



Izmir Institute of Technology
Faculty of Architecture
Graduate Program in Architectural Restoration

RES 552 LABORATORY RESEARCH TECHNIQUES OF HISTORICAL BUILDING MATERIALS

2025-2026 Spring Semester

Course Credit: (3+2) 4, ECTS: 6

Course Team:

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Office Hours:

Thursday, 10.00-12.00

Monday, 10.00-12.00

Objective of the course:

The objective of this course is to give fundamental knowledge about laboratory research techniques for conservation works. The students will gain experience in study of basic laboratory practices, microscopy, chemical and physical testing of historic building materials.

Assessment Method:

Assignment 1: 10 %

Assignment 2: 10 %

Midterm: 20 %

Contribution to laboratory works and final report: 20 %,

Final: 40 %

Grading:

The grading of the course will be based on the university catalogue system.

Attendance:

Attendance at the course is mandatory. Attendance will be tracked separately for lectures, seminars and laboratory practices.

Schedule of the course:

25.02.2026	Introduction to the course
04.03.2026	<i>Field study – RES 508 Preservation of Historic Environment</i> <i>No lecture</i>
11.03.2026	<i>Field study – Sampling for laboratory analyses</i>
18.03.2026	Mud, mud mortars, mudbricks
25.03.2026	Gypsum mortars and plasters
01.04.2026	Presentation of Assignment 1
08.04.2026	Historic fired bricks, production and characteristics
15.04.2026	Midterm
22.04.2026	Production of lime, classification and characteristics of lime
29.04.2026	Historic lime mortars, natural and artificial pozzolans
06.05.2026	Seminar: Tuğçe Aydınalp
13.05.2026	<i>Spring break</i>
20.05.2026	Seminar: Dr. Taygun Uzelli
27.05.2026	<i>Holiday</i>
03.06.2026	Characteristics and conservation of historic mosaics
10.06.2026	Presentation of Assignment 2
24.06.2026	Final

Assignments

- Presentations should meet the following criteria: Depth of research & accuracy, Integration of material science with conservation practice, critical evaluation of the findings (not just description) and clarity.
- Presentations should be made in an interactive classroom environment. To achieve this, students should contribute to the presenter with their comments and questions. These contributions will also be evaluated.
- This research and related presentations will also be a tool for understanding the importance of materials analysis and the application areas of different experimental methods.
- Presentations should be planned to last no longer than 10 minutes.

Assignment 1 – Case Study

Theme: Conservation/Restoration of a Historic Mud Structure or an Archaeological Site

Description:

In this mini case study project, each student:

- will select a case study involving the protection, conservation, or restoration of a mud brick (adobe) structure or an earthen archaeological site.
- conduct academic research using databases (Web of Science, Scopus etc.), articles, books, conservation reports, and technical documentations.
- prepare an oral presentation (10 min.) analyzing the selected site or project.

Assignment 2

Themes:

- 1. The Evolution of Lime in Historical Construction**
– From lime plaster to lime mortars: historical preparation methods, regional variations, and conservation applications today.
- 2. Gypsum in Architectural Heritage**
– Historical uses, physical/chemical properties, decay forms, and approaches to restoration.
- 3. Brick in Antiquity and Beyond**
– Regional traditions in brick production, microstructural characteristics, and diagnostic methods for conservation.
- 4. Mortar Analysis in Architectural Restoration**
– Laboratory techniques for identifying binder–aggregate ratios, inclusions, and how analysis informs compatible restoration materials.
- 5. Mosaic Materials and Degradation**
– Types of tesserae (stone, glass, ceramic), binder mortars, deterioration processes, and conservation challenges.
- 6. Salt Crystallization in Historical Materials**
– Mechanisms of salt weathering in porous materials (brick, lime, gypsum) and case studies of damage in historical sites.
- 7. Compatibility Issues in Restoration**
– Why using modern materials (e.g., Portland cement) often fails in conservation, with examples of damage caused by incompatibility.
- 8. Analytical Techniques in the Characterization of Historical Materials**
– Comparative overview of methods such as XRD, SEM-EDS, FTIR, TG/DTA, and optical microscopy for conservation science.

Description:

Each student will

- select a theme from those provided above
- conduct academic research using databases (Web of Science, Scopus etc.), articles, books and proceedings.
- prepare an oral presentation (12 min.)

Evaluation Criteria for Assignment 1 - 2

- Quality and depth of research
- Understanding the subject
- Critical analysis of conservation strategies (not only descriptive)
- Clarity and organization of presentation
- Proper use of references and visual material

Schedule of the laboratory practice:

25.02.2026	Introduction to the course
04.03.2026	<i>Field study – RES 508 Preservation of Historic Environment</i>
11.03.2026	<i>Field study – Sampling for laboratory analyses</i>
18.03.2026	Preparation, labelling and photography of the samples
25.03.2026	Determination of the basic physical properties of the samples
01.04.2026	Determination of the basic physical properties of the samples and raw material compositions of lime mortars and plasters
08.04.2026	Determination of the raw material compositions of lime mortars and plasters
15.04.2026	Determination of the raw material compositions of lime mortars and plasters
22.04.2026	Determination of mineralogical, chemical and microstructural characteristics of materials by XRD and SEM-EDS analysis (IZTECH Center for Materials Research)
29.04.2026	Determination of pozzolanic activities of bricks and aggregates
06.05.2026	Submission of the preliminary report
13.05.2026	<i>Spring break</i>
20.05.2026	Determination of hydraulic properties of lime mortars and plasters
27.05.2026	Evaluation of XRD and SEM-EDS analyses
03.06.2026	Examinations under binocular and polarizan microscopes
10.06.2026	Finalization of laboratory practice
26.06.2026	Submission of the final report

Laboratory Practice Report

The results of the laboratory practice should be submitted in a report. The report should include an introductory section with a literature review, definition of the samples with their photographs, results of the analyses (with necessary tables, graphs, etc.), discussion of the results, and conclusions.

Use and Statement of AI:

The use of AI-based tools is strictly limited to language support, text editing, formatting, and technical assistance. Academic content, decisions, discussions, analytical evaluations, and creative work must be the student's own. The use of AI to generate ideas, analyses, discussions, or outputs without the student's critical engagement is not permitted. Students are responsible for ensuring academic integrity and originality in all coursework. Any AI tools used must be clearly stated.

Recommended Reading:

Please note that, these reading suggestions are for guidance only.

- Teutonico, J. M. A. (1986). *Laboratory Manual for Architectural Conservators*. Rome: ICCROM.
- Friedman, D. (1995). *Historical Building Construction*. New York: W. W. Norton & Co.
- Ashurst, J., & N. (1988). *Practical Building Conservation - Vol. 1: Stone Masonry*. Aldershot: Gower Technical Press.
- Ashurst, J., & N. (1988). *Practical Building Conservation -Vol. 2: Brick, Terracotta and Earth*. Aldershot: Gower Technical Press.
- Ashurst, J., & N. (1988). *Practical Building Conservation- Vol. 3: Mortars, Plasters and Renders*. Aldershot: Gower Technical Press.
- Ashurst, J., & N. (1988). *Practical Building Conservation - Vol. 5: Wood, Glass and Resins*. Aldershot: Gower Technical Press.
- Mora P, Mora L, Philippot P. (1984). *Conservation of Wall Paintings*. London: Butterworths
- S. Holmes and M. Wingate (1997). *Building with Lime*, Intermediate Technology Publications, 103-105 Southampton Row, London WC1 B 4HH, UK, 327 p.
- C. Edwin, C.E. Eckel (1928). *Cements, Limes and Plasters*, John Wiley & Sons, London, Chapman & Hall, Limited, 699 p.
- R.S. Boynton (1966). *Chemistry and Technology of Lime and Limestone*, John Wiley & Sons, 569.
- N. Davey (1961). *A History of Building Materials*, Phoenix House, London.
- W.C. Feist (1990). "Outdoor Wood Weathering and Protection". *Archaeological Wood Properties, Chemistry, and Preservation*. Advances in Chemistry Series. American Chemical Society, Washington DC 1990. (Doc. No.4)