Course Syllabus

On-Line Class Meetings
Fridays, 2:00 PM to 5:00 PM (Eastern Daylight Time/Eastern Standard Time)
All class meetings will be synchronous via Zoom.

Communications
Office hours: By appointment, Fridays, 11:00 AM to 1:30 PM (EDT/EST) via Zoom
Telephone: By appointment, weekdays, 9:00 AM to 5:00 PM (EDT/EST)
E-mail: Note: Subject heading of emails should state “HSPV 551”.
Note: I send emails from mhenry@watsonhenry.com, please add this address to your “Safe Senders”.

Course Description
Buildings, their sites, systems and supporting infrastructure embody substantial investments in capital, labor and energy. Historic buildings embody the added value of their architectural, cultural or social significance.

The post-construction performance and function of buildings inevitably decline due to various pathologies. These pathologies are enabled by factors present in the environment, by use and occupancy of the building and by time. Eventually, the aggregate effect of these pathologies necessitates appropriate interventions to slow the loss of, or reinstate, utility and functional performance of the building. Appropriate interventions address the causal factors of the pathologies, slowing damage and inappropriate or symptomatic interventions exacerbate pathologies, increasing damage.

Building Pathology is the study of the deterioration processes that can ultimately determine a building’s survival or loss. The course presents building pathologies as dynamic systems with causal factors such as energy and moisture acting over time, thus informing prevention as well as remediation. The course prepares the historic preservation professional to analyze existing conditions and identify the causal mechanisms and enabling factors of deterioration and loss. The course prepares the architect to identify potential building longevity problems during design of new buildings.

Building Pathology will:
- Consider the problem inherent to the longevity and sustainability of any building – deterioration, loss of utility and loss of functional performance as a function of time;
- Review the investment of capital, labor and energy embodied in new and existing buildings and the added value of buildings considered to be historically significant;
- Emphasize a systemic approach to understanding building deterioration, considering the building, its physical, economic and climatic contexts, its occupancy and use, and the implications of changes in these over time;
- Review the properties of building materials, their comparative values in terms of performance assets and potential vulnerabilities to deteriorative mechanisms;
- Review the mechanisms and causal factors of building deterioration - mechanical, hygrothermal, biological and electrochemical - as dynamic systems;
- Identify the factors necessary for the deterioration mechanisms to occur and the contextual sources for these factors;
- Study examples of how these mechanisms occur singly or synergistically in a building’s structure, enclosure or systems;
- Consider the implications of preventive conservation, sustainability, and adaptability for building survival;
- Consider how to set objectives for remedy, mitigation and prevention of deteriorative mechanisms once the causal mechanisms are known and how to identify and evaluate intervention strategies for achieving the objectives; and,
- Consider the implications of designing and implementing the intervention strategies.
HSPV 551 Building Pathology is complemented by HSPV 552 Building Diagnostics and Monitoring, which addresses diagnosis and monitoring of building pathologies.

Building Pathology will be taught by:
- Preparatory readings;
- Lectures;
- Class exercises and discussions;
- Tests of knowledge;
- Assignments.

Learning Objectives
Upon successful completion of the course, you should be able to:
- Think of buildings systemically in spatial and temporal dimensions;
- Understand the problem of achieving and maintaining adequate utility and functional performance in buildings;
- Recognize building materials for their vulnerabilities to deterioration and for their performance assets and durability;
- Know the primary mechanisms/processes of deterioration in buildings, the causative factors that are necessary and sufficient for these mechanisms to occur, and the potential for synergistic interaction between different mechanisms;
- Understand building deterioration as a dynamic system, rather than symptomatic results;
- Think critically and broadly about factors that differentiate between building survival and loss;
- Express building pathology issues in quantitative and qualitative terms, using professional terminology;
- Research technical information on building and building materials in professional journals;
- Define the objectives and evaluate potential intervention strategies to mitigate, remedy or prevent deterioration;
- Prepare a professional-quality reports that demonstrate application of the above to case studies of actual buildings.

Teaching and Learning On-Line
Building Pathology will be taught on-line using the following platforms:
- Canvas will be used for quizzes and tests.
- Canvas will be used for distribution of materials, readings and lecture notes.
- Zoom will be used live on-line class meetings and individual student meetings.
- Zoom and telephone will be used for meetings with individuals and teams.

Class meeting time will be structured to maximize active learning and interaction among students and between students and the Instructor. As a consequence, lecture time will be minimized in favor of class discussion, exercises and case studies and application of the course material to real-world building pathology problems. This approach will require thorough preparation before class, including review of the readings and lecture slides. Class meetings will not be recorded unless a student cannot attend due to exceptional circumstances, such as an acute health issue.

The final assignment, consisting of one critical review of a published research article and two Building Consultations, will be introduced at the beginning of the semester. Drafts of the major sections of the final assignment will be submitted incrementally during the semester, so that feedback can be provided in time for more research and refinement of the final work product by the student teams.

On-line meetings with individual students are mandatory; anticipate two meetings throughout the semester in addition to meetings with individual student teams.

Initiated with HSPV 551 in Spring 2020, on-line teaching and learning remains a novel and evolving undertaking for each of us. Real-time feedback on the effectiveness of the methods used in this course will be welcome, so that we can make mutually agreeable adjustments and introduce improvements during the semester. Your candid feedback on course content, readings, class exercises and teaching methods are encouraged so that the course may be continuously developed and improved. Course feedback may be delivered directly, or through the Teaching Assistant.
Information Sources

- Texts
  The following texts for the basis for the course and will be on reserve at the Fisher Fine Arts Library:

- Print and other media
  In addition to the texts, the Course, Reading and Submission Schedule lists other materials required for class preparation.

- Other Resources
  The following professional references will be useful in the course and in the final assignment:
  - *Architectural Engineering and Design Management*. This publication analyses and discusses the integration of the main stages within the process of design and construction and multidisciplinary collaborative working between the different professionals involved. Taylor & Francis.
    http://www.tandfonline.com/action/journalInformation?journalCode=taem20#.Vpv4JfkrIfI
  - *Architectural Science Review*. This publication presents papers on environmental issues, covering topics such as thermal comfort, lighting, and sustainable architecture. Taylor & Francis.
    http://www.tandfonline.com/action/journalInformation?journalCode=tasr20
    http://www.journals.elsevier.com/building-and-environment/
  - *Building Research and Information*. This publication focuses on buildings, building stocks and their supporting systems, reflecting the complexity and linkages between culture, environment, economy, society, organizations, quality of life, health, well-being, design and engineering of the built environment. Taylor & Francis.
    http://www.tandfonline.com/action/journalInformation?show=aimsScope&journalCode=rbri20#.Vpv5xPkrIfI
  - Building Science Corporation. *Building Science Digests* and *Building Science Insights* series.
    http://www.buildingscience.com/index_html
    https://www.canadianarchitect.com/?s=Architectural+Science+Forum
    http://www.journals.elsevier.com/construction-and-building-materials/
    http://www.journals.elsevier.com/energy-and-buildings
  - Engineering Weather Data: a compilation of National Climate Data Center Charts and Tables for worldwide locations as used in the course. Can be accessed for free at University of Indiana University, Bloomington website.
http://webapp1.dlib.indiana.edu/cgi-bin/virtcdlib/index.cgi/4910250
at bottom of page select either “Download” for the entire file or “Browse” then open “EngineeringWeather.html” to find a location.


International Journal of Architectural Heritage. This publication provides a multidisciplinary scientific overview of existing resources and modern technologies useful for the study and repair of historical buildings and other structures, including information on history, methodology, materials, survey, inspection, non-destructive testing, analysis, diagnosis, remedial measures, and strengthening techniques. Taylor & Francis. http://www.tandfonline.com/action/journalInformation?show=aimsScope&journalCode=uarc20#.Vpv61Pkrflf


Journal of Building Physics. Covers on-structural performance of a building and particularly in heat, air, moisture transfer and includes: insulation and building envelope materials and systems including polymeric, mineral, cellulose-based, and composites, building interactions with the environment, occupants, and allied building materials, components, and sub-systems, green roofing, double skinned envelopes and interaction of building enclosure with mechanical systems. Sage. http://intl-jen.sagepub.com/


National Research Council of Canada:
Canadian Building Digests series https://researchguides.georgebrown.ca/CBD
Construction Technology Updates series http://www.nrc-cnrc.gc.ca/ctu-sc/


Learning - Your Responsibilities as a Student

- **Attendance**
You are expected to attend all classes and attendance will be taken. Notify me by email before class if you will not be able to attend a class meeting. The Course Absence Report system will not be used for this course.

- **On-line Class Meetings**
You should treat on-line class meetings as if you are in a live classroom or a live business meeting with other professionals. Eliminate distractions to you and your fellow students. Turn-off mobile your phones, email and texting apps/programs. Eat your lunch/dinner before or after, but not during, class.

- **Highlights of the Previous Class**
Beginning with the third class meeting, each class will begin with a ten-minute student summation of the key points of the previous class meeting. Prior to the second class meeting, you will contact the Teaching Assistant to secure your presentation date.
• **Class Exercises**
  Class exercises are an important part of the student-centered learning process and will apply information or methods addressed by the readings and lectures. Class exercises require reasoning, analysis, basic mathematical calculations and sketching. Some exercises will be done individually; others will be collaborative.

  You must have knowledge and comprehension of the assigned reading materials and will need a simple calculator, graph paper and writing instruments to complete the class exercises.

• **Quizzes**
  Periodic quizzes demonstrate your progress with assimilation of the course material in the lectures and the readings. All quizzes will be “closed-book.” You will need a simple calculator, graph paper and writing instruments for the quizzes.

• **Tests of Knowledge**
  The tests of knowledge demonstrate that you have command of essential course content. The tests of knowledge require your comprehension and retention of information contained in the readings and lectures. The tests will be “closed-book.” You will need a simple calculator, graph paper and writing instruments to complete the test.

• **Final Assignment Deadline**
  The deadline for the final assignment is firm and there will be ample time for you to plan and execute the assignment. Short of hospitalization, no extensions will be granted. Late delivery of your assignment will be reflected in your grade.

• **Academic Integrity**
  *Honesty is fundamental to your future practice as a professional and academic honesty is fundamental to our community at the University of Pennsylvania. Honesty includes attributing and citing the sources used in your assignments.*

  *The UPenn Code of Academic Integrity can be found at https://catalog.upenn.edu/pennbook/code-of-academic-integrity/*

  *A confirmed violation of that Code in this course will result in failure for the course.*

**Metrics for Student Performance**
Letter grades and their numerical equivalents will be based awarded upon successful completion of the course. The final grade will be based on the following allocation:

- Preparation for and participation in class 25 %
- Test of Knowledge 1 15 %
- Test of Knowledge 2 20 %
- **Building Pathology Consultations** 40 % (1/3 for each consultation)
- Total (maximum) 100 %

At the Instructor’s discretion, the final course grade will be adjusted to reflect unexcused absences and late assignments.

Participation in class will be based on your individual:
- Preparation, including demonstration of retention and comprehension of the readings;
- Exercises - participation and outcomes;
- Engagement in discussions.

*Tests of Knowledge* will be scored based on based on points and letter grades will be assigned based on distribution of the numeric scores.

*The Building Pathology Consultations* will be graded on:
- Focused, substantive and concise content, founded on clear and logical analysis, substantiated by facts, research beyond the course materials and citations, including professional citations from outside the course readings;
- Clear and logical narrative exposition of the information, substantially free of grammatical, punctuation and spelling errors;
- Graphical presentation of key concepts illustrating the important or complex points of the narrative;
- Conformance with format requirements.
The grading rubric for **Building Pathology Consultations** will be:

- **A** Exceptional work, equivalent to professional quality, thorough grasp and synthesis of all course content.
  - Thorough preparation for class, demonstrated by engagement and participation.
  - Writing: Logically organized, clear and concise with correct use of technical terminology.
  - Research: citations from professional journals and publications other than class readings.
  - Graphics: multi-variant, demonstrating causality & connections, clear and compelling.

- **B** Very good work, near-professional quality, thorough grasp and synthesis of nearly all course content.
  - Rare lapses in preparation for class, occasional lack of engagement and participation in class.
  - Writing: rare lapses in clarity or application of technical terminology.
  - Research: citations from class texts and readings.
  - Graphics: dual variant, showing causality or correlation, clear and convincing.

- **C** Average work, sub-professional quality, understanding of basic information.
  - Marginal class preparation, moderately engaged, occasional participation.
  - Writing: Weak organization or structure, poor application of technical terminology.
  - Research: citations on technical matters from popular web sources, such as Wikipedia.
  - Graphics: single variant, clear.

- **F** Unacceptable work.

**Student Work Product - Building Pathology Consultations: Overview, Format Submission & Disposition**

In partial fulfillment of the course, students will work in teams of two, and each team will submit three (3) distinct **Building Pathology Consultations**. Two of the consultations consist of a professional-level letter addressing a specific building pathology problem. The third Building Consultation will be a critical review and interpretation of a published technical article. The letters (up to 6 pages of text for each letter) will be supplemented by appendices and graphics.

The requirements for each consultation will be provided in the first three weeks of the course and the students will submit a draft of one consultation on three separate dates as indicated in the *Course, Reading and Submission Schedule*.

In preparing the **Building Pathology Consultations**, students will apply and extend critical concepts, fundamental principles, methods and information from the lectures and readings, supplemented by their own research in professional and technical publications. This effort will provide active, student-centered learning in the context of authentic, real-world building problems.

The narratives must be clear and logical exposition of the facts.\(^1\) Writing must be substantially free of grammatical and spelling errors. Graphics should illustrate the important or complex points of the narrative.\(^2\) Conclusions and recommendations must be substantiated by facts and reflect a rational thought process.

The format of the **Building Pathology Consultations** must conform to the following:

- White paper, 8.5 by 11.0-inch, portrait orientation, single-sided printing for text and small graphics;
- White paper, 11.0 by 17.0-inch, landscape orientation, single-sided printing, z-folded for large graphics;
- Calibri font, 10-point, black print, single spaced lines;
- Margins set at 1.25 inches (binding edge), 1.00 inches (other edges);
- Single-line footer with Project Name (left) and page number (right);
- Pages numbered sequentially:
  - 1, 2, ... for report body; A1, A2, ... for appendix A, similar for B, et cetera;
- Endnotes;

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\(^1\) *Elements of Style Illustrated* by William Strunk, Jr. and E. B. White is a classic guide to writing. The current edition is delightfully illustrated by Maira Kalman.

Photographs, images and charts/graphics:
Landscape format (top edge to rings) or portrait format.
Black and white or color, laser/bubble jet printed from digital images or scans.
4 inches in the least dimension.
Captioned with self-evident descriptive text, source name and date;

Cover (Title) page with:
Course number, title and program and date of report
Each student’s printed name and signature with statement “I have contributed equally with my team partner(s) in this assignment”

Submission of Final Assignment:

- Prepare a digital copy of the entire assignment as a single .pdf file and title the file: “2021 HSPV551 Final Assignment xxxx and xxxxx” where xxxx are the names of the student team members. Upload the digital copy of the Building Pathology Consultations to the address provided to you of the Building Pathology Consultations before the time and date specified in the Course, Reading and Submission Schedule.
- Self-Evaluation: Each team member must complete a self-evaluation of the final assignment using the grading rubric.
- Upload the digital copy of the Building Pathology Consultations and the self-evaluations before the time and date specified in the Course, Reading and Submission Schedule.
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<thead>
<tr>
<th>Date</th>
<th>Topics</th>
<th>Readings and Preparation</th>
<th>Reading Orientation Questions</th>
<th>Submittals (due prior to class)</th>
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<tr>
<td>22 January 2021</td>
<td>Class 1&lt;br&gt;Getting underway&lt;br&gt;Introductions, course orientation, content&lt;br&gt;Learning methodologies, tests of knowledge&lt;br&gt;Student work product&lt;br&gt;Building pathology, survival &amp; loss, Utility &amp; use, Functional performance, Obsolescence &amp; adaptability, Assets &amp; liabilities, Value, Sustainability, Contexts</td>
<td><em><em>Required Readings (</em> denotes provided on-line):**&lt;br&gt;Henry. HSPV 551 Course Syllabus</em>&lt;br&gt;Henry, GCI Technical Note: Context and Use*&lt;br&gt;Levin, Preventive Conservation, in Conservation Perspectives 7.1 Spring 1992*&lt;br&gt;<strong>Required Readings (From Texts)</strong>&lt;br&gt;Brand, How Buildings Learn, Chapters 1-4, Chapter 10, Appendix.</td>
<td>• How does Brand’s diagram of shearing layers of change inform our understanding of buildings?&lt;br&gt;• What are examples of new forces that are changing buildings today?&lt;br&gt;• What does “preventive conservation” mean when applied to immoveable cultural heritage?</td>
<td>Self-assessment Current resume</td>
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<td>29 January 2021</td>
<td>Class 2&lt;br&gt;Entropy: It’s a law &amp; the results are inevitable&lt;br&gt;Basic concepts in material longevity:&lt;br&gt;Entropy &amp; the 2nd Law of Thermodynamics&lt;br&gt;Durability &amp; service life&lt;br&gt;Deterioration &amp; loss of performance&lt;br&gt;Damage &amp; failure&lt;br&gt;Intervention &amp; prevention&lt;br&gt;Sustaining building longevity thru reinvestment&lt;br&gt;Exercise: Building Reinvestment</td>
<td><em><em>Required Readings (</em> denotes provided on-line):**&lt;br&gt;For fun: <a href="http://www.youtube.com/watch?v=KTHiIwxcexI">http://www.youtube.com/watch?v=KTHiIwxcexI</a>&lt;br&gt;Watt, Building Pathology, Chapters 1-2</em>&lt;br&gt;Lstiburek, BSD 144, Increasing Durability of Building Construction*&lt;br&gt;Henry, Technical Note: Building Reinvestment Model*&lt;br&gt;CSA S478-95 Guideline on Durability in Buildings, Appendix D pp65-72*</td>
<td>• What costs does the Heritage Building Reinvestment Model not include? Why does it not include these costs?&lt;br&gt;• Consider the different requirements of buildings as outlined by Watt. How are these requirements related? How can they be prioritized?&lt;br&gt;• What are the terms used to define durability in buildings?</td>
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<td>05 February 2021</td>
<td>Class 3&lt;br&gt;Materials:&lt;br&gt;A brick is&lt;br&gt;A brick is&lt;br&gt;Or is it?</td>
<td><em><em>Required Readings (</em> denotes provided on-line):**&lt;br&gt;Harris, Material Profile Charts – Brick, Steel, Wood &amp; Blank</em>&lt;br&gt;Watt, Building Pathology, Chapter 3*&lt;br&gt;Henry, NCPIT Technical Note: Materials and Older Buildings*&lt;br&gt;Porous Building Materials Handout*</td>
<td>• For which properties were units of measurement difficult to find?&lt;br&gt;• How do the units of measure inform our understanding of the property?&lt;br&gt;• Do some material properties have more than one unit of measure? Why?&lt;br&gt;• How do we know that actual measurements for material properties are comparable and consistent?&lt;br&gt;• How do you define material compatibility if selecting a replacement material in historic fabric?</td>
<td>Complete the blank Materials Property Chart by entering the units of measure for each of the properties</td>
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<td>12 February 2021</td>
<td>Class 4</td>
<td>Basics of psychrometrics</td>
<td>• Do you have a proficient understanding of psychrometrics?</td>
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<td>Psychrometrics</td>
<td>Required Preparation:</td>
<td>• Do you understand the relationship of the properties of moisture vapor?</td>
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<td>Air, moisture &amp; earth:</td>
<td>Psychrometric Chart tutorial – basic</td>
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<td>The stuff around the building</td>
<td><a href="https://www.youtube.com/watch?v=OsWm8dfhP_U">https://www.youtube.com/watch?v=OsWm8dfhP_U</a></td>
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<td>Psychrometric Chart tutorial – in depth with quiz</td>
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<td><a href="http://www.uwsp.edu/paperci/Pages/charttut/story_html5.html">http://www.uwsp.edu/paperci/Pages/charttut/story_html5.html</a></td>
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<td>Download climate data near your hometown from:</td>
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<td><a href="http://www1.ncdc.noaa.gov/pub/data/EngineeringWeatherData_CDROM/engwv/">http://www1.ncdc.noaa.gov/pub/data/EngineeringWeatherData_CDROM/engwv/</a></td>
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<td>Browse the Web Soil Survey and learn about soil near your hometown:</td>
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<td><a href="http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm">http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm</a></td>
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<td>Required Readings (* denotes provided on-line):</td>
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<td>Soils and Water Handout*</td>
<td>• Do you understand what the climate data presents? (Hint: Read the NCDC Handbook)</td>
<td>Draft Consultation 1 due</td>
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<td>USGS, Basic Groundwater Hydrology Water Supply Paper 2220, p. 1-15*</td>
<td>• How does your hometown climate compare with a climate for a city in different part of the United States?</td>
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<td>Watch: Water Movement in the Soil</td>
<td>• Do you know the properties and behaviors of the different soil types?</td>
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<td><a href="https://www.youtube.com/watch?v=ego2FkuQwxc">https://www.youtube.com/watch?v=ego2FkuQwxc</a></td>
<td>• What is the fundamental difference between water moving in a pipe and water moving through very fine sand?</td>
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<td>Watch: Capillary rise in soil</td>
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<td><a href="https://www.youtube.com/watch?v=5waNTa2b-yg">https://www.youtube.com/watch?v=5waNTa2b-yg</a></td>
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<td>Optional Resources:</td>
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<td>NCDC Climate Data Handbook*</td>
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<td>ASHRAE, Climatic Data for Building Design Standards*</td>
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<td>19 February 2021</td>
<td>Class 5</td>
<td>Building Physics</td>
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<td>Building physics:</td>
<td>Material structure</td>
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<td>“follow the water”</td>
<td>Moisture and thermal energy transport in materials</td>
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<td>Thermal response</td>
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<td>Moisture transport and soluble salts</td>
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<td>Exercise: Africa House</td>
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<td>Date</td>
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<td>25 February 2021</td>
<td>Test of Knowledge 1</td>
<td>Correct Test of Knowledge 1 in class. Required Readings (* denotes provided on-line): Henry, Technical Note: Systems Thinking*  Watt, Building Pathology, Chapter 4, p. 96-114  Harris, Building Pathology, Chapter 2, p. 15-28  Meadows, Thinking in Systems, a Primer (complete reading the entire book before this class)*</td>
<td>• Define necessary and sufficient factors for deterioration?  • Can we represent a deterioration mechanism, or a necessary and sufficient factor for a deterioration mechanism, with a system diagram?</td>
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<td>05 March 2021</td>
<td>Biological Deterioration</td>
<td>Required Readings (* denotes provided on-line): Watt, Building Pathology, Chapter 4, p. 120-125*  Watt, Building Pathology, Chapter 4, p. 130-137*  Meloy, Technical Note: “Biological Mechanism of Deterioration”*  Andrady, et. al., “Effects of Increased Solar Ultraviolet Radiation on Materials”*  Davis, Corrosion: Understanding the Basics, Chapter 2*  Harris, Building Pathology, Chapter 3, p.95-130</td>
<td>• What are the necessary and sufficient factors for fungal growth to occur?  • What are the different types of wood-attacking insects and how do they interact with wood differently? Consider characteristics such as the insect’s diet, modes of transportation, etc.  • How does the electromotive series influence how galvanic corrosion occurs?  • How are ozone degradation and UV degradation related? In what ways are they different?</td>
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<td>12 March 2021</td>
<td>Mechanical deterioration</td>
<td>Required Readings (* denotes provided on-line): Harris, Building Pathology, Chapter 3, p. 58-95*  CBD 047, Extreme Temperatures at the Outer Surfaces of Buildings*  CBD 056, Thermal and Moisture Deformation in Building Materials*  Stresses and Constraints Handout*</td>
<td>• Why is constraint/restraint such an important consideration for the performance of building materials?  • What kinds of materials are anisotropic? How will this characteristic affect their performance with respect to their hygrothermal response?  • There are different types of gradients: thermal, moisture, and stress gradients. Why are gradients important to understand and identify?</td>
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**Notes:**
- * denotes provided on-line.
- Draft Consultation 2 due.
<table>
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<th>Date</th>
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<th>Readings and Preparation</th>
<th>Reading Orientation Questions</th>
<th>Submittals (due prior to class)</th>
</tr>
</thead>
</table>
| 26 March 2021  
Class 9  
Structures: Loads & bones | Building Structures  
Strength & stiffness  
Forces & loads  
Soils & groundwater  
Foundations  
Types of structures  
Performance deterioration  
Failures | Required Readings (* denotes provided on-line):  
Finish reading Blockley’s *Structural Engineering: A Very Short Introduction before this class*  
CBD 003, Soil & Buildings*  
CBD 054, Horizontal Deflections of Structural Members*  
CBD 148, Foundation Movements*  
Expansive soils [https://www.youtube.com/watch?v=5W-NoiM726U&t=23s](https://www.youtube.com/watch?v=5W-NoiM726U&t=23s) |  
• What are the components of the three-phase system of soil? What are the important implications of this system with respect to building foundations?  
• Imagine you are in a historic wood-frame house. According to the L/360 rule for allowable deflection without cracking of finishes, how much is a 15-foot-long wood joist allowed to deflect?  
• Settlement is typically divided into two phases: immediate settlement and consolidation settlement. What are the differences between these two phases of settlement? How do these two phases, as well as other factors, affect/cause differential settlement of a structure?  
• The active statics site looks at trusses and hanging cables/arches in two-dimensions. Consider the visual presentation of these statics’ scenarios. What components of the visual presentation were helpful to you for understanding the concepts? Were any of the force distributions surprising or counter-intuitive to you? | Draft Consultation 3 due |
| 02 April 2021  
Class 10  
Enclosure: external organs | Building enclosure systems  
Static elements: roofs & walls  
Types of wall systems  
Operable elements  
Sash, shutters/shades & doors  
Energy efficiency improvements | Required Readings (* denotes provided on-line):  
Straube, BSD 018, *Building Enclosures*  
Straube, BSD 011, *Thermal Control in Buildings*  
Straube, BSD 030, *Rain Control Theory*  
Straube, BSD 013, *Rain Control in Buildings*  
Lstiburek, BSI 106, *Understanding Vapor Barriers*  
Lstiburek, BSI 117 *Rain Control in Buildings* |  
• Review the vapor profiles for the different types of wall assemblies laid out in Lstiburek’s article. What might complicate these assemblies? I.e. how is the cladding connected to the structure?  
Comfort is an extremely important consideration in how buildings function. What are the features of traditional enclosures that can be used to improve comfort? | Draft Consultation 3 due |
<table>
<thead>
<tr>
<th>Date</th>
<th>Topics</th>
<th>Readings and Preparation</th>
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<tbody>
<tr>
<td>09 April 2021</td>
<td>Class 11</td>
<td>Building systems</td>
<td>From last week’s reading, the important of ventilation was made clear with respect to moisture transport in wall assemblies. What are the negatives of having good ventilation?</td>
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<td>Systems: internal organs</td>
<td>Comfort, climate &amp; environmental Health &amp; sanitation</td>
<td>What features do all utility systems have? Consider how these different features could fail and the consequences of these failures?</td>
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<td>Fire detection &amp; protection</td>
<td>Human thermal comfort can be affected by both physiological and psychological factors. Consider what these could be.</td>
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<td>Information: security, data &amp; communications</td>
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<td></td>
<td></td>
<td>Harris, <em>Building Pathology</em>, Chapter 6, p. 618-635</td>
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<td>NPS, <em>Preservation Brief 24: Heating, Cooling &amp; Ventilation in Historic Buildings</em></td>
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<td>Straube, BSI-022 Perfect HVAC*</td>
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<td>Straube, BSD 109 Pressure in Buildings*</td>
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<td>Padfield, <em>How Air Conditioning Works</em></td>
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<td><strong>Optional Resources:</strong></td>
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<td>Ching, <em>Building Construction Illustrated</em>, Chapter</td>
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<td>16 April 2021</td>
<td>Class 12</td>
<td>Interventions</td>
<td>What are the benefits of Harris’ intervention Matrix, as well as the way in which he sorts intervention options and the variations on this (Table 2.2-2.5)? What are the potential problems with this type of evaluation?</td>
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<td>We know what’s wrong—what can we do about it?</td>
<td>Setting objectives</td>
<td>How are the questions and tables that Watt presents helpful? How could they potentially be problematic given that each building is unique?</td>
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<td>Identifying evaluating &amp; selecting preferred strategies</td>
<td>Harris’ general categorization of intervention approaches is helpful; however, the interventions he discusses are really more like individual treatments. Instead, interventions should be thought of as projects that more holistically consider the building—not only the different deterioration mechanisms and systems present but also the building’s environmental and cultural context. Consider the differences between the four levels of intervention identified by the Secretary of the Interior. Additionally, how should treatments and the environmental and cultural context be integrated into these approaches?</td>
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<td>Design for intervention &amp; prevention</td>
<td>How should character-defining features guide interventions?</td>
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<td>Longevity &amp; maintainability, reversibility</td>
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<td>Material &amp; craft availability, costs</td>
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<td>Harris, <em>Building Pathology</em>, Chapter 1, p. 36-56</td>
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<td>Watt, <em>Building Pathology</em>, Chapter 5</td>
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<td>Brand, <em>How Buildings Learn</em>, Chapter 8 and 11-12</td>
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<td>NPS *Preservation Brief 17: “Architectural Character—Identifying the Visual Aspects of Historic Buildings as an Aid to Preserving Their Character”</td>
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<td>05 May 2021</td>
<td>Upload digital copy of Final Assignment and the Self-Evaluations to the designated DropBox folder before 12 Noon EDT. No extensions.</td>
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<tr>
<td>24 April 12 Noon EDT</td>
<td>Take Test of Knowledge 2 on-line using Canvas. No extensions.</td>
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**Notes:**
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