Course offered for the PhD program
in Civil, Chemical and Environmental Engineering
Curriculum in Structural and Geotechnical Engineering, Mechanics and Materials
A.Y. 2024/2025 (XL cycle)
(the course is open for participation of students from other PhD cycles or programs)

1. Title: EXPERIMENTAL TESTING OF MATERIALS AND STRUCTURES

2. Course Description

The course deals with issues (in fact, several issues) that are usually neglected in Master courses in spite of the great importance they have in Structural Engineering applications: laboratory and *in situ* testing of materials and structures.

Due to a limit in the teaching time (30 hours), the course discusses the basic issues of experimental testing and data processing; equipment, building materials, static and dynamic testing of structures, case studies.

Along with the theoretical lessons, practical applications are required to the students. Since the Department has an active and quite well equipped Laboratory, the students are required to follow one of the testing campaigns that the Laboratory carries on following it from the very beginning (design of the tests), to the active phase till the processing of the test outcomes. The examination consists of two questions on the themes discussed in the lessons and a discussion on the report that the student is required to write on of the test campaign he/she followed.

3. Course Organization

A- General themes – 6-8 hours

- *Testing materials and structures*. The basic issue of testing: from material testing (local tests) to the whole structure (global response). The meaning of the mechanical parameters.
- *What is the strength of a material*? Is it a material property? Does it depend on the conditions in which the material has to perform? Does it depend on the test?
- *Directly measured and derived quantities*: what is measured? What is derived? What has to be include in a test report?
- *Control schemes of a test*: force and displacement control, i.e. applications vs. research
- *Calibration of a test*: procedure, verification, reliability
- *Reduced scale testing*: criteria for model-to-prototype similarity.
- *The concept of precision*: from the equipment to the measure.
- *Error theory* and correction of the errors

B- Equipment – 4 hours

- *Load sensors*: Load cells and pressure sensors
- *Displacement sensors*: LVDTs and potentiometers, transducers
- *Data acquisition*: in Laboratory and on site, wireless transmission
- *Universal testing machines*: hydraulic, mechanical, MTS type.

C- Material testing – Concrete – 8 hours

- Fresh concrete (in situ tests)
- Hardened concrete (from 3 days to 12 months)
- Existing structures: NDTs (rebound hammer, sonic tests), MDTs (pull out and core drilling)
- Combined methods (SONREB, SONREB-WIN)
- Other tests/methods
- Critical discussion of the procedures
- Case study

D- Material testing – Masonry– 6 hours

- NDTs: sonic tests, rebound hammer, georadar
- MDTs: flat jacks, core drilling, endoscope
- Combined methods
- Other tests (Thermography)

- Critical discussion of the procedures
- *Compression tests (axial)* on stacks of bricks and small assemblages of brickwork
- *Diagonal compression test*: in situ and in Lab tests.
- Case study

E- Material testing – Other materials – 4 hours
- Steel and other metallic materials
- Wood
- Case studies

F- Structure testing – Static load tests – 6 hours
- *Aims and scope*: can the safety of a structure be assessed by means of a load test?
- *Experimental setup*: where and how to load, where and what to measure.
- *Technology*: Which devices best fit the specific case? How to choose these devices?
- *Designing the test*, i.e. a direct connection between theory, technology and reality
- Data processing
- *Load tests on slabs*: loads, load cycles, data processing, mechanical interpretation of the tests. Theoretical displacements, Acceptable tests; when a test is to be considered as failed.
- *Load tests on bridges* loads, load cycles, data processing, mechanical interpretation of the tests. Theoretical displacements, Acceptable tests; when a test is to be considered as failed.
- Case study

G- Structure testing – dynamic identification – 6 hours
- Aims and scope
- Experimental setup
- *Electric measures*: sampling and aliasing, resolution, precision
- Technology
- Designing the test
- Data processing
- Case study

4. Teacher: Antonio BRENCICH – some external contributions for specific issues to be defined

5. Duration and credits: 30 hours

6. Activation mode and teaching period: to be defined

7. Deadline for registration

The deadline for applications is the first day of the course.
Please, send an e-mail confirmation to brencich@dicca.unige.it.

8. Final exam: Oral Discussion of a written report related to an experimental activity of the student