eastern Canada’s existing building stock building technologies, the discussion and analysis will include examples of buildings of all types, sizes, and locations.

Learning Outcomes: Working individually and in teams, students will be able to:

- Explain/assess historic and modern building envelope and structural systems, assemblies and materials and their patterns and causes of decay and deterioration.
- Formulate a methodology for the assessment of the physical condition and performance of buildings in support of assessment and performance evaluation and design;
- Identify, analyze and recognize historic construction materials, assemblies and structures;
- Recognize the roles of architects, engineers, materials conservation specialists, building scientists, architectural/building historians, traditional building trades and other disciplines;
- Design a rehabilitation treatment option based on the visual inspection and analysis of physical conditions, considering conservation principles and other criteria (health and safety, cost, accessibility, etc.)
- Describe specific historic and modern building rehabilitation issues, including preserving patina, addressing inherent vice, locating substitute materials, using modern technologies, and identifying appropriately skilled labour.

One of the underlying objectives is to help to interpret the connection between conservation and sustainability, as well as sustainable conservation strategies: Critical to the development of an integrated sustainable conservation project is the understanding of the history of the building’s construction and use, its inherent environmental features, past and current performance patterns, and the types and causes of deterioration of its specific materials, assemblies and structures. Effective, affordable, and respectful means of maintaining and repairing important and well-crafted built features should continue to offer years of use – thus sustaining our built heritage and reducing the impact of new construction on the environment.

References: Through the use of a diverse range of paper and web-based references, students will also become familiar with the extent of Canadian and international resources for working on historic/existing buildings. There is no required textbook, but many critical texts are on reserve at the library.

A list of books on reserve and Internet resources is provided below. Also, a list of weekly readings on specific topics will be provided at the first class.

Format: This is a blended course that involves a mixture of synchronous meetings at the scheduled time and asynchronous online activities. Most of the Lectures and tutorials will be available online a week ahead of schedule. Students are expected to be available during the synchronous meeting times (weekly forums). When possible, some site investigation and documentation will be conducted. Also, discussion of case studies, readings and research, essay and report writing are expected. The first weeks include a
3-hour Lecture period and a 3-hour lab led by the instructor and teaching assistants. The blended Lecture period will include teaching modules, discussion of assigned readings and presentations, or assignments. Lab time will be used for fieldwork, work on assignments 2 to 5, described at the end of the outline, and meet the instructor and/or teaching assistants. Lectures/ field visits may include guest speakers. Students are encouraged to participate in analytical discussions and make links with other courses, projects and experiences.

Preferable to use a good internet connection: Ethernet, not WIFI, do not use smartphones or tablets to access synchronous activities. Get a good headset, webcam and microphone to participate in the synchronous activities.

Grading:

There are 4 online class quizzes (20%) and an online take-home exam (20%) dealing with in class online content, including Lectures and readings. There will be five assignments worth 50%. The description of each assessment follows the detailed course description below. The grading of the five assignments will be as follows:

- **Assignment 1**: 5% (consist of three parts that need to complete for getting a full grade)
- **Assignment 2**: 10%
- **Assignment 3**: 5%
- **Assignment 4**: 5%
- **Assignment 5**: 25% (this includes a dossier - 15% and a group presentation submissions – 10%)
- **Course Quizzes**: 20%
- **Take-Home Exam**: 20%

The remaining 10% of the final mark is discretionary based on online synchronous forum attendance, including participation, punctuality, and technical compliance. The instructor might review the zoom attendance report, so make sure you spell your name correctly in the zoom profile. **Please show respect for all by utilizing a stable internet connection, use a good microphone, headset and switching on your camera; muting yourself while others talk is critical to prevent background noise.** Eventually, depending on the sources' progress, a **bonus assignment worth 5% in total of additional grades might be implemented.**

**Attendance in the first class is required, and there will be no make-up time for students who join after the term has begun. Attendance at labs is also obligatory unless the instructor designates it otherwise at the time.**

Concise and accurate technical writing is important in professional work; student wrote, and verbal work will be assessed on language (grammar, spelling, structure, style) and content. Only referenced peer-review academic publications will be accepted as bibliographical support; this should be presented using appropriate academic citation styles; for this, you are recommended to consult: [https://library.carleton.ca/help/citing-your-sources](https://library.carleton.ca/help/citing-your-sources). See also below for more general information.

**Emails:**

Emails will be answered within 24 hours. Except for during the 30 minutes after class, meetings outside class hours will be by appointment only.
OVERVIEW OF COURSE CONTENT: Modules

1. Introduction
2. Characterization of buildings
3. Building pathology
4. Materials, assemblies and structures:
   a. Wood
   b. Masonry
   c. Metals
   d. Concrete
5. Building Envelope & Introduction
6. Building rehabilitation
7. Sustainable rehabilitation

DETAILS ON EACH TOPIC

INTRODUCTION
- Learning objectives, methodology, definitions
- The conservation process and values-based decision-making
- Bridging between conservation and sustainability
- Principles and practices
- The role of documentation
- Overview of principal references
- Overview of all assignments and student evaluation process
- BP&R skills assessment

CHARACTERIZATION OF BUILDINGS
1: Introduction:
- The importance of understanding/ being able to ‘read’ buildings for pathology
- Three types of characterization: construction, functional types and performance
- Sources of information: primary (site, archival documents) / secondary research

2: Construction types:
- Structural systems (masonry, timber, steel, concrete, hybrid)
- Assemblies (roofs and roof related elements, exterior walls and foundations, windows and doors, interior features and finishes)
- Materials (wood, stone, brick, metals, glass, plaster, stucco, tile, etc.)
- Comfort and service systems (heating, ventilation, lighting, elevating, etc.)

3: Functional types:
- Residential, commercial, institutional, cultural, religious
- Issues due to scale, number and location of buildings

4: Performance and climate
- Standards and performance measures: comfort, security, acoustics, air quality
- Code requirements for existing buildings: fire protection, egress, accessibility
- Performance expectations: service life, obsolescence and life cycle
- Workmanship and design quality
- Site-specific, regional and climate-based conditions
• Inherent/historic environmental features: size, orientation, massing, materials, durability, natural daylight, ventilation

BUILDING PATHOLOGY

1: Building deterioration: defects, damage and decay
• Definitions: defects, damage, decay
• Extrinsic versus intrinsic causes of deterioration
• Understanding weather and climate
• Natural causes: water, wind, sun, freeze/thaw, fire, earthquakes, vegetation, insects
• Human-made causes
• Short-term deterioration (disasters)
• Long-term deterioration (weathering or lack of maintenance)

2: Investigation: condition and performance assessment
• Step-by-step procedures of investigation and diagnostics
• The investigation team: architect, engineer, technologist, builder/craftsperson
• Principles and proven methods
• Tools and resources
• Health and safety considerations
• The roles of building historians, materials conservators, conservation scientists, building science specialists, and traditional trades in an assessment
• Destructive and non-destructive testing
• Performance assessment tools and methods: thermal, seismic, comfort, etc
• Climate change considerations (impact assessment and mitigation)

3: Diagnostics: criteria and analysis
• Step by step: the process of analysis
• Review of applicable codes, standards and guidelines
• Evaluation of previous repairs and alterations
• Historic codes, standards and repair approaches
• Ageing and patina
• Durability and service life
• Inherent vice and design "flaws."
• Monitoring and testing
• Establishing priorities

MATERIALS, ASSEMBLIES AND STRUCTURES

1: Building Envelope: Roofs, Walls, Windows
• Building envelope characteristics, objectives and typical problems or deterioration
• Roofs and rainwater controls: types, components and problems of sloped and flat roofs
• Exterior walls including foundations, cladding, curtain walls: types, components and problems
• Windows and doors, including glazing materials, frames and hardware: types, components and problems
• Key sustainability issues and typical conservation strategies

Revised – 7 January 2022
2: Introduction to the Materials, Assemblies and Structures (MAS) modules
- Overview of the MAS modules. Each MAS module will address the specific:
- Examples of character-defining elements in Canadian buildings
- Key developments in the technology’s history
- Material and assembly/structure properties
- Typical deterioration and defects
- Testing for identification of materials and assessment
- Performance issues and sustainability
- Conservation guidelines
- Analysis and treatment options (Maintenance, Repair, Replacement)
- Available references

3: Wood materials, assemblies, and structures
- Including timber, wood, engineered wood products

4: Masonry materials, assemblies, and structures
- Including natural stone, brick and terra cotta

5: Metal materials, assemblies, and structures
- Including iron, steel(s), copper and alloys, and aluminum

6: Concrete materials, assemblies, and structures
- Including cast stone, terrazzo and mortar

BUILDING REHABILITATION

1: Planning the repair approach
- Criteria for treatment selection (e.g. heritage, health/safety, cost, sustainability)
- Level of intervention: minimum intervention in addressing causes of deterioration
- Principles of conservation repair/values-based decision-making
- Integration of performance improvement objectives
- Prioritization of proposed work
- Modern repair technologies
- Use of substitute materials, re-use of heritage materials, sourcing materials
- Integration of specific treatments in an overall conservation plan

2: Addressing performance issues
- Upgrades to meet changes to codes and standards
- Addressing seismic, security & accessibility requirements
- Improving thermal performance and other sustainability upgrades
- Fire protection
- Removal and encapsulation of toxic materials
- Replacement of poor original materials or addressing poor design
- Development of integrated treatment/upgrade options
- Options analysis and recommendations

3: Planning repair work and upgrades
• Step by step project planning (in public and private practice, for generalists and specialists).
• Specifications for conservation and sustainability: reduced VOCs, embodied energy, durability, local materials and waste management
• Site-specific issues
• Role of mock-ups
• Identifying appropriately skilled labour
• Pre-qualification of contractors
• Cost estimation
• Contracting considerations

SUSTAINABLE REHABILITATION

1: Sustainable conservation strategies
General & specific principles for integrating conservation and sustainability, including
• The integrated design process and community consultations
• Assessment of current conditions and performance
• Understanding of historic environmental design principles and features
• Application of common principles of minimal intervention (repair before replacement)
• Using appropriate new or historic technologies
• Designing for durability, compatibility and reversibility
• Planning for long-term use, growth and change

2: Sustainable conservation examples
• Case studies of successful integration of conservation and sustainability, including appropriate alterations of site, building envelope, systems and interiors
• Discussion of how to use environmental rating systems in the context of rehabilitation

REFERENCES

Readings will be identified from online sources, and the final take-home examination will include selected questions from these readings:

• Eric Arthur, Thomas Ritchie, Iron: cast and wrought iron in Canada from the seventeenth century to the present, University of Toronto Press, 1982 (Available online through Carleton Library’s HathiTrust Access)
• John Ashurst, Francis G. Dimes, editors, Conservation of Building and Decorative Stone, London, Butterworths, 1990 (Available online through Carleton Library’s HathiTrust Access)
• Jean Carroon, Sustainable Preservation, Greening Existing Buildings, Wiley, 2010 (Available online through Carleton Library’s E-Book central)
• Frances Gale, editor, Preservation Technology Primer: readings from the APT Bulletin, 2008. (Available online through Carleton Library)
Carleton University
CIVE4601/ARCN 4200 BUILDING PATHOLOGY AND REHABILITATION
2021-2022 WINTER SESSION – COURSE OUTLINE

Revised – 7 January 2022

  (Available online through Carleton Library)
  (Available online through Carleton Library’s HathiTrust Access)
• Susan Macdonald, editor, Concrete: Building Pathology, Wiley-Blackwell, 2002 (Available online through
  Carleton Library)
• Thomas F. McIlwraith, Looking for Old Ontario, Two Centuries of Landscape Change, University of Toronto
  Press, 1997 (Available online through Carleton Library)
• Richard Oxley, Survey and Repair of Traditional Buildings, A Sustainable Approach, Donhead, 2003
  (Available online through Carleton Library’s HathiTrust Access)
• J. Stanley Rabun, Structural Analysis of Historic Buildings: Restoration, Preservation and Adaptive Reuse
  Applications for Architects and Engineers, Wiley 2000. (Available online through Carleton Library’s
  HathiTrust Access)
• John Rempel, Building with Wood, and Other Aspects of Nineteenth-century Building in Central Canada,
  University of Toronto Press, 1980 (Available online through Carleton Library’s HathiTrust Access)
• Thomas Ritchie, Canada Builds, 1867-1967, University of Toronto Press, 1967 (Available online through
  Carleton Library’s HathiTrust Access)
• Susan M. Ross (2017) Sustainable conservation strategies for Canada’s modernist wood legacy, Journal of
  Carleton Library)
  through Carleton Library)
  online through Carleton Library’s HathiTrust Access)

Also, the following references are available online:

• EWAGLOS – Illustrated Glossary of Conservation Terms for Wall Paintings and Architectural Surfaces -
  http://heritageportal.eu/Resources/Useful-Links/EWAGLOS---Illustrated-Glossary-of-Conservation-Terms-
  for-Wall-Paintings-and-Architectural-Surfaces.17783.shortcut.html
• Parks Canada, The Standards and Guidelines for the Conservation of Historic Places in Canada
  NB. Also, the bibliography includes references from provincial heritage departments and organizations across
  the country.
• Canada Mortgage and Housing Corporation – Better Buildings Case Studies
  www.cmhc-schl.gc.ca/en/inpr/bude/himu/bebu/bebu_001.cfm#CP_JUMP_189275
• Canada Mortgage and Housing Corporation – Con Ed Articles for Architects: Building Envelope
  Online damage-expert for monumental buildings system
  http://mdcs.monumentenkennis.nl
• APT Bulletin articles (through Jstor)
  www.apti.org/bulletin-index/
• APT Publications – Historic Trade Publications
  www.apti.org/publications/apt-building-technology-heritage-library/
• USA National Parks Service Preservation Briefs and Tech Notes
  www.nps.gov/tps/how-to-preserve/briefs.htm
  www.nps.gov/tps/how-to-preserve/tech-notes.htm
• USA GSA HP Technical Procedures
  http://www.gsa.gov/portal/hp/hpc/category/100371/hostUri/portal/searchBy/ALL
• Getty Conservation Institute publications
  Myers, D. Smith, S.N. Shaer, M. A Didactic Case Study of Jarash Archaeological Site, Jordan: Stakeholders
  and Heritage Values in Site Management, The Getty Conservation Institute,
• National Institute of Building Sciences – Whole Building Design Guide
### Tentative schedule

The Lectures and activities might change over the weeks, given the availability of guest Lecturers and the unprecedented effect of COVID on the course progress.

<table>
<thead>
<tr>
<th>Week</th>
<th>Tutorial</th>
<th>Class</th>
<th>Contents and tasks</th>
</tr>
</thead>
</table>
| 1    | Jan 13   | Jan 14 | Lecture 1: Introduction to Building Pathology & Rehabilitation.  
Watch: Lecture 3: Characterization of buildings; construction types; functional types; inherent environmental features  
Guest Lecture: Carleton Library Resources (Kristof Avramsson)  
Jan 14 | No Tutorials |
| 2    | Jan 20   | Jan 21 | Watch: Lecture 4: Building deterioration: Defects, damage and decay.  
Watch: Lecture 5: Investigation: Condition & Performance Assessment.  
Watch: Lecture 6: Values centred assessments  
Guest Lecture by Rebecca Bartlett (Carleton Library) on GIS  
Introduction of Assignment 2  
Review suggested readings at Brightspace.  
Jan 21 | Group Meetings with Teaching Assistants  
Submit you teams' site and composition (January 21 – 5 PM) |
| 3    | Jan 27   | Jan 28 | Watch: Lecture 7: Diagnostics, Criteria & Analysis.  
Watch: Lecture 8A: Repairs: Planning the conservation approach.  
Watch: Lecture 8B: Adaptive Reuse - Preparation of a Conservation Management Plan  
Review suggested readings at Brightspace.  
Quiz 1 on Building Pathology concepts starts at 8:30 am to 5:00 PM  
Jan 28 | Tutorial 1: Preparing Site Reconnaissance  
Submit Assignment 1 due January 28 (5 pm) |
| 4    | Feb 3    | Feb 4  | Lecture 10: Preparing a Statement of Significance in Canada (L. Smith)  
Watch: Lecture 12A: Introduction to masonry, metals, Earth, Wood and Concrete. Also includes discussion about Wall Paintings  
Lecture 12B: Masonry materials, assemblies, and structures (J. Marrs)  
Introduction to Assignment 3 and 4  
Review suggested readings at Brightspace.  
Feb 4 | Group Meetings with Teaching Assistants and working on Tutorial 2 |
| 5    | Feb 10   | Feb 11 | Watch: Lecture 13: Metal materials, assemblies, and structures.  
Lecture 14: Hygrothermal Properties and Performance of Masonry (M. Gultland)  
Review suggested readings at Brightspace.  
Feb 11 | R01: (A2 and A1): Review A02 Draft with TA  
Tutorial 2: Preparing an essay for Building Pathology relevant to Assignment 3 |

**Reading Week (Feb 15-19)**

<p>| 6    | Feb 17   | Watch: Lecture 15: Earth: materials, assemblies, and structures |</p>
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>Feb 18</td>
<td><strong>Submit Assignment 2 due Feb 18 (5 pm)</strong></td>
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<td></td>
<td>Site visit (pending permissions)</td>
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<td>7</td>
<td><strong>Submit Assignment 3 due Mar 11 (5 pm)</strong></td>
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<tr>
<td>Mar 3</td>
<td>Watch: <strong>Lecture 17: Energy Modelling for Existing Buildings (L. Ide)</strong></td>
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<td>Also, A TED Talk by Larissa is also provided</td>
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<td></td>
<td>Watch: <strong>Lecture 18: Wood materials, assemblies, and structure (S. Ross)</strong></td>
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<td>Guest Lecture by Joe Kallas about Recording and condition assessment of Beirut's heritage after the devastating explosion.</td>
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<td>Watch: <strong>Lecture 19: Rehabilitation 3: Projects: Planning repair and upgrades</strong></td>
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<td></td>
<td>Introduction to Assignment 4 and 5</td>
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<tr>
<td></td>
<td>Review suggested readings at Brightspace.</td>
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<td></td>
<td>Quiz 2 on topics covered until Feb 18 starts at 8:30 am to 5:00 PM</td>
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<tr>
<td>Mar 4</td>
<td>Working session on Assignment 4 and 5 (Tutorial on Photogrammetry)</td>
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<td></td>
<td>Site visit (pending permissions)</td>
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<td>8</td>
<td><strong>Submit Assignment 4 and 5 due Mar 11 (5 pm)</strong></td>
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<tr>
<td>Mar 10</td>
<td>Watch: <strong>Lecture by Guest Practitioner: John Cooke</strong></td>
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<td></td>
<td>Watch: <strong>Lecture by Elyse Hamp on Structural Assessment of a Historic Buildings in Ottawa</strong></td>
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<tr>
<td>Mar 11</td>
<td>Working session on Assignment 4 and 5 (Tutorial on condition assessment and values assessment)</td>
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<td></td>
<td>Quiz 3 on topics covered until March 17 starts at 8:30 am to 5:00 PM</td>
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<tr>
<td>9</td>
<td><strong>Submit Assignment 5 Task 1 - Presentation PPT/PDF (5 pm)</strong></td>
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<td>Mar 17</td>
<td>Lecture by Guest Academic: Rebecca Napolitano</td>
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<td>Live Cycle Management Inspections by Ryan Waddell (NCC)</td>
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<td>Lecture 22 - Thermal Photography: Introduction for Building Pathology and Rehabilitation</td>
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<td></td>
<td>Review suggested readings at Brightspace.</td>
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<td></td>
<td>Quiz 3 on topics covered until March 17 starts at 8:30 am to 5:00 PM</td>
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<tr>
<td>Mar 24</td>
<td>Working session on Assignment 4 and 5 Task 1</td>
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<td><strong>Submit the name of the team member that will upload data into dataverse by email to instructor (5 PM)</strong></td>
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<tr>
<td>10</td>
<td>Lecture 20: Concrete materials, assemblies, and structures.</td>
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<td>Lecture 21: Sustainability of Historic Buildings.</td>
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<tr>
<td></td>
<td>Guest Lecture: <strong>Condition Assessment of Historic Decorated Surfaces by Yu Sheng</strong></td>
</tr>
<tr>
<td></td>
<td>Review suggested readings at Brightspace.</td>
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<tr>
<td></td>
<td>Quiz 3 on topics covered until March 17 starts at 8:30 am to 5:00 PM</td>
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<tr>
<td>Mar 25</td>
<td>Working session on Assignment 4 and 5 Task 1</td>
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<tr>
<td>11</td>
<td>Lecture 23 - Key messages</td>
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<td></td>
<td>Lecture 24: How to submit your course data and report on dataverse for posterity</td>
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<tr>
<td>Apr 1</td>
<td>Working session on Assignment 5 Task 2</td>
</tr>
<tr>
<td>12</td>
<td>Assignment 5 presentations (Questions &amp; Answers + feedback)</td>
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<tr>
<td></td>
<td><strong>Submit Assignments 4 and 5 due April 15 (5 pm), but late submissions until April 18 (5 pm) will not be penalized.</strong></td>
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</table>

**ONLINE CLASS QUIZZES**

Revised – 7 January 2022
Students are expected to read class readings. They provide useful and important information about illustrating the performance, condition and potential conservation strategies for historic buildings. Four class quizzes (Q1: 5% and Q2: 5%) will be conducted during the course. Questions will cover essential issues; the instructor will indicate potential topics throughout the course.

ASSIGNMENTS

Part of the evaluation of student work will be based on the following four assignments. For final details, see the instruction sheets provided when the assignment is introduced. The submission schedule will be described in the draft course schedule. An assignment handed in late will be deducted 10% per day from the assessed grade.

Assignment 1: Introduce Yourself and Logistics Compliance:

Individually submit a personal introduction (see Brightspace for details). Also, include the following statement at the end of your post: "I (insert name), confirm that I have read and understood the entire syllabus for this course. If I have questions about the course, I promise to check the syllabus, the online material (assignment guides, tutorials, examples, etc.) before emailing Professor Santana and/or Teaching Assistants.

Furthermore, fill the following forms and submit answers: (1) Student Consent to Publish and (2) Informed Consent agreement.

Assignment 2: Building characterization – 5 pages minimum (11 x 17) survey

Each student selects a building from a list of buildings and prepares a visual survey/building characterization sheet, which provides an overview of its character-defining elements, its construction and functional types, and identifies inherent environmental features. Due to COVID-19 restrictions, the scope will be limited to the external envelope of the building. Students can use files provided by the professor’s dataverse dataset to make this assignment and the GIS data available at MacOdrum Library.

A group template will be developed/ provided based on inventories with one page of text in point form, one overall photograph and one plan 10% of the total mark. This building (or site) will be used during the entire class as a case study.

At the end of the course, you are expected to submit all supporting material; please follow the digital file format and naming protocols provided on Brightspace under the course outline.

Assignment 3: Conservation technology – 1500-word essay on issues

Each student selects a type of (historic or modern) building material, assembly or structure from the site being studied and will write a brief essay on this technology. The essay should provide a brief history of the technology's development and use in Canada. Identify 2 pathological conditions or issues that affect this technology and 2 interventions that can enhance sustainability (ex. improved energy efficiency or lifecycle impact).

For each pathological condition:
1. briefly describe what the condition is (ex. identification and cause of the problem);
2. why it is important to repair this condition (ex. what are the benefits);
3. how to repair this condition;
4. concerns about repairs, if applicable (ex. a solution that works in one climate may not be suitable in another climate);
5. additional information about why this repair is sustainable.

For each sustainable intervention:
1. briefly describe what the intervention is;
2. what are the benefits of this intervention;
3. how to implement this intervention;
4. concerns about this intervention, if applicable (ex. a solution that works in one climate may not be suitable in another climate);
5. additional information about why this intervention is sustainable.
6. in a table, state whether this intervention improves each of the following: insulation, air-tightness, ventilation, solar-heat gain/shading, daylighting, thermal mass, durability, repairability/ease of maintenance, embodied energy, end-of-life disposal

Topics are generally based on Eastern Canadian building technologies. However, topics from other regions or countries will be allowed with prior approval. The essay should be submitted in a two-sided letter format with a cover page. It may include up to five illustrations with credits. Only scientific peer-review articles will be permitted to use bibliographical references found on or accessed electronically through the MacOdrum Library or class-readings.

Assignment 4: A surface condition report – 2 pages, including a Measured Drawing and 400-word report

This is an assignment conducted in groups of two or three members of each team; it is built on Assignment 4, submitted by the entire. The purpose of this exercise is to reinforce the use, benefits, and constraints of recording techniques, in this case, photogrammetry or rectified photography (learned on CIVE3207), to prepare an elevation drawing, as well as, to prepare a surface condition representation.

Each sub-team will prepare a measured drawing of at least one elevation using files provided by the professor’s dataverse dataset. It will use the data provided to produce photogrammetric models to prepare an ortho-corrected image. This is conducted using specialized software. This software allows users to produce corrected images from 3D models. The element's main features should be drawn from the resulting ortho-image using CAD overlay (e.g. Windows, doors, pediment, etc.). Equally, each sub-team will identify construction materials (e.g. stone type 1, stone type 2, brick type 1, etc.) and deterioration patterns (e.g. cracks, missing material, biological growth). 5% of the total mark

For the submission of supporting material, please follow the digital file format and naming protocols provided on Brightspace under the course outline. See appendix 1 and 2 – You need to upload all material also on dataverse.

Assignment 5: Conservation Investigation – field notes and report

This is the main course assignment, and it is developed in two task submissions. It includes site visit(s) (depending on permissions and limited to the external envelope), investigation and recording of observed conditions, analysis of the causes of deterioration and recommendations for repair of the envelope and interiors of an Ottawa-area building (or site) used during the semester. The assignment will be reviewed and discussed according to field notes, draft report, class presentation (during labs). A typical report table of contents will be provided.
Task 1: In the presentation, groups are expected to produce a recording of 10 minutes underlying the dossier's conservation investigation outcomes and contents to be submitted later, which will be presented in class on the last day of the course. Each group is also expected to ask one question to their fellow teams.

Task 2: the final report: consists of a letter-size double-sided manuscript with a maximum of 12 pages of text and 8 pages of photos. 10% is assigned to the group presentation and 15% of the report submission (total 25%). Students must use the Nara Grid and the online damage-expert for monumental buildings system (http://mdcs.monumentenkennis.nl) to prepare this report.

For the submission of supporting material, please follow the digital file format and naming protocols provided on Brightspace under the course outline. You will need to upload the data onto dataverse, a team member should be appointed to upload, send an email before March 25, 2022 – 5 PM with the name of the person, remember that a dataverse login is required. See appendix 1 and 2.

Technical Prerequisites

To be able to take the course and produce assignments, students are required to:

- Laptop / Desktop computer minimal configuration (recommended):
  - CPU: Intel VT-x 64bit Processors - i5/i7/i9 7th Gen or more (minimum)
  - Memory: 8GB RAM (minimum) Strongly recommend 16GB or more
  - Drive: 256GB or Larger SSD (Solid State Drive)
  - GPU: Nvidia Quadro, GeForce GTX, Radeon Pro, (>2GB Graphics Card)
  - Networking: WIFI (AC or AX) Recommend a 1Gig or Faster Ethernet Port or Adapter (Use a USB 3.0 to ethernet adapter, so you do not need a physical ethernet port on your laptop)
  - Audio & Video: Camera, Microphone & Speaker

Software: the following software should be installed on students' laptops or desktops before the course:

- Get AutoCAD 2020 through 2022 and Autodesk Recap (latest version). Free copies of AutoCAD and Recap release are available for download by registering at the Autodesk Education Community (http://students.autodesk.com). AutoCAD is also available at the computer lab if you do not have a laptop computer.
- Get Bentley Context Capture (version v10.15.0.76), also bear in mind that an update of Bentley CONNECTION Client (to v10.0.19.27) is needed and an update of the NVIDIA GTX 1050 Ti video card driver (to 451.48 “standard”), a tutorial will be organized to install and get a license from Carleton to use this software.

Students are also expected to know the two-dimensional drawing features of the Computer-Aided Design (CAD) application. For tutorials, Carleton offers free access to LinkedIn Learning https://carleton.ca/learninganddevelopment/linkedinlearning/ here; you can find CAD and other digital tools tutorials. Limited classroom instruction in the elements of CAD may be offered, depending on demand, but will not occur during course time.

It is highly recommended for the course to complete the following training:
- Learning AutoCAD (2h) Shaun Bryant
- AutoCAD 2020 Essential Training (3h 25m) Shaun Bryant
- AutoCAD: Construction Drawings (3h 18m) Shaun Bryant
- Learning FARO: Laser Scanning (39m) Dustin Manning
- 3D Scanning with a Camera (57m) Kacie Hultgren
- ReCap Workflow for Reality Capture (2h 52m) Paul F. Aubin

To access these training, read https://students.carleton.ca/services/linkedin-learning/, and they are also listed in Brightspace. Also, Students are expected to know the two-dimensional drawing features of the Computer-Aided Design (CAD) application. Depending on permissions, to be provided by the Department of Civil and Environmental Engineering:

- A camera tripod.
- Hand recording kits (measuring tape, Disto (electronic distance meter (EDM)), plumb bob and string.
- DSLR digital cameras: Nikon D5300 + 18-55 mm Nikkor Lens;
- Laser level;
- Total Station kit with the tablet.

TAKE HOME EXAM

A take-home exam will cover a basic understanding of material performance, condition and potential conservation strategies to maintain historic buildings. It builds upon the two quizzes conducted during class. This exam will be launched online on the last day of class, and it will be available for 5 days to answer. It is worth 30%. It will consist of one question-related material conditions, one question about performance and one question about a potential conservation strategy. When starting the online session, the length to answer 10 questions will be 30 minutes.

BIOGRAPHICAL SKETCH OF INSTRUCTOR

Mario Santana-Quintero is a professor on Architectural Conservation and Sustainability at the Department of Civil and Environmental Engineering at Carleton University. He is also the Director of the NSERC Create program "Engineering Students Supporting Heritage and Sustainability (HERITAGEENGINEERING)" based at the Carleton immersive Media Studio Lab (CIMS). He has an architectural degree, holding a master's in the conservation of historic buildings and towns and a Ph.D. in Engineering from the R. Lemaire International Centre for Conservation (University of Leuven, Belgium). He is also a guest professor at the Raymond Lemaire International Centre for Conservation (University of Leuven). These past years he has also been teaching at the Universidad Central de Venezuela, Universidad de Guadalajara (Mexico) and Universidad de Cuenca (Ecuador). He was a Professor at the University College St Lieven and Lecturer at the University of Aachen RWTH and the Historic Preservation Programme at the University of Pennsylvania between 2006 and 2011. Along with his academic activities, he serves as Secretary-General of the International Council of Monuments and Sites (ICOMOS), and he is the past president of the ICOMOS Scientific Committee on Heritage Documentation (CIPIA). Furthermore, he has collaborated in several international projects in heritage documentation for UNESCO, The Getty Conservation Institute, ICCROM, World Monuments Fund, UNDP, Welfare Association, and the Abu Dhabi Department for Culture and Tourism.

INTELLECTUAL PROPERTY, COPYRIGHT AND FAIR DEALINGS

As a condition of participating in the course and for academic evaluation, students will be required to upload in-progress and completed work to the instructor's desired online platform(s). It is expressly
understood that any such records or copies of student work will be used for nonprofit presentation. The purposes of this authorization, the nonprofit presentation includes showing, screening, publication and releases or presentation as a public service by internet distribution, commercial broadcasting or publication in furtherance, of course, specific and institutional learning objectives.

Please, under no circumstances, download course documents or presentations for distribution without first acquiring the author/instructor has written permission for reasons of intellectual property and copyright.

**ACADEMIC ACCOMMODATIONS**

You may need special arrangements to meet your academic obligations during the term. For an accommodation request, the processes are as follows:

Pregnancy obligation: write to me with any requests for academic accommodation during the first two weeks of class or as soon as possible after the need for accommodation is known to exist. For more details, see the link below.

Religious obligation: write to me with any requests for academic accommodation during the first two weeks of class or as soon as possible after the need for accommodation is known to exist. For more details, see the link below.

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally scheduled exam (if applicable). [https://devsite.carleton.ca/equity/accommodation/academic/course-outline-wording/](https://devsite.carleton.ca/equity/accommodation/academic/course-outline-wording/)

**Survivors of Sexual Violence**

As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and survivors are supported through academic accommodations as per Carleton’s Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, [https://carleton.ca/sexual-violence-support/](https://carleton.ca/sexual-violence-support/)

**Accommodation for Student Activities**

Carleton University recognizes the substantial benefits, both to the individual student and the university, resulting from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class or as soon as possible after the need for accommodation is known to exist. [https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf](https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf)
For more information on academic accommodation, please contact the departmental administrator or visit: students.carleton.ca/course-outline

Student Wellness Resources

- General (All Resources Available): https://students.carleton.ca/wellness/
- Mental Health and Wellbeing: https://students.carleton.ca/services/mental-health-well-being-website/
- International SOS: https://students.carleton.ca/services/international-sos/
- Therapy Assisted Online (TAO): https://students.carleton.ca/services/therapy-assisted-online/

ACCESSIBILITY

Students with disabilities requiring academic accommodation in this course must register with the Paul Menton Centre for Students with Disabilities (PMC) for a formal evaluation of disability-related needs. Documented disabilities could include but are not limited to mobility/physical impairments, specific Learning Disabilities (LD), psychiatric/psychological disabilities, sensory disabilities, Attention Deficit Hyperactivity Disorder (ADHD), and chronic medical conditions. Registered PMC students are required to contact the PMC, 613-520-6608 every term to ensure that instructor receives your Letter of Accommodation no later than two weeks before the first assignment is due or the first-in-class test/midterm requiring accommodations. If you only require accommodations for your formally scheduled exam(s) in this course, please submit your request for accommodations to PMC by the deadlines published on the PMC website:

https://carleton.ca PMC/
https://carleton.ca registrar/registration/dates-and-deadlines/

STUDENT CONDUCT

Please refer to https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/ for specific information regarding Student Conduct and Academic Integrity standards.

STUDENT RESPONSIBILITY

https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/student-responsibility/

CONDUCT DISCRIMINATION AND HARRASSMENT

https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/academic-integrity-and-offenses-of-conduct/

ACADEMIC INTEGRITY

The University has adopted a policy to deal with allegations of academic misconduct. This policy is expressed in the document Carleton University Academic Integrity Policy, found here: https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/academic-integrity-and-offenses-of-conduct/

SECURITY AND SAFETY

Avoid Working Alone After Hours · In Case of Emergency, Dial Extension 4444 from any campus phone.
APPENDIX 1: DIGITAL FILES FORMAT AND NAMING

The following guidelines pertain to the creation and manipulation of digital files for the historic site recording assessment course; the purpose is to provide a framework for appropriate storage, retrieval and provenance of files prepared during the course. The data produced in the course will be stored for posterity on Carleton's dataverse system: https://library.carleton.ca/services/dataverse. This will make it available to the university community.

Digital Images

File Name

Image files should be named according to the following format:
BP _ SITE# _ YEAR _ PHOTO# . EXTENSION

The following explains each site within this file naming convention:
BP: Letter “AC” precedes SITE# to indicate ARCN /CIVE course.
SITE#: 3-digit acronym, which indicates the acronym assigned to each of the groups in the course. Your group will decide this suffix on Assignment 1. For example, a Bytown museum can be BTM or Mayfair building could be MFB.
YEAR: 4 digit number indicating the year in which photo was taken (i.e., created).
INITIALS: 3-digit acronym, indicating the author's name taking a photograph (i.e., MSQ).
PHOTO#: 4 digit number assigned to the photo to distinguish it from other photos of the same site created in the same year. If the number is less than 4 digits, it should be preceded by an appropriate number of 0's.
EXTENSION: The file type, such as JPG.
The following is an example of an image file name following this convention:
BP_MFB_2016_ARCH0002.jpg

File Format

It is recommended that image files be in the JPG format to minimize file size.

File Size

It is recommended that image files be no larger than one megabyte (12 MB) in size.

Description Information

The following information should be recorded to describe the photograph in the accompanying spreadsheet:

- Specific date photo was taken/created (in the following format): YEAR (4 digit number) MONTH (3 digits alphabetic abbreviation) DAY (2 digit number; if a date is only 1 digit, then precede with a 0);
- Photographer name (in the following format): SURNAME, GIVEN NAME
• Image copyright holder: indicate the name of institution(s) or individual(s) holding image copyright; if copyright no longer held (e.g., expired), then indicate "no copyright", in most cases indicate Carleton University.

• Site name: indicate the site's primary name in agreement with instructors.

• The subject of photograph: indicate the subject of the photograph, which should describe the reason for taking the photo; the following are examples:
  • Context photography: interior and exterior (e.g. Situating the site in its environment, west facade, general exterior view, etc.)
  • Character defining elements (e.g. Ornamentation, hardware, etc.)
  • Condition photography (e.g. Disturbances, threats, decay).

**CAD drawings, point clouds and other electronic files**

**File Name**

AutoCAD files should be named according to the following format:
BP _ SITE# _ YEAR _ DRAWINGNAME# . EXTENSION

The following explains each site within this file naming convention:
BP: Letter “BP” precedes SITE# to indicate ARCN /CIVE course.

SITE#: 3-digit acronym, which indicates the acronym assigned to each of the groups in the course. Your group will decide this suffix on Assignment 1. For example, a Bytown museum can be BTM, or a Mayfair building could be MFB.

YEAR: 4 digit number indicating the year in which photo was taken (i.e., created).

DRAWINGNAME#: 4 digit number assigned to the drawing to distinguish it from other drawings of the same site created in the same year. If the number is less than 4 digits, it should be preceded by an appropriate number of 0's.

EXTENSION: The file type, such as DWG.

The following is an example of an image file name following this convention:
BP _001_2012_0002.DWG

**Description Information**

The following information should be recorded to describe the photograph in the accompanying spreadsheet:

• The specific date when the drawing was last updated (or created) (in the following format): YEAR (4 digit number) MONTH (3 digits alphabetic abbreviation) DAY (2 digit number; if the date is only 1 digit, then precede with a 0);

• Author name (in the following format): SURNAME, GIVEN NAME

• Drawing copyright holder: indicate the name of institution(s) or individual(s) holding image copyright; if copyright no longer held (e.g., expired), then indicate "no copyright", in most cases indicate Carleton University.

• Site name: indicate the site's primary name in agreement with instructors.

• The subject of the drawing: describe the context and contents of the drawing (e.g. Plan section: level 1: condition assessment)
Guidelines for the layer naming and structure will be discussed during the class and agreed upon to submit the assignments.

**Other electronic files’ submission**

Students are expected to submit all the files used to produce the different assignments and course report in digital format. Please consider using similar naming guidelines for digital images and CAD drawings to name and organize all your files. The provenance information of your files is crucial for the storage, management and retrieval of these files in the future.
APPENDIX 2: UPLOAD PROTOCOL FOR DATaverse

Prepare Data for Upload

Remember to send an email to the instructor with the person’s dataverse login that will upload the data before March 25 - 5 PM.

Before the dataset is uploaded to Dataverse one must ensure that the data is clear so others may use it in the future. Remember that you need to upload your Integrated Project Dossier, assignments and all the accompanying files that were used to prepare these deliverables (e.x. Indesign files, PPT; DWG, PDF, Illustrator, Photoshop, etc).

1. Ensure that your files comply with the digital file formatting and naming protocol in Appendix 1. If mass renaming is needed use Adobe Bridge for efficiency.

   a. Open adobe bride opens your file containing your data right click and choose batch rename
b. Rename your files according to the protocol.

2. Compress your files Dataverse will unzip your files upon uploading so zip the files twice.
   a. Remember each file should be less than 3 GB in size. If you need more than one zip file, just use a sequence in the numbering of the directories.
   b. Compress the directory using a Zip file format
   c. Right click on the file >send to> compressed (zipped) file
   d. Renamed the Zip file according to the suggested protocol (see following part) If you need more than one zip file, just use a sequence in the numbering of the directories.

Suggested data structure

- **01_BP_2022_BTM_BCHARS**: here include the Assignment 2 PDF and all the files to prepare the sheets (e.g. photoshop, indesign, PPT, etc)
- **02_BP_2022_BTM_REPORT**: here include the Assignment 4 report PDF and all the files to prepare the report (e.g. photoshop, indesign, PPT, etc)
- **03_BP_2022_BTM_PHOTOS**: digital photos that you might have used for the condition assessment
- **04_BP_2022_BTM_GIS_files**: GIS files and data for the preparation of the Site Plan
- **05_BP_2022_BTM_CAD**: including AutoCAD files, ortho-corrected images, photogrammetry, point clouds, etc. used to create measured drawings;
- **06_BP_2022_BTM_PDF**: PDF of the AutoCAD files
- **07_BP_2021_BTM_POINTSC**: include here all the 3D Scanning and Photogrammetry that you use in the assignment (Recap, E57);
- **08_BP_2021_BTM_FPRES**: here include the PPT and all the files to prepare the final presentation (e.g. photoshop, indesign, PPT, etc)
- **09_BP_2021_BTM_OTS**: a folder containing other relevant files you consider to be needed to support your report.
Uploading the Data
Once the data is ready it’s time to upload it to Dataverse.

1. Ensure you have the proper permissions to contribute to the dataset of your site. If not, you must request access from the owner (Mario Santana Quintero).
2. With this permission you are free to upload the dataset.

   a. Select the upload button
   b. From here you can and either drag and drop your files or find them on the computer.
   c. Wait for the files to upload
3. Write a description for your dataset. Ensure this is clear so future downloaders understand exactly what files they are getting.
   a. Complete the upload by saving changes.

4. Ensure your dataset is complete and to your liking and uploaded properly.
   a. You will be brought to the main page for that data set. Click on the data and check that it is to your satisfaction.

5. Send an email to your instructor and Teaching Assistant that the data has been uploaded correctly.