HSPV5550-001:
Introduction to Architectural Conservation:
Performance, Durability, and Weathering of Traditional Building Materials

Fall 2024 | Tue 1:45 – 4:45pm | DUHR 051

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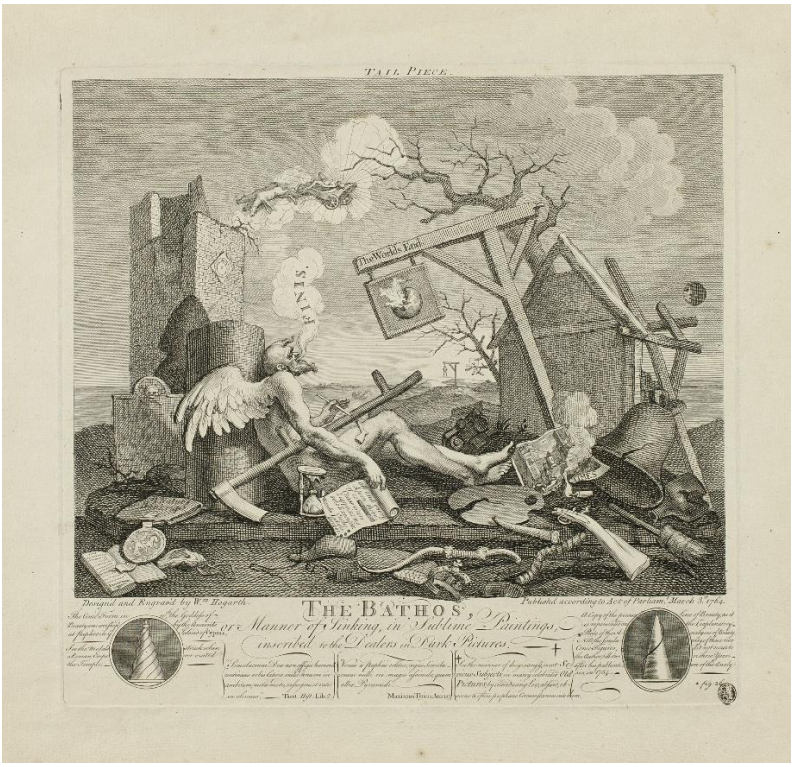
At the instructor's discretion, this syllabus is subject to modification during the semester. For the very latest updates (e.g., readings, assignments, due dates), refer to instructor emails.



William Hogarth, *Finis or, the Tail Piece.— The Bathos, &c.*

"The gorgeous palaces, the solemn temples, Yeaeven the grate globe itself, And all that it inhabit shall dissolve, And like the baseless fabric of a vision, Leave not a wreck behind."

—William Shakespeare.
The Tempest. Act 4, Scene 1

1.0 COURSE DESCRIPTION

1.1 ***Architectural Conservation*** is the science of preserving the physical fabric of the built environment: examining, recording, and analyzing the materials, construction, evolution, and deterioration of structures; conducting investigations to diagnose the cause and effect of material and systemic pathologies; and designing and executing interventions focused on maintaining the integrity of the historic fabric. It is the technical means by which the whole spectrum of preservation interventions is accomplished on a broad range of immovable cultural property: buildings, structures, monuments, landscapes and archaeological sites. As one specialization within the broader field of Historic Preservation/Heritage Conservation, it is distinguished by the application of *scientific method* in the study of historic buildings and sites in accordance with a clearly defined theoretical and methodological approach. This implies an established system of principles, practices, and procedures developed specifically for the examination, analysis, and treatment of historic and cultural resources. Such an approach depends on inter-disciplinary cooperation that must precede any conservation intervention and includes historical research, archaeological investigation, survey and documentation, materials analysis, testing and evaluation, and craft. It is part of the larger concept of *Heritage Science* as a more inclusive, integrated, and interdisciplinary description of all scientific activities addressing natural and cultural resources.

1.2 ***HSPV 5550/Introduction to Architectural Conservation Science*** is an introduction to the technical study of traditional building materials. The course focuses on the properties, durability, and especially weathering of these materials and the basic laboratory-based methods that can be employed for their study and characterization. Lectures and coordinated laboratory sessions introduce the nature, structure, composition, and deterioration mechanisms of a wide array of building materials including earth, stone, brick, terra cotta, concrete, mortars and plasters, metals, wood, and paints. The course provides a basic knowledge of the major building materials in use before the Second World War in industrialized as well as pre-industrial traditional contexts. (For those interested in Modernism and its material expressions-see HSPV 7410/Topics in Conservation: Modern Matters. HSPV 5550 and HSPV5510/Building Pathology form the introductory elective core for the concentration in Architectural Conservation in the first year. Advanced material seminars in specific material/construction systems complete the sequence in the second year.

2.0 STRUCTURE

2.1 Class Structure

The course will commence each week with a 1.5-hour lecture followed by a 15-minute break, followed by a lab session where participants will be introduced through first-hand experience to the material properties and standard tests used to determine those properties for the week's materials. Microscopy will be introduced as an examination tool early in the semester to allow students to make visual connections between a material's composition and microstructure and its physico-chemical properties.

2.2 Course Folder

The PennBox course folder HSPV5550ConSci will be organized by:

Folder Name	Contents
Course Materials	Syllabus, presentation slides, class notes, lab facility guidelines, and info memos
Readings	Bibliography and digital readings, organized by material/week
Labs	Weekly labs and supplemental materials
Quizzos	Weekly quizzos
References	General reference material

2.3 Readings

Readings for each week will be posted in the course folder in *Readings* and will be available either digitally or if a non-ebook, on reserve in the Fisher Fine Arts Library under the course name HSPV 5550. The TA will also place info memos and other documents on the course folder to assist you in class and lab. These will be placed either in the individual weekly *Readings* or *Labs* folders or (if general) in *References*.

2.4 Labs

Labs and lab supplemental information will be placed on the course folder *Labs* weekly. **All students are expected to bring print outs or have digital access to the labs during each lab session. Copies will not be provided**. TA-assisted lab hours will be scheduled as per class/TA availability. All students will be required to follow university health and safety protocols. Lab coats and safety glasses will be required for all lab work. For lab report writing see: http://writingcenter.unc.edu/handouts/scientific-reports/

3.0 REQUIREMENTS

3.1 Attendance

Enrolled (non-audit) students are required to attend the lectures and laboratory sessions. Official audits will be expected only to attend lectures and may participate in the laboratory sessions pending available space. Of course, I understand that sometimes emergencies or other unexpected circumstances arise that make attendance that day impossible. If this is the case, please communicate with me as soon as possible so we can plan to get you caught up. If you will be absent from a class for a university-sponsored activity, please make arrangements with me or the TA beforehand regarding any work you might miss.

3.2 Weekly Quizzo

To test your understanding of key concepts related to the readings each week, a real-world problem will be posted in the *Quizzos* folder and to be answered by each lab group. Each group will submit a response presented in a professional-level letter, referencing principles, concepts, methods, and information acquired from lectures and readings due by 5:00pm the day before class. Keep your responses to 200-250 words or approximately 1 page, using a clear and logical narrative. Writing should be free of grammatical and spelling errors. The format of the letter must conform to the following:

- Times New Roman 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 group name (left) and page number (right);
- Endnotes or footnotes

Quizzo responses will be briefly discussed at the beginning of each class.

3.3 Lab Reports

The lab write ups constitute a large part of this course. In addition to helping you directly observe many of the concepts in the readings and lectures, the labs will introduce you to scientific method, technical writing, and professional testing standards. The lab files are presented to you as fillable PDFs; however, you may decide to write and design your own reports. Both are acceptable submissions. All photomicrographs should include a scale bar and total magnification. Draft lab reports are to be uploaded to the PennBox folder *HSPV555 ConSci Submissions* generally no later than two weeks after the lab session (see 6.0 for due dates). All labs will be returned with comments for revision in a timely fashion. Labs requiring more than one week for completion are noted in the class schedule. **All final labs and quizzo responses are due no later than Dec 19 at 12:00 noon. Lab reports are to be submitted in PDF format to the course folder <Labs-Final> by last name(s). No extensions will be allowed.**

3.4 Readings

Required readings for each week will be placed in the Readings folder (See 5.0 below). Optional material will also be posted each week for your viewing pleasure but is not required reading. Readings may be done BEFORE or AFTER the class session; do whatever works best for you. The lectures, readings, and labs are all coordinated to maximize your understanding of the weekly topic.

3.5 Grades

As an elective, I assume you will do the work to the very best of your ability. Grading will be based primarily on the labs and the incorporation of the readings in answering the lab questions. Individual labs will each be numerically graded, and their sum will generate the course grade translated to a letter. – or + will be utilized based on class participation.

4.0 COMPETENCIES

- Gain an historical perspective in the development of architectural conservation and contemporary ethics and practice
- Understand the broad principles of material science and their application to the study of building material behavior and performance and especially weathering
- Apply laboratory skills to conduct experiments and research
- Learn standard test methods
- Interpret quantitative and qualitative evidence, including graphical representations
- Read technical conservation literature to understand its contributions to research and practice.
- Apply scientific research to explain performance phenomena
- Communicate scientific findings and debates to diverse audiences through oral, visual, and written media
- Explore the ethical considerations related to scientific research. On the history of scientific method, see: https://www.coursera.org/lecture/being-researcher/the-scientific-method-a-historical-perspective-3plmn

5.0 COURSE STANDARDS

5.1 Academic Integrity

Academic honesty is fundamental to our scholarly community. The *Penn Student Handbook* (https://www.design.upenn.edu/student-handbooks) contains the University Code of Academic Integrity, to which the School of Design strictly adheres. A confirmed violation of that Code in this course will result in a failing grade, and likely in other disciplinary measures. The UPenn Code of Academic Integrity is available online at: https://catalog.upenn.edu/pennbook/code-of-academic-integrity/

5.2 Students with disabilities

The University of Pennsylvania provides reasonable accommodations to students with disabilities who have self-identified and been approved by the office of Student Disabilities Services (SDS). Please make an appointment to meet with me as soon as possible in order to discuss your accommodations and your needs. If you have not yet contacted SDS, and would like to request accommodations or have questions, you can make an appointment by calling SDS 215.573.9235. The office is located in the Weingarten Learning Resources Center/Stouffer Commons 3702 Spruce St- Ste 300.

5.3 #AskMe

In order to insure a positive, open and respectful learning environment, I invite you all to let me know as to how you identify: preferred name to use in class, preferred pronouns, anything that will allow us to create the best classroom environment possible to learn and enjoy the material.

5.4 Laptops/tablets/mobile phones

It is understood that laptop computers will be used only for taking lecture notes or for activities directly related to in-class exercises, not for homework or non-academic purposes. Rogue activities are distracting, disruptive, and disrespectful to our collective objectives to learn through classroom participation. In-class computer use is a privilege that may be suspended at the instructor's discretion if the above guidelines are violated. Laptops/tablets are discouraged during lab sessions as they could be damaged from spills, dust, etc. Rather, it is suggested that you keep a **lab notebook** to record all work. **Cell phone use is prohibited during class except during break time. All mobile phones are to be turned off and placed out of sight during class and lab.**

5.5 AI Tools

You may use generative AI tools for your work in this class, but you must indicate where and when these tools are used. Non-disclosure of AI tools will be considered a violation of Penn's Code of Academic Integrity. All AI usage must be cited on any work submitted. For further information see: https://cetli.upenn.edu/resources/generative-ai-your-teaching/

6.0 FULL CLASS SCHEDULE

Date	Lecture topics / *labs and quizzos*	Lecturer	Readings and videos	Assignments due
Aug 27	Introduction to Architectural Conservation: Discipline and Practice	Frank G. Matero with guest conservation faculty	**Required:** ACL Facility Guidelines 1.1 Caple and Williams, "Conservation Skills for the 21st Century," Chapter 3. Holing, "The Technique of Conservation" Matero, "HSPV5550-001 Course Syllabus" Viñas, "Contemporary Theory of Conservation"	
	(4:00 pm) Lab orientation and safety *Lab 0: Scavenger Hunt* *Quizzo 1: Professional Ethics*	Amanda Bewley Environmental Health & Radiation Services (EHRS)	**For fun:** https://youtube.com/watch?v=N0QqLVUDkvA **Optional:** Smith and Wharton. "Philosophy and Ethics." Smith, *Materials.* Smith, "Matter versus Materials"	
Sept 03	Porous building materials *Lab 1: Porosity of Granular Beds* *Lab 2: Porosity of Solids*	Frank G. Matero	**Required:** Torraca, *Porous Building Materials*, Chapter 1, pp. 1-16. Borrelli, *Porosity*, pp.3-9. Porosity and Permeability Demo (youtube.com) Porosity Perm Capillarity.mov (youtube.com) **Optional:** Vos, "Water Absorption and Drying of Materials" pp. 679-694. Sereda et al. "Wetting and Drying of Porous Materials," pp. 130-1 to 130-4. Sereda, "The Structure of Porous Building Materials," pp. 127-1 to 127-4. Honeyborne, "The Structure of Porous Building Stone and its Relation to Weathering Behavior," pp. 343-365.	Lab 0, Quizzo 1

Date	Lecture topics / *labs and quizzos*	Lecturer	Readings and videos	Assignments due
Sept 10	Introduction to microscopy and photomicrography *Lab 3: Introduction to Optical Microscopy*	José C. Hernández	**Required:** Allen, *Microscopy: A Very Short Introduction*, Chapters 2-3. McCrone, *Polarized Light Microscopy*, pp. 1-22,63-65. Möllring, *Microscopy from the very beginning*, pp. 5-14. **Optional:** Cebulla, *Handbook of Incident Light Microscopy*, pp. 8-19, 23, 31-38. *Stereo Microscope Stemi 305 User Manual*, p. 13. Rochow, *Glossary of Microscopical Terms and Definitions.*	
Sept 17	Microscopy Quiz review Earthen Materials *Lab 4. Characterization of Granular Samples by Sieve Analysis* *Lab 5. Particle Size Analysis of Soils* *Lab 6. Plastic and Liquid Limits of Soils* *Quizzo 2. The Walls of Ávila*	Frank G. Matero	**Required:** Alison et al, Practical *Building Conservation: Earth, Brick & Terracotta*, pp. 84-94. Houben, *Earth Construction: A Comprehensive Guide*, pp. 17-33, 46-59. Torraca, *Porous Building Materials*, pp. 97-106. Particle Size Analysis (Sieves and Hydrometer) (youtube.com) Plasticity and Plastic State & Plastic Limit of Soil and its Determination (youtube.com) **Optional:** Dickensheets and Matero, "Performance Testing of Acrylic-Amended Earthen Mortars at Wupatki National Monument in Arizona," pp. 5-14. Correia, *Conservation in Earthen Heritage.* Minke, *Building with Earth.*	Labs 1 and 2 due

Date	Lecture topics / *labs and quizzos*	Lecturer	Readings and videos	Assignments due
Sept 24	Stone I: Mineralogy *Lab 7. Introduction to Optical Mineralogy*	Marie-Claude Boileau	**Required:** Boileau, *HSPV555 Supplemental Readings* Cargille Laboratories, "The Becke Line Method" Cargille Laboratories, "Measuring the Becke Line of Liquids" Michell-Levy Color Chart	Lab 3 due
Oct 01	Stone II: Petrology *Lab 8. Thin-section Petrography of Common Building Stones*	Marie-Claude Boileau	**Required:** Boileau, *HSPV555 Supplemental Readings* **Optional:** Ingham, *Geomaterials Under the Microscope*, Chapter 2.	Labs 4, 6 due
Oct 08	Stone III: Stone weathering and decay *Lab 9. Identification of Stone Hand Specimens*	Frank G. Matero	**Required:** Torraca, *Porous Building Materials*, Chapter 7. Martin and Wood, *Practical Building Conservation: Stone*, pp. 26-41. Winkler, *Stone: Properties, Durability in Man's Environment* **Optional:** Grasseger, *Decay Mechanisms of Natural Building Stone.* Hall and Matero, "Considerations on Complex Sequential Treatments of Gypsum Crusts" Jefferson, *Building Stone: the Geological Dimension*, pp. 305-319. Lefèvre, "Atmospheric Pollution and Building Materials: Stone and Glass." Wilson, *Minerals and Rocks*.	Lab 7, Quizzo 2 due

Date	Lecture topics / *labs and quizzos*	Lecturer	Readings and videos	Assignments due
Oct 15	Mortars and Plasters I *Lab 10. Gravimetric Mortar Analysis* *Lab 11: Properties of Masonry Mortars (2 weeks)* *Quizzo 3: The Crumbling Tombs of New Orleans*	Frank G. Matero	**Required:** Torney and Snow, "Lime Mortars in Traditional Buildings" Torraca, *Porous Building Materials*, Chapter 6. **Optional:** Carran et al., "A Short History of the Use of Lime as a Building Material beyond Europe and North America." Harry & Stewart, *Practical Building Conservation: Mortars, Renders & Plasters*, pp. 27-52.	Lab 8 due
Oct 22	Mortars and Plasters II *Lab 12: Mechanical Testing of Masonry Materials*	Frank G. Matero Steve Szewczyk	**Required:** Davison, "Masonry mortar" Torraca, *Porous Building Materials*, Chapter 2. **Optional:** Elsen, "Microscopy of Historic Mortars—a Review," pp. 1416-1424. Wiggins, "Traditional Lime Mortars and Masonry Preservation," pp. 28-37. Ingham, *Geomaterials Under the Microscope*, Chapter 8.	Lab 9, Quizzo 3 due
Oct 29	Metals *Lab 13. Microchemical Spot Test for Metals*	James Churchill	**Required:** Godfraind et al., *Practical Building Conservation: Metals*, pp. 25-32, 134-151, 153-157. Torraca, *Porous Building Materials*, Chapter 3. **Optional:**	Lab 10 due

Date	Lecture topics / *labs and quizzos*	Lecturer	Readings and videos	Assignments due
Nov 05	Architectural Ceramics: Brick and Terra-Cotta *Lab 14: Capillary Rise in Brick* *Lab 15: Surface Water permeability (RILEM 11.4)* *Quizzo 4: The Schuylkill River Floods*	Casey Weisdock	**Required:** Torraca, *Porous Building Materials*, Chapters 1. Alison et al, Practical *Building Conservation: Earth, Brick & Terracotta*, pp. 6-10, 386-409, 654-657. **Optional:** Ingham, *Geomaterials Under the Microscope*, Chapter 9. Gurcke, *Bricks and brickmaking*, Chapter 1. Mack, "The Manufacture and Use of Architectural Terra Cotta in the United States" Robinson, "Characterization of Brick and their Resistance to Deterioration Mechanisms"	Labs 5, 11, 12 due
Nov 12	Paints and Related Surface Finishes *Lab 16: Opacity of White Pigments and Pigment Manufacture*	Catherine Myers	**Required:** Ashton, "Paint-what is it?" Matero, Frank G. "Paints and coatings." Penn, "Decorative and Protective Finishes, 1750-1850" **Optional:**	Lab 13, Quizzo 4 due
Nov 19	Architectural Wood *Lab 17: Wood Identification Properties* *Quizzo 5: The Lindbergh Kidnapping*	Andrew Fearon	**Required:** Core et al., *Wood Structure and Identification*, Chapter 1. Hoadley, *Understanding Wood*, Chapter 3. **Optional:** McCaig and Brian, *Practical Building Conservation: Timber*, pp. 3-16, 33-36,	Labs 14, 15 due
Nov 25	No class: Thanksgiving week schedule			

Date	Lecture topics / *labs and quizzos*	Lecturer	Readings and videos	Assignments due
Dec 03	Concrete *18. Properties of Concrete*	Irene Matteini	**Required:** ASTM, "Standard Terminology Relating to Concrete and Concrete Aggregates" Gaudette and Slaton. *Preservation of Historic Concrete*. Matteini, *HSPV 741: Modern Matters: Glossary Definitions* Torraca, *Porous Building Materials*, pp.78-82. Odgers, *Practical Building Conservation: Concrete*, pp. 42-51. **Optional:** Custance-Baker et al., *Concrete Heritage: An Annotated Bibliography*, Chapter 2. Croft, *Concrete Architecture*. Ingham, *Geomaterials Under the Microscope*, Chapter 5. Neville, *Properties of concrete*, Chapters 1-3. Broomfield, "The Identification and Assessment of Defects, Damage and Decay." Urquhart, *Historic Concrete in Scotland*, Chapter 4.	Lab 16, Quizzo 5 due
Dec 19	No class			All revised labs and quizzos due

7.0 COURSE BIBLIOGRAPHY

Introduction to Architectural Conservation: Philosophy & Ethics

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Douglas-Jones, Rachel, John J. Hughes, Siân Jones, and Thomas Yarrow. "Science, Value and Material Decay in the Conservation of Historic Environments." In *Journal of Cultural Heritage 21* (2016): 823-833.

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Smith, Landis and Glenn Wharton. 2023. "Philosophy and Ethics." Held in Trust. https://www.culturalheritage.org/docs/default-source/publications/reports/held-in-trust/heldin-trust-report.pdf.

Viñas, Salvador Muñoz. 2002. "Contemporary Theory of Conservation." *Studies in Conservation 47* (sup1): 25–34. doi:10.1179/sic.2002.47. Supplement-1.25.

Microscopy for Architectural Conservation

Allen, Roy Morris. "Practical Refractometry by Means of the Microscope." (1962).

Cebulla, W. *Handbook of Incident Light Microscopy.* Carl Zeiss, 1974.

Möllring, Friedrich Karl. *Microscopy from the Very Beginning.* Carl Zeiss, 1975.

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Porous building materials

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Correia, Mariana Rita Alberto Rosado. *Conservation in Earthen Heritage: Assessment and Significance of Failure, Criteria, Conservation Theory, and Strategies*. Cambridge Scholars Publishing, 2016.

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Brick & Terra-cotta

Henry, Alison, Iain McCaig, Clara Willett, Sophie Godfraind, and John Stewart. *Practical Building Conservation: Earth, Brick & Terracotta*. Oxon and New York: Routledge Publishing, 2018.

Gurcke, Karl. *Bricks and Brickmaking: a Handbook for Historical Archaeology*. Moscow and Idaho: University of Chicago Press, 1987.

Mack, Robert C. “The Manufacture and Use of Architectural Terra Cotta in the United States” In *The Technology of Historic American Buildings: Studies of the Materials, Processes, and the Mechanisms of Building Construction*, ed. Edward Jandl. Washington, DC: Foundation for Preservation Technology, 1983.

Robinson, Gilbert C. "Characterization of Brick and their Resistance to Deterioration Mechanisms." In *Conservation of Historic Stone Buildings and Monuments. Proceedings of the Conference Held in Washington, D.C., February 2-4, 1981*, 1982.

Stone

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Carran, Dorn, John Hughes, Alick Leslie, and Craig Kennedy. "A short history of the use of lime as a building material beyond Europe and North America*." International Journal of Architectural Heritage 6*, no. 2 (2012): 117-146.

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7.2 OTHER RESOURCES

The following references will be useful in the course:

Heritage Conservation Timeline. https://www.tiki-toki.com/timeline/entry/1825773/Professional-Membership-Organizations-for-Conservators-of-Cultural-Heritage/

Amàco, atelier matières à construire https://vimeo.com/atelieramaco

Grain de Builders https://vimeo.com/album/3264861

Soil Mechanics and Elementary Engineering:

Soil Mechanics https://www.youtube.com/watch?v=i--51DBtOGU

Soil Formation and Soil Type https://www.youtube.com/watch?v=kGNlKoE8Nn8

Soil Mineralogy https://www.youtube.com/watch?v=Qh6wSfVN45s

Soil Classification https://www.youtube.com/watch?v=i9Q3hjFaAPI

Soil Field Tests https://www.youtube.com/watch?v=JvU-OXOyiTU

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