



SEISMIC DESIGN OF STRUCTURES

Enrollment year	2020/2021
Academic year	2021/2022
Regulations	DM270
Academic discipline	ICAR/09 (CONSTRUCTION TECHNIQUES)
Department	DEPARTMENT OF CIVIL ENGINEERING AND ARCHITECTURE
Course	CIVIL ENGINEERING
Curriculum	Strutturistico
Year of study	2°
Period	1st semester (27/09/2021 - 21/01/2022)
ECTS	9
Lesson hours	78 lesson hours
Language	Italian
Activity type	WRITTEN AND ORAL TEST
Teacher	SILVA MOURA PINHO RUI JORGE (titolare) - 9 ECTS
Prerequisites	The course foresees that students will have already successfully followed the courses on Structural Mechanics and Structural Engineering.
Learning outcomes	<p>The course aims at introducing and initiating students in the structural design process, starting from the architectural requirements in order to arrive at a structural configuration, then passing on to the design and detailing of structural members, with a particular focus on earthquake resistance.</p> <p>At the completion of the course it is expected that students will find themselves equipped with the necessary knowledge to independently pre-design a reinforced concrete building, correctly model the latter in a structural analysis software package, undertake the necessary static and dynamic analyses, and then design and detail columns, beams, walls and nodes, all with the explicit consideration of seismic actions.</p>

The course can be considered as structured in four main parts, listed below. In addition, during the course the students will also be asked to undertake a design project in which a building, whose architectural project will have been previously developed by the students, will need to be designed.

STRUCTURAL DESIGN – SOME GENERAL ISSUES AND CHALLENGES

Construction materials (concrete, steel, masonry, timber...); structural configuration (frames, structural walls, cores...); examples of different structural configurations (frames, warehouses, skyscrapers...); actions on structures and their influence on the structural response (vertical loads, wind, thermal variations, explosions, fire, ground settlements...); seismic action (intensity, scales, factors influencing the ground motion, action definition for structural design, response spectrum...).

INTRODUCTION TO STRUCTURAL MODELLING

Objective of the numerical analysis; use of structural analysis; selection of appropriate modelling and analysis method; modelling of frames; representation of structural elements (columns, beams, beam-column joints, structural walls...); representation of constraints and restraints (joints, foundations...); introduction to adopted structural analysis program (materials, sections, elements, nodes, constraints, loads, "rigid-ends", "end-releases"); example case-studies.

REVIEW OF THE BASICS OF REINFORCED CONCRETE DESIGN

Ultimate and Serviceability limit states; material properties (mean and characteristic values); safety coefficients; internal actions (axial, bending, shear); reinforcement design; design of slabs, beams and columns.

DESIGN OF A REINFORCED CONCRETE FRAME

Load combinations, characteristic values, design values, combination factors, etc; load distribution; predesign; choice of slab system; sizing of beams and columns; computer modeling; structural verification; modal analysis; seismic action calculation; design of structural elements and foundations.

Lectures (hours/year in lecture room): 52
Tutorials (hours/year in lecture room): 26
Workshops (hours/year in lecture room): 0

**Recommeneded or required
readings**

Some textbooks pertinent to the course are listed in what follows:

- L. Petrini, R. Pinho, G.M. Calvi. Criteri di Progettazione Antisismica degli Edifici. IUSS Press, 2004.
- E. Cosenza, G. Magliulo, M. Pecce, R. Ramasco. Progetto Antisismico di Edifici in Cemento Armato. IUSS Press, 2004.
- M. Mezzina, D. Raffaele, A. Vitone. Teoria e pratica delle costruzioni in cemento armato (Vol. 1 e 2). Città Studi Edizioni, 2007.
- AICAP. Guida all'uso dell'Eurocodice 2 - con riferimento alle Norme Tecniche D.M. 14.1.2008 (Vol. 1 e 2). AITEC, 2008.
- V. Nunziata. Teoria e pratica delle strutture in cemento armato (Vol. 1 e 2). Dario Flaccovio Editore, 2004.
- F. Angotti, M. Guiglia, P. Marro, M. Orlando. Progetto delle strutture in calcestruzzo armato. Hoepli, 2011.
- E. Giangreco. Teoria e tecnica delle costruzioni (Vol. 1). Liguori Editore, 2003.
- B. Furiuzzi, C. Messina, L. Paolini. Prontuario per il calcolo di elementi strutturali. Le Monnier, 2010.
- F. Rossi, F. Salvi. Manuale di ingegneria civile 2 - Scienza delle costruzioni. Tecnica delle costruzioni. Ponti. Zanichelli, 2001.

Two intermediate written exams are foreseen. In addition, a design project is also compulsory and its progress will be monitored throughout the course; at the end of the latter, the project undertaken by the students will be assessed through a discussion of both the results obtained as well as the design procedure adopted. The final exam will be oral and available only to those students who will have successfully undertaken the aforementioned written exams and also completed and delivered the course project.

