HSPV 739-301 SEMINAR IN ARCHITECTURAL CONSERVATION: MASONRY
Graduate Program in Historic Preservation/Weitzman School of Design/University of Pennsylvania
Fall 2022 / Wednesday 8:30 am-11:30 am EST/ Meyerson B6 & Various

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Course Description & Approach

This course will focus on understanding in greater detail the conditions associated with masonry materials and system deterioration and the current methods of analysis and treatment repair. Particular attention will be paid to a variety of masonry (stone, brick, terra cotta, mortar, tile, and terrazzo) and its use as a material (architectural and sculptural) and building envelope wall systems (structural/performance) Specific types of instrumental/field analysis and intervention methods/materials will be discussed within the context of conservation problem solving. The concept of craft will also be discussed as it relates to both original construction and repair techniques.

There are several factors that have aided in the large quantity of masonry used in building construction, particularly within the latter half of the 19th century and early 20th Century in the United States. The abundant variety of masonry materials, the ability to manufacture and transport that material efficiently, coupled with a skilled labor force, allowed masonry to be an economical and aesthetic choice for architects and builders.

The historic context in which masonry has been used is relevant to the behavior of individual materials and the manifestation of conditions over time. Much of what is considered visible deterioration can be attributed to any number of intrinsic and extrinsic factors including the ways in which the masonry was formed/manufactured, method/placement during installation, associated building materials/features, and interaction with the environment. All of these factors must be taken into account when understanding behavior of masonry and developing a strategy for conservation.

Aside from understanding the properties of masonry, basic principles of deterioration, and the methodology behind developing an analysis & treatment program, it is essential to recognize that each conservation project comes with a set of parameters. These parameters may come in the form of physical restrictions or limited project resources, however, in many cases what appear to be constraints can aid in guiding the project approach.

The first half of the course will offer a more in-depth introduction to masonry materials, quarrying/manufacturing, construction technologies, deterioration, and methods of instrumental analysis. The second half of the course will focus on treatment and repair of masonry buildings and monuments as well as post-treatment analysis. Lab and field exercises along with individual and group projects will be offered to supplement the lectures and to provide more practical experience for the students.

At the end of the course, students should have a grasp on how to identify, analyze, and record masonry conditions, select methods to evaluate level of deterioration, develop strategies for repair and recognize potential project parameters. In addition, students will be further introduced to the role of conservator within a larger project structure, implementing treatments, and communicating with consultants, design professionals, and masonry craftworkers.

Course Requirements

Attendance

Attendance is required for all scheduled classes, mid-term and final presentation sessions, unless permission for missing a class has been granted by the instructor in advance.

Participation

As a seminar, all students are expected to participate equally beginning with class attendance, discussion participation, and contributions of individual and group assignments. All work must follow the universities standards for academic integrity listed at the following link: https://catalog.upenn.edu/pennbook/code-of-academic-integrity/

Lab Assignments

Analytical and treatment labs have been developed to support the lecture component of the course. Labs will require coordination and use of the architectural conservation lab with various materials and with other courses. Please be respectful of others working in the lab, both from a safety and logistical standpoint. All proper lab safety PPE protocol and material handling/disposal must be followed and you will be evaluated based on your compliance. If it is discovered that such protocol is not being followed, action will be taken and a reduction in grading may occur.

Site Project

One site with multiple structures, distinct features, and materials has been pre-selected for this project. Each student group will prepare and conduct: (***Note: all assignments should be submitted to the corresponding folders on PennBox in PDF format compressed to the lowest possible file size without resulting in reduced legibility***)

- Brief Archival Research – Conservation research and testing programs should always begin with a brief overview of the site, including construction and treatment/maintenance history. However, this is not a course on historic documentation, therefore it is important to keep this section of the report concise and relevant. Each student group will be required to provide this context for their assigned portion of the site. (No more than 500 words)
- Materials Characterization – At the beginning of this project students will begin to identify and describe all the types of masonry materials that are incorporated into the structure and using published research to support their findings and descriptions. This information will provide context

for further discussion of these materials (and their deterioration phenomenon) throughout the report.

- Drawing Set w/ Ortho-Rectified Photo-Elevations – Each student group will be required to prepare and initial CAD drawing set with elevations, plan (& roof plan if applicable), along with orthorectified photographic elevations. Since this is a combined group/site project, coordination will need to take place to ensure that each group produces drawings and photographs that follow the same graphic standards.
- Gravimetric Mortar Analysis – Each student will perform at least one (1) gravimetric mortar analysis on samples taken from the site projects. Each structure is likely to have multiple types of masonry, and/or repointing campaigns. Therefore, each student will, with the assistance of the instructors, try to identify and extract samples of the earliest bedding and/or pointing campaigns for analysis. Based on the findings, students will provide a recommended repair formulation supported by the knowledge gained through the Treatment Assignment #2.
- Graphic Condition Survey Drawings Set. – Student groups will use their established drawing set to document and graphically represent conditions layers. Similar to the initial drawing exercise, coordination will need to take place to ensure that each group produces condition drawings that follow the same graphic standards.
- Graphic Conditions Glossary – In addition to the condition drawings a master conditions glossary should be created for the site that can be used for each group as a reference in their individual efforts. This may include reviewing resources such as the ISC glossary and others found in the distribution folder (following the aforementioned group standards). The glossary should at least include a photograph of each typical condition (with a scale card), a written description of the condition, and the graphic used to indicate that condition on the condition drawing set.
- Prioritized Conditions Report – This portion of the report should begin with both a brief listing of the overall conditions and their priority level as well as definitions of priority criteria. Typically, priorities may fall within these categories, however each site might have unique or extenuating circumstances which elevate certain conditions to higher or lower condition levels:

    - Priority 1 – (High) Conditions pose potential risk to public safety or immediate loss of historic fabric. Repairs should be implemented within 1 year.
    - Priority 2 – (Moderate) Conditions pose continued deterioration of historic fabric. Repairs should be implemented within 2-5 years.
    - Priority 3 – (Low) Conditions pose very little loss of historic fabric. Repairs should be implemented within 5-10 years (or not at all)

  This brief conditions summary should be followed by a more in-depth narrative description of the major site issues and material conditions and phenomenon. Student groups should discuss the overall site issues surrounding their individual structures that might affect the performance/preservation of the structure (site drainage, site vegetation, etc). From there students should discuss the building system conditions (i.e. foundation, walls, etc.) and then move into a more in-depth discussion of the masonry material conditions.

- Treatment Recommendations & Treatment Testing Program with preferred treatment options. (Treatments and intervention approaches must be backed up by a literature review that cites other case studies or research relevant to the issues. It must be clear in your report why certain treatments have been selected for testing.)

Course Submissions

There are several benchmark deadlines for site projects and lab assignments throughout the course of the semester. Take a close look at the schedule and plan your time accordingly to ensure theses deadlines are met.

Final Presentation & Paper

The Final Presentations & Papers are to be fully documented with illustrations, citations and bibliography. (Examples of previous student work can be found in the course folder and should be used as reference only). Documentation and report for each student project should be unique to the selected site and project requirements. With the exception of sickness, injury, or family emergency, all late papers will be penalized by an automatic incremental drop in a half grade for each day late.

Grading

General	Class Attendance/Participation/Quizzes	10%
Site Project Submission #SP1	Archival Research & Material Characterization	5%
Site Project Submission #SP2	Drawing Set w/ Orthorectified Photography	5%
Site Project Submission #SP3	50% Draft & Presentation w/ Condition Drawing Set & Conditions Glossary	15%
Site Project Submission #SP4	Gravimetric Mortar Analysis	5%
Site Project Submission #SP5	Prioritized Conditions Report	10%
Site Project Submission #SP6	100% Final Draft – w/ Treatment Recommendations & Testing Program	30%
Site Project Submission #SP7	Final Report & Presentation	10%
Treatment Assignment #TA1	Masonry Cleaning	5%
Treatment Assignment #TA2	Mortar Formulation	5%

Grading will be in accordance with general academic policies: a grade of A/A- will represent exceptional work, B/B+ will represent good work that meets the academic standard set for the course, and B- will represent work that is just under the established standard. C and C+ are barely passing for graduate courses and will indicate work that is less than satisfactory. Failure to meet the minimum requirements will result in an F. All work is to be delivered on the dates described in the syllabus or agreed upon in class if changed. (It is generally assumed that graduate students devote a minimum of 2 hours of study for every hour of class- time per week. We would suggest reserving 6 hours of non-class time each week for the seminar.)

Course Schedule

Class 1 - Off Campus Class/Site-Visit (8/31)	Course Introduction & Review of Brick Masonry Materials
Location: Fort Mifflin 6400 Hog Island Rd, Philadelphia, PA 19153	This session will provide an overview of the course and offer a review and more in-depth discussion on brick masonry materials. Case studies will be offered for conservation context. Students will be introduced to the course site projects.
Recorded Lecture – Terra Cotta	Students are required to view a recorded sessions that builds upon the previous class discussion to include a review of terra cotta materials as well as their incorporation into historic building technologies.
Deadline - Quiz (9/6)	After viewing the above recording, students will be required to complete and submit the quiz to the course instructors no later than 5 pm on Tuesday 9/6.
Class 2 (9/7)	Review of Stone Masonry Material & Historic Masonry Building Technology
Location: Meyerson B6	This session will provide an overview of natural stone materials along with stone conservation case studies.
Saturday Off-Campus Workshop 9/10 – 8:00am-12:00pm	Stone Carving Guest Instructor: Jens Langlotz
Location: Woodlands Mansion Carriage House 3900 Woodland Ave, Philadelphia, PA 19104	Students will work with Master Stone Carver, Jens Langlotz for the stone carving portion of the workshop. Several different textures in dressed stone masonry will be reviewed and students will learn which chisels to use in order to get the chosen texture. The process of creating a straight planer surface will be demonstrated. Wear appropriate work clothes, long sleave paints and closed-toe shoes. Additional PPE will be provided.
Deadline (9/13)	Site Project Submission #SP1: Archival Research & Material Characterization
Class 3 (9/14)	Mortar Material Properties & Formulations
Location: Architectural Conservation Lab Duhring Wing 051	This session will provide a brief review of mortar materials and technology timeline as well as an in-depth discussion of contemporary mortar materials and formulations. Specific attention will be paid to the role of mortar within wall assemblies.
Deadline (9/20)	Site Project Submission #SP2: Drawing Set w/ Orthorectified Photography
Class 4 (9/21)	Concrete & Cast Stone Guest Instructor: Irene Matteini
	This class will provide an overview on Concrete Fundamentals through an interactive lecture where several case studies will be presented on the different topics. During this lecture we will explore the fundamentals of Concrete, its assessment and conservation. Concrete Properties: How is concrete made? What

	are its key properties? Concrete Deterioration Mechanisms: An overview of the most common deterioration mechanisms that affect reinforced concrete structures. Concrete Repair: An overview of traditional repair methods and electrochemical techniques.
Class 5 (9/28)	Masonry Material Conditions
Location: Meyerson B6	All masonry materials experience similar deterioration phenomenon and either due to inherent characteristics, environmental factors or secondary materials within the wall assembly. This session will provide an overview of these types of general and specific conditions and ways in which deterioration in particular can affect building performance as a whole. Time will be spent reviewing deterioration phenomenon.
Recorded Lecture – Field & Lab Analysis	Students are required to view a recorded sessions that showcase both field and laboratory analysis techniques and instrumentation.
Deadline - Quiz (10/4)	After viewing the above recording, students will be required to complete and submit the quiz to the course instructors no later than 5 pm on Tuesday 10/4.
Class 6 (10/5)	Masonry System Conditions Guest Instructors: Jason Coleman, PE. WJE
Location: Meyerson B6	This session will focus on effective methodologies for assessment and repair of masonry facades. Through project case studies, the presenters demonstrate best practices for a successful approach to masonry repair, emphasizing the implementation of a project methodology that establishes general parameters for the project in the investigation and design phases that are refined during construction.
Class 7 (10/12)	Ft Mifflin Working Session Identification and Documentation of Conditions
Location: Fort Mifflin 6400 Hog Island Rd, Philadelphia, PA 19153	This will be an onsite class to allow each student to further identify and document conditions. We will review some sites as a group and then each student will go to their individual sites. Instructors will be available to meet one-on-one to assist in the process. This will also be your opportunity to retrieve mortar samples for SP4.
(10/14) – Time TBD	Gravimetric Mortar Analysis Lab
Location: Architectural Conservation Lab Duhring Wing 051	
Deadline (10/18)	Site Project Submission #SP3: 50% Draft w/ Condition Survey Drawing Set & Conditions Glossary
Class 8 (10/19)	Masonry Cleaning
Location: Meyerson B6	This session presents the rationale and methodology for addressing cleaning of masonry substrates in both interior and exterior

	applications. Understanding how to approach and develop a proper testing program is the first step in determining which technique will clean the masonry while promoting long-term performance. This session will introduce current cleaning systems and describe their general performance and applications. Specific attention will be paid to chemical, micro-abrasive, and laser systems. Introduction to Treatment Assignment #1: Masonry Cleaning
Deadline (10/25)	Site Project Submission #SP4: Gravimetric Mortar Analysis/Characterization
Class 9 (10/26)	Formulating Repair Mortars, Composite Repairs, Concrete Repairs & Repointing Techniques Guest Instructor: Amy Woods, PE. IMI
Location: Architectural Conservation Lab Duhring Wing 051	This session will build upon the information gathered from survey work, gravimetric, chemical, and instrumental analysis to develop repair mortar formulations. Given the similarity of materials, proprietary and custom composite repair materials will also be discussed as well as aesthetic matching of concrete. Mixing, application, protection, and curing methods will be introduced. Introduction to Treatment Assignment #2: Mortar Formulation
Recorded Lecture - Mechanical Pinning, Grouting, & Unit Repairs	In many instances historic masonry walls or materials require redesign or reinforcing to either stabilize or strengthen the materials or systems. These situations may arise from any number of reasons including poor original design or construction, damage due to seismic activity, or just general weathering and/or deterioration. This course will outline some of the most common scenarios and present a variety of current methods available to address the causes as well as the symptoms. Particular attention will be paid to pinning and grouting, & crack repair systems which have been designed for structural and non-structural applications.
Workshop (10/28) - Friday	Laser Ablation Guest Instructor: Adam Jenkins
Location: Architectural Conservation Lab Duhring Wing 051	Full-day workshop on the use of Nd:YAG laser systems to clean architectural materials. Includes a lecture on how laser cleaning works and descriptions of both low frequency (fixed optic) and high frequency (scanning optic) systems. This will be followed by a short practicum where students can test both types of system on sample materials.
Deadline - Quiz (11/01)	After viewing the above recording, students will be required to complete and submit the quiz to the course instructors no later than 5 pm on Tuesday 11/01.
Class 10 – Hands-on Workshop (11/02)	Mortar Removal, Mortar Mixing, Repointing, Traditional Bricklaying, & Composite Repairs

Location: IMI/BAC Training Center, 2702 Black Lake Pl, Philadelphia, PA 19154 Note: Training center is the building located at the end of the cul-de-sac	This session is designed to provide the participants with practical experience in mortar removal, mortar mixing, repointing, traditional bricklaying, & composite repairs.
Deadline (11/8)	Site Project Submission #SP5: Prioritized Conditions Report
Class 11 – Recorded Lecture (11/9)	Masonry System Repairs, Moisture Management, & Thermal Upgrades Guest Instructors: Rachel Will and Ed Gerns. WJE
	The first half of this session will focus on the necessary repairs moisture management such as flashing to address critical conditions and/or design flaws. Additional information will be provided on considerations for attempting thermal upgrades to historic masonry structures. The second half of this session will be led by our guest instructors who will present case studies on masonry repair projects and strategies for system repairs.
Deadline - Quiz (11/15)	After viewing the above recording, students will be required to complete and submit the quiz to the course instructors no later than 5 pm on Tuesday 11/15.
Deadline (11/15)	Treatment Assignment #TA1: Masonry Cleaning
Class 12 (11/16)	Masonry Coatings & Surface Treatments
Meyerson B6	There are any number of traditional and contemporary coatings that can be used to address performance and aesthetic issues surrounding historic and existing masonry structures. These products range anywhere from hydrophobic coatings used to minimize water infiltration, to consolidants used to strengthen the surface of weathered masonry; brick, terra cotta, natural stone, & concrete. This session will introduce general types of coatings, their properties/chemical composition, methods of application, and performance. Particular attention will be paid to the processes which cause conditions that may warrant the use of a surface coating as well as when these types of products should and should not be used.
Deadline (11/29)	Treatment Assignment #TA2: Mortar Formulation
Class 13 (11/30)	Tile & Terrazzo – Conservation and Repair

	Ceramic tile and cementitious terrazzo have served both decorative and functional purposes for centuries. We will discuss history of manufacture, installation, performance, deterioration, and restoration of these materials. Since floor and wall materials typically experience the most wear in a building, a particular focus will be on the unique maintenance and repair practices of tile and terrazzo.
Class 14 (12/7)	Final Site Project Presentations
Meyerson B6	Students will offer a brief overview of the conditions that they presented at the mid-term to refresh the class on the major issues at play. The presentation, however, should focus specifically on the treatment recommendations and testing program that has been developed. Feedback will be provided by the instructor, fellow students, and invited guests to be incorporated into the final report.
Deadline (12/14)	Site Project Submission #SP6: 100% Draft Reports (These documents will be reviewed and returned by 12/18 with suggestions and comments which should be incorporate into your Final Reports).
Deadline (12/21)	Site Project Submission #SP7: 100% Final Reports

Textbooks:

There are no mandatory books for you to purchase for this course however, the reserved books listed below will be primary resources for the course and invaluable in your careers.

Reserved Reference (Fisher Fine Arts):

- Henry, Alison. Stone Conservation, Principles and Practice. Dorset: Donhead, 2006.
- Henry, Alison, and John D Stewart. Earth, Brick & Terracotta. Practical Building Conservation. Farnham: Ashgate Publishing, 2012
- Henry, Alison, and John D Stewart. Mortars, Renders & Plasters. Practical Building Conservation. Farnham: Ashgate Publishing, 2012
- Odgers, David, and Catherine Croft. Concrete. Practical Building Conservation. Farnham: Ashgate Publishing, 2012
- Odgers, David, and Alison Henry. Stone. Practical Building Conservation. Farnham: Ashgate, 2012.
- Siegesmund, Siegfried, and Rolf Snethlage. "Stone in Architecture: Properties, Durability". Springer 2014

Digital Reference:

- Doehne, Eric. and Price, Clifford. Stone Conservation, An Overview of Current Research. Los Angeles: Getty Conservation Institute, 2010.

  http://www.getty.edu/conservation/publications_resources/pdf_publications/pdf/stoneconservation.pdf

- ICOMOS-ISCS :Illustrated glossary on stone deterioration patterns:

  http://www.icomos.org/publications/monuments_and_sites/15/pdf/Monuments_and_Sites_15_ISCS_Glossary_Stone.pdf

- NYC Buildings – FAÇADE CONDITIONS: An Illustrated Glossary of Visual Symptoms

  https://www1.nyc.gov/assets/buildings/images/content/misc/FacadePresentation.pdf

Bibliography:

A fairly comprehensive masonry bibliography will also be provided at the beginning of the course.

Project Site Information:

Fort Mifflin
6400 Hog Island Road
Philadelphia, PA 19153

Main Site Contact and Emergency Contact:
Beth Beatty, Executive Director
Email: fortmifflininfo@gmail.com
Office: 215-685-4167
Cell: 609-314-5567

Social Media:
www.FortMifflin.us
Facebook: OfficialFortMifflinInfo
Twitter: @Fort_Mifflin

Site Hours:
Wednesday – Sunday 10 am – 4 pm
Monday - Tuesday **CLOSED**

Site Visit Protocol:
The class TA is required to work with students to coordinate site visits and to communicate the intention to visit at least 48 hours ahead of time via email to Beth Beatty, Fort Mifflin Executive Director. Students are required to check in as a general visitor and obtain a wristband, though they will not be charged for admission. Wednesday-Friday check in is in the second-floor office in the Kitchen (Hospital) building. Saturday-Sunday check in is at the Front Gate or in the Gift Shop (Store House).

Personal Protection Equipment (PPE):
When onsite, please treat it like an active work site and wear appropriate PPE. Hardhat, safety glasses, gloves, long pants, and work boots/closed-toe shoes should be worn.

Directions:
https://goo.gl/maps/f5Moh7qg39nFfRik6
Fort Mifflin is about a 20-minute drive from Meyerson Hall. It is not accessible by public transportation.

Parking:
Students can park in the vistor parking lot inside of the front gates to the left.

Archival Research & Reading:

Library of Congress
https://www.loc.gov/

Historical Society of Pennsylvania
1300 Locust St.
Philadelphia, PA 19107
https://www.portal.hsp.org/

The Athenæum of Philadelphia
219 S. 6th Street
Philadelphia, PA 19106-3794
https://philaathenaeum.org/

Reading and Research:
Albert, Anne, Kelsey Britt, John Giganti, Sara Gdula, Anthony Hita, and Sara Stratte. 2017. Fort Mifflin. University of Pennsylvania Historic Preservation Graduate Studio Seminar.

Historic American Buildings Survey (HABS) documentation:
HABS No. PA-1225, "Fort Mifflin, Mud Island, Marine & Penrose Ferry Roads, Philadelphia, Philadelphia County, PA", 74 photos, 10 color transparencies, 9 measured drawings, 130 data pages, 1 photo caption page

Further Optional Reading:

Historical Society of Pennsylvania:
Alotta, Robert I, "Old Fort Mifflin: The Buildings and Structures" Shackamaxon Society, Philadelphia, Pennsylvania, United States of America 1973.

Alotta, Robert I, "Historic Old Fort Mifflin" Shackamaxon Society, Philadelphia, Pennsylvania, United States of America 1973.

Alotta, Robert I, "A Glossary of Fortification Terms as they relate to Old Fort Mifflin" Shackamaxon Society, Philadelphia, Pennsylvania, United States of America 1972.

Dorwart, Jeffery (1998). Fort Mifflin of Philadelphia: An Illustrated History. University of Pennsylvania Press. ISBN 978-0-8122-1644-8. Google Books.

Liggett, Barbara; Laumark, Sandra (1979). "The Counterfort at Fort Mifflin". Bulletin of the Association for Preservation Technology. Association for Preservation Technology International (APT). 11 (1): 37–74. doi:10.2307/1493677. JSTOR 1493677.

Scull, G. D., ed. (1881). "The Montresor Journals". Collection for the Year 1881. New York Historical Society.
https://babel.hathitrust.org/cgi/pt?id=yale.39002002224252&view=1up&seq=456&q1=Fort%20Mifflin