

PRESENTATION OF THE COURSE

STRUCTURAL MECHANICS

The ERAMCA Project

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

V2022317

This work is licensed under a [Creative Commons “Attribution-ShareAlike 4.0 International”](#) license.



Co-funded by the
Erasmus+ Programme
of the European Union



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

TABLE OF CONTENTS

Objectives

Prerequisites

Learning outcomes

Exam rules

References and tools



Co-funded by the
Erasmus+ Programme
of the European Union



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

OBJECTIVES



Co-funded by the
Erasmus+ Programme
of the European Union



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

Notions and tools to:

- interpret the mechanical behavior of structures, i.e., how they respond to **actions** (forces, temperature variations, subsidence of foundations...) in terms of **displacements**, **strength** and **stability**
- understand and apply the concepts of **safety** and **reliability**
- **solve** simple structures and critically evaluate the results and calculation performed

1. **Behavior of structural elements** (beams): general rules obtained from the observation of how the structures react to the applied loads and mathematical models to describe their behavior
2. **Methods of structural analysis**: how to calculate the necessary physical quantities to design structures and verify their safety
3. **Application**: a laboratory activity is planned to apply the knowledge acquired

1. Course introduction

1.1 Introduction, exam...

1.2 Introduction to structural programs

2. Structural safety

3. Elastic rectilinear beam

- 3.1 Introduction to beam theory
- 3.2 Supports
- 3.3 Remarks on ineffective constraints
- 3.4 Kinematics
- 3.5 Statics
- 3.6 Virtual work theorem
- 3.7 Constitutive equations
- 3.8 Geometrical properties of the cross section
- 3.9 Axial displacements
- 3.10 Deflection of beams
- 3.11 Stress definition
- 3.12 Physical meaning of the material properties

3.14 Elastic stresses:

3.14.1 normal stress

3.14.2 tangential stress (shear)

3.14.3 tangential stress (torsion)

3.15 Failure due to exceeding the strength limit in the cross sections (material failure theories)

PREREQUISITES



Co-funded by the
Erasmus+ Programme
of the European Union



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

- **Mathematical methods** and **concepts** are used all along the course
- Knowledge of **calculus** (functions, derivatives, integrals, differential equations, vector and matrix) is required

LEARNING OUTCOMES



Co-funded by the
Erasmus+ Programme
of the European Union



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

- Students will learn the fundamental notions about the mechanical behavior of structures and materials, in terms of **strength** and **deformability** and the basic concepts of structural safety.
- Students will understand the simplest models of evaluation of the **structural response**, being able to select the relevant **geometrical** and **mechanical** parameters, as well as the actions to be considered. In addition, the students will be able to understand and assess properly the results obtained from the **calculations**, included those obtained with the computer.

- Students will be able to **schematize** and **solve** a planar frame structure, and to provide the results in terms of internal forces and displacements of the structure.
- Students will be capable of assessing the **strength** of sections and the **stability** of structural elements.

EXAM RULES



Co-funded by the
Erasmus+ Programme
of the European Union



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

Exams will be written.

The questions are:

1. solution of a statically determinate structure, i.e., determination of the normal force, shear force and bending moment diagrams
2. calculation of the geometrical properties of a plane area and calculation of stresses
3. a question about one of the topics covered during the course

Assessment criteria: class attendance 40%, written exam 60%.

REFERENCES AND TOOLS



Co-funded by the
Erasmus+ Programme
of the European Union



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

- Reading list:
 - F. Beer, E. Russell Johnston, J. DeWolf, D. Mazurek, **Mechanics of Materials**, McGraw-Hill Science, 2011
 - M. Salvadori, **Why buildings stand up: the strength of architecture**, W.W. Norton & Company, 1980
 - D.L. Schodek, M. Bechthold, **Structures**, Pearson, 2014
- Additional reading list:
 - J.H. Allen, **Statics For Dummies**, Wiley Publishing Inc., 2010
 - J.H. Allen, **Mechanics of Materials For Dummies**, Wiley Publishing Inc., 2011
 - W. Nash, M. Potter, **Schaum's Outline of Strength of Materials**, McGraw Hill Professional, 2010

- **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!)