A6702, Investigative Techniques, Spring 2025

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Wednesdays, 1:00 pm – 3:30 pm, 655 Schermerhorn Extension

Buildings are complex assemblies. The study of existing buildings allows us to understand their construction and present condition and to evaluate compatible materials and methods for their conservation. Investigation also gives us a way to recognize alterations that have been done over time, and to determine the critical role played by architectural decisions made during construction and subsequent repairs. The tools and techniques of building investigation in use today are numerous and vary widely from low- to high-tech approaches, providing practitioners an array of options to study their structures. This course will include hands-on testing on campus, laboratory testing, lectures, and guest speakers.

Requirements:

- Attendance
- Participation in discussions
- Lab assignments
- Weekly readings (will be posted on Canvas)
- Assignment #1: Documentation and presentation of a Conditions Survey. Select a building to conduct a conditions survey and minimal archival research. You will map conditions of a building on an image, create a conditions legend, and draft a conditions glossary which provides:
    - condition name
    - a definition of each condition
    - a detailed image of each condition
    - details and notes on each condition specific to your building
    - possible causes of the condition

  Building should be a maximum of four stories to allow for a detailed survey and easy use of binoculars while surveying. Building must not be painted over the majority of its main façade and should exhibit significant deterioration. Presentation must include one historical image of your building.

- Assignment #2: Presentation: defense of investigative techniques to be used on your building from Assignment #1 for the following:
    - identification of historic materials
    - characterization of historic materials
    - determination of façade assembly/construction
    - determination of causes of deteriorations in materials and the structure
    - the mechanical performance and behavior of the historic materials
    - the mechanical performance and behavior of possible repair and replacement materials

  Describe each technique/test you would recommend, and why, to attain information on each of the inquiries above for all building materials. Provide information on the sample sizes, sample locations, defense of tests, what you hope to learn from each investigation, and pros and cons of each of the techniques and tests. Assume you have no budget or timeline.

Material Identification

Class 01

- Introduction
- Binocular microscopy; polarized light microscopy, field microscopes, hand lenses
- Visual assessment - stone

Class 02

- Simple mortar characterization and gravimetric analysis and polarized light microscopy
- Visual assessment - mortar and stucco

Class 03

Sample Fabrication

- Mortar mixing and forming for use in future testing

Class 04
- Microchemical spot testing
- Strip tests
- X-Ray Fluorescence (XRF)

Electron Microscopy and Characterization Lab Tours
- X-ray Diffraction (XRD)
- Raman Spectroscopy
- Fourier Transform Infrared Spectroscopy (FTIR)
- Scanning Electron Microscopy – Energy Dispersive Spectrometry (SEM-EDX)
- Visual assessment - metals

Durability / Treatment Assessment / Construction of Assemblies / Condition Assessment

Class 05
Construction Details
- Probes
- Borescope
- Infrared imaging
- Hyperspectral imaging

Class 06
Water and Building Materials
- Karsten/RILEM
- Absorption by immersion
- Initial rate of absorption
- Water vapor transmission
- Saturation coefficient
- Moisture meter
- Visual assessment - brick and terra cotta

Class 07
Assignment #1 Presentations and Conditions Glossary Due

March Spring Break

Class 08
Non-Destructive Evaluation - Atkinson-Noland & Associates Guest Lecture
- Ground penetrating radar, pachometer
- Schmidt hammer; pendulum hammer
- Ultrasound (pulse velocity impact echo)

Class 09
Strength Testing – Carleton Laboratory Tour
- Compressive strength
- Flexural strength
- Splitting tensile strength

Class 10
- Accelerated weathering
- Hydric dilatation
- Freeze-thaw

Class 11
Concrete & Corrosion Studies
- Half-cell potential
- Linear polarization reaction
- Magnetometry
- Crack monitoring
- Dataloggers
- Surface temperature measurement

Class 12
Coatings and Color
- Tape test
- Adhesion Pull-Off Tester
- Colorimeter
- Glossmeter
- Visual assessment – Finishes & Coatings

Class 13
Cleaning Testing
- Mechanical cleaning
- Cleaning with water
- Chemical cleaning

Class 14
Final Presentations: 10-minute presentation

Schedule subject to change