PRESENTATION OF THE COURSE

Advanced Structural Mechanics

The ERAMCA Project

Environmental Risk Assessment and Mitigation on Cultural Heritage assets in Central Asia

v2022317

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Objectives

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The course will be used to:

- apply classical structural analysis methods to civil engineering systems, with emphasis on historical buildings

Program

1. Course introduction
2. Failure due to elastic instability
3. Truss structures
4. Curved beams (arches), general aspects of plates and shells (domes).
5. Unit load method:
   - 5.1 Displacement calculation
   - 5.2 Statically indeterminate structures
6. Structural dynamics
7. Introduction to numerical methods and to structural software (SAP2000)

Prerequisites

Prerequisites/Assumed knowledge

- Notions provided by the Structural Mechanics course

Learning outcomes

Expected learning outcomes (1/2)

Students will be:

- capable of assessing the stability of structural elements and the strength of truss structures
- able to understand the behavior of curved beams, arches, plates and domes
- able to solve simple statically indeterminate structures
- able to understand the behavior of simple structures loaded by dynamic forces (earthquakes)
- able to properly assess the results obtained from the calculations, included those obtained with the computer for a case study

The course is delivered with lectures (both in presence and online through the Moodle platform) in order to present all the topics of the subject; attendance to all lectures is strongly recommended.

A case-study project, to be carried out step by step during the course is assigned to groups of students (3-4 individuals). This assignment will be delivered at the end of the course and contribute to the final evaluation.

Workshops and lectures organized in cooperation with experts from practice are also presented to students.

Exam rules

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The assessment criteria of acquired knowledge, comprehension, and skills are based on the class attendance and participation, the results of case-study project (report and presentation) and a on a written exam.

Assessment criteria: class attendance 20%, case-study project (final report and presentation) 40%, written exam 40%.

References and tools

- Reading list:
  - D. Johnson, Advanced structural mechanics An introduction to continuum mechanics and structural mechanics, Thomas Telford Limited, 2000
  - E.L. Wilson, Three-Dimensional Static and Dynamic Analysis of Structures – A Physical Approach With Emphasis on Earthquake Engineering, Computers & Structures Inc., 2002
  - J.N. Reddy, Energy Principles and Variational Methods in Applied Mechanics, 3rd edition, Wiley, 2017
  - A.I. Rusakov, Fundamentals of Structural Mechanics, Dynamics and Stability, ???
  - A.J.M. Ferreira, N. Fantuzzi, MATLAB Codes for Finite Element Analysis, 2nd Edition, Springer, 2020

- Additional reading list:
  - R. Szilard, Theories and Applications of Plate Analysis, John Wiley & sons Inc., 2003
  - S. Timoshenko, S. Woinowsky-Krieger, Theory of Plates and Shells, 2nd ed., McGraw-Hill Book Company, New York, 1959
  - M. Como, Statics of Historic Masonry Constructions, Springer Series in Solid and Structural Mechanics, Volume 9, 2016
  - B. Ghiassi and G. Milani, Numerical Modeling of Masonry and Historical Structures, Woodhead Publishing Series in Civil and Structural Engineering, 2019

IT TOOLS

- Internet offers many resources to deepen or clarify aspects of the subject matter (i.e., Wikipedia or Youtube). However, not all sources are equally reliable (develop critical thinking!)
- Given the importance that the automatic calculation has assumed in the current professional practice, part of the course is devoted to the introduction of more advanced solution methods that use the computer (SAP2000)