

(Version 2014-Dic 06th 2014)

CIVIL ENGINEERING

MECHANICS OF HISTORICAL MASONRY STRUCTURES

1° CICLO 6CFU

The course covers the Analysis of Masonry (historical) under complex loading conditions. The Masonries considered are regular brick or worked natural stone systems.

Contents 2014

PRELIMINARY ASPECTS (~ 5 h.)

- Earthquake events and damage on Historic Construction in Emilia (2012) and Abruzzo (2009): a) special survey on churches, towers and campanili b) emergency and provisional supports preliminary to Reconstruction.
- Conservation policy and Terminology in the UNESCO frame.
- Relevant phenomenology regarding collapse: spontaneous implosion, seismic injure.

PART ONE Standards and Experimental Evidence (~ 20 h.)

1. Morphology and materials of historical masonries (stonework/ashlar or rubble, Brickwork/ Flemish or English bond, Italian traditional systems).
2. Standards on masonry construction: Eurocode 6, Italian code, U.S. code (TMS 402-08/ACI 530-08/ASCE 5-08). Linee Guida MiBAC.
3. Experimental evidences on Tests of lapideous (cohesive) materials evaluating mechanical parameters. Constitutive relationships (experimental) for Lapidaceous materials.
 - 3.1 Units and Mortars,
 - 3.2 Regular Brick Masonry: characterization on specimens (Literature Review: experimental data -tension orthogonal to bed-joints, compression orthogonal to bed-joints, splitting and shear properties, principal stresses at different bed joints orientations)
4. Regular Stone (Volcanic Tuff, Calcarenite) Masonry: characterization on specimens.
5. Ancient-roman typology of masonries. Reference to Ancient Pompei and Villa Adriana in Rome.
6. Non-destructive evaluation of masonry mechanical properties and stress state in situ (flat jack, penetrometer or Darmstadt test (mortar evaluation), sonic and ultrasonic waves, radar-graphia, ambient vibration record for identification, acoustic emission analysis for fracture evolution).
7. Masonry walls: theory of collapse for rigid block mechanisms, concepts on FRP or FRCM strengthening.

PART TWO Theories and Models (~ 20 h.)

0. Revised concepts and formulas in Structural Mechanics (tensor, Invariants, Deviator, Mohr circles)
1. Macroscopic criteria of local crisis and Fracture limit surfaces for lapideous materials (Mohr-Coulomb_Tension cut-off_capped, Drucker-Prager).
2. Basic Concepts of Linear Elastic Fracture Mechanics (Griffith and Irwin problems) and Fracture models of dominant crack in cohesive materials (Hillerborg fictitious crack, Fracture Energy and Size effect, softening vs. hardening)
3. Micro-models and Macro-models of masonry
4. Exercises on topic 0, 1 and 2.
5. Composites FRP or FRCM as crack inhibitors

PART THREE Case Histories

A. Gothic Churches in Bologna (s. Petronio-B0, s. Francesco-B0, s. Maria dei Servi-B0, s. Martino B0) and comparative analysis with French and English traditional Gothic.

NOTE:

The specific bibliography has been delivered during lectures.
The informatic slides presented by the teacher during the course are deposited on unibo site for downloading. This slides are only a part of the lectures; the remaining part is presented orally and written on blackboard by teacher.

EXAMS

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The student will present 20 ppt slides, as personal choice on the topic of the Academic Year: Masonry Structural Macro-elements in Gothic Religious Architecture in Bologna, with special reference to the tools given in PART ONE and in case histories in PART THREE of the annual program, as MID-TERM pre-exam.

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On the PART TWO (1,2,3,4) of this program some questions will be asked in written form and student will answer in written form, last day of the course.

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The student will present the PERSONAL notes (sic !) taken during the lectures (COMPLETE set, preliminary aspects included) and the discussions will concern on it (final exam/oral colloquium).

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English is the official language of the course.

This sheet must be presented in oral colloquium by the student.

Student Family nameGiven name.....