



Code: ICAR/09

Credits: 6

Matter: Reinforced Concrete Structures

Main language of instruction: Italian

Other language of instruction: English

Teaching Staff

Head instructor

Prof. Barbara Ferracuti - barbara.ferracuti@unicusano.it

Introduction

1. Objective of the course:

The course of “Reinforced concrete structures” provides the principals skills to the design of reinforced concrete structures. Starting from the structural reliability for vertical loads, the definition of the proper structural schemes and methodologies for performing the calculations of members internal actions will be analyzed in depth up to the design of simple RC frame structures.

2. Requirements

Students enrolled in the course must be able to manage the principal methods for the resolution of isostatic and basing methods for solving simple statically redundant structures (such as force method, displacement method, virtual work principle, etc...), must have a sound knowledge of the beam’s theory and of section analysis for linear homogeneous materials. Students must also be familiar with the concepts equilibrium and compatibility and the main aspects of the statics.

The aforementioned topics are covered in the course “Mechanics of Solids and Structures”.

Objectives

3. Course Structure:

The course has the following objectives:

1. Structural Reliability
2. Structural analysis of statically redundant structures
3. Materials
4. Cross-sectional Analysis in elastic range
5. Design/verification of reinforced concrete (R/C) elements

Competencies:

At the end of the course students will gain the necessary knowledge concerning: structural analysis methods for statically redundant structures, design methods for simple R/C structures, common construction details, and the most important methodologies for the execution of structural elements. Students will be also able to face and understand the principal technical standards for structural design.

Syllabus

4. Programme of the course:

Subject 1 – Structural Reliability - Reference standards. Limit state design approach. Elements of probability theory. General rules of the limit states design

Subject 2 - Structural analysis of statically redundant structures: Symmetric loading conditions for structures. Force and displacement methods. Non-sway frames: rotational stiffness evaluation (Hardy-Cross method). Shear type frames: translational stiffness evaluation (Shear-Type frames).

Subject 3 – Materials – Concrete: composition; technology; mechanical properties in tension and in compression, conformity. Reinforced bars: steel mechanical characteristic in tension and in compression, strength classes, requirements, conformity. Constitutive laws for materials.

Subject 4 – Cross-sectional Analysis in elastic range

General rules and hypotheses. Homogenization coefficient. Analysis of R/C sections in bending. Preliminary criteria for structural elements.

Subject 5 - Design/verification of reinforced concrete (R/C) elements

Limit state design method for the R/C. Failure modes for cross sections in bending. Ultimate moment for bending actions. Verification and design of elements against shear actions. Elements subjected to axial and bending actions: interaction between M-N. Simplified rules for design and verification of element.

Subject 6 – E-tivity – Design of a RC structures: one-way slab, beams and columns.

Design of slabs: Loads definition. Type of structural elements. One-way slabs: Design rules, multiple supports structural model, reinforcement layout, verification against bending and shear actions.

Design of R/C frames: Identification of the structural layout. Type of beams. Simplified methods for the evaluation of the internal actions and preliminary design of the elements. Loading conditions. Design criteria and reinforcement layout. Detailing rules. Design of columns. Preliminary design of columns. Loading conditions. Design criteria and reinforcement layout. Detailing rules

Evaluation system and criteria

The learning assessment of the student is carried out through the development of a design project(e-tivity) and a written final exam, which will establish the achievement of the requested knowledge. The projects assigned consist in the design of a simple R/C frame according to the Italian Building Code.

The examination test consists in a written test lasting 90 minutes.

The test consists of exercises and questions on the following topics:

1. Exercises on the resolution of statically redundant structures;
2. Design and calculation of R/C elements;
3. Theoretical questions concerning the course program;

The test entitles you to a maximum of 20 points. Up to 10 points are associated with the e-tivities and will be summed to the total score obtained with the written exam. Before the final exam, the student has to complete the E-tivities.

Bibliography and resources

5. Materials to consult:

Lecture Notes: Lecture notes available online completely cover the course syllabus and are integrated by slides and video-lessons. This material is necessary and sufficient for the study of the subject.

6. Recommended bibliography:

Books

- *Bill Mosley, John Bungey and Ray Hulse, Reinforced Concrete Design to Eurocode 2, Sixth Edition, Palgrave Macmillan.*
- *George F. Limbrunner, Reinforced Concrete Design 8th Edition, Kindle Edition.*

Reference Standards:

- Italian Building Code “Norme Tecniche per le Costruzioni – D.M. 2018”.
- Eurocode 2. EN 1992-1-1:2005 Part 1-1: General rules and rules for buildings.