Learning outcomes

The overarching goal of the course is to provide students with fundamental tools for the analysis of historical masonry structures. In particular, the course introduces the theoretical aspects, the practical tools, and the experimental techniques for an effective structural diagnosis of historical structures aimed at their preservation and rehabilitation. Structures from different periods of history are in general analysed.

Course content (tentative)

1. Fundamentals of Fracture Mechanics (**)
   1. Linear elastic fracture mechanics: stress intensity factor and energy release rate
   2. Quasi-brittle materials: the cohesive model
   3. Size effects

2. Statics of Masonry Solids and Structures (*)
   1. No-tension masonry models
   2. The masonry continuum
   3. Equilibrium and compatibility
   4. Collapse state

3. Masonry Strength and Deformability (**)  
   1. Tests on mortar or block (natural or artificial stones, or clay-brick) specimens
   2. Formulation of a tri-axial failure criteria for lapideous materials
   3. Micro-model or macro-model of masonry (fictitious-homogeneous)
   4. Masonry compression, tensile or shear strength
   5. Masonry deformation
   6. Non destructive Tests (NdT) to evaluate mechanical characteristic of masonry

4. Arches and Vaulted Structures (*)
   1. Masonry arches: the concept of thrust and limit analysis
   2. Domes: membrane state, cracking patterns, brief description of some famous cases
3. Barrel, polygonal, and cross vaults: membrane state, cracking patterns, brief description of some famous cases
4. Exercises on collapse mechanisms of arches

5. Piers, Towers, and Gothic Cathedrals (*) (**)
   1. Piers: Compression strength under eccentric loading
   3. Cathedrals: Historical notes, construction techniques, relevant static problems in Gothic Architecture (case histories).
   4. Relevant interventions to protect historical constructions in seismic area with composite materials.

(*) Module 1
(**) Module 2

Readings/Bibliography

- Class hand-outs (slides available on the web site http://campus.cib.unibo.it).

Teaching methods

The course content will be entirely covered by the lectures. The course includes some laboratory sessions, field trips, and invited keynote lectures, which will help cover the practical aspects of the lectures. The instructors will supervise students during all activities.

Assessment methods

A full comprehensive final (written and oral) exam will be used to assess students' knowledge and understanding of the topics covered in the course. The written exam will consist of two problems. The first problem will be related to Module 2 and it will deal with topics covered in section 1 (Fundamentals of Fracture Mechanics) of the course content. The second problem will be related to Module 1 and it will deal with topics covered in section 4 (Arches and Vaulted Structures) of the course content. In addition, a project related to the study of a historical building will be assigned. Students will present their project at the end of the course (20 slides in pptx). The assessment of the presentation will be part of the final grade.

Teaching tools.

The teaching tools are overhead projector and PC.

Links to further information

http://www.eng.dicam.unibo.it/