1. BASIC INFORMATION

Course	Structural Design and Foundations
Degree program	Bachelor's in the Fundamentals of Architecture
School	Architecture, Engineering and Design
Year	Cuarto
ECTS	6 ECTS (150 hours)
Credit type	Compulsory
Language(s)	English
Delivery mode	Classroom
Semester	First Semester
Academic year	2025/2026
Coordinating professor	José Agulló de Rueda
Professor	José Agulló de Rueda

2. PRESENTATION

This is the fourth course on structures and deals with knowledge of soil as a structural element and the behaviour of foundations and containments. It also tackles the complete process of design, calculation and documentation of a structure up to the preparation of a complete project structure with its different documents in accordance with regulations.

The course begins with **Soil Mechanics**, an understanding of soil as a structural material, and goes into further depth with Geotechnical Studies and how they are elaborated and what data of interest we can obtain from them. We then move on to the study of Foundations and Containments, its regulations, and verifying stability, resistance and rigidity.

The second part of the course deals with the criteria of **Foundations and Retaining Design**, and the review of structure design criteria. We will look at the types of foundations and retaining elements, pre-sizing criteria, construction and economic valuation in order to choose the most appropriate type. This part will focus on assessing all options and choosing the most appropriate from the different points of view.

The third part of the course is the preparation of an **execution project for a structure**, with all the necessary documents to define it: Plans, Description, Quality Control Plan, Conditions and Measurements Specifications and Budget. A review will be made of the previous notions of design, computer calculation, dimensioning, documentation and development of construction details.

Practical exercises will be carried out so that the student understands and practices the mathematical concepts necessary to the course. Projects will be carried out so that the student understands the processes in the design, analysis, dimensioning and documentation of building structures.

3. COMPETENCIES AND LEARNING OUTCOMES

Core Competencies: 1, 2, 3, 4, 5

- CB1: That students have demonstrated knowledge and understanding in a field of study that is based on general secondary education, at a level which, although supported by advanced textbooks, imply some knowledge of the latest advances in their field of study.
- CB2: That students know how to apply their knowledge to their work or vocation in a professional manner and possess the skills that are usually demonstrated through the elaboration and defence of arguments and the resolution of problems within their area of study.
- CB3: That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include reflection on relevant social, scientific or ethical issues.
- CB4: That students are able to convey information, ideas, problems and solutions to both specialized and non-specialized audiences.
- CB5: That students have developed the necessary learning skills to undertake further studies with a high level of autonomy.

General Competencies: 4, 5, 6

- CG4: Understands the structural, construction and engineering design issues associated with building projects, as well as building resolution techniques.
- CG5: Understands the physical problems, the different technologies and the function of the buildings, in order to provide them with internal conditions of comfort and protection from climatic factors.
- CG6: Knows the industries, organizations, regulations and procedures to translate projects into buildings and to integrate plans into the planning process.

Cross-curricular Competencies: 1, 2, 4, 5, 6, 7, 9, 10

- CT1: Responsibility: aptitude or capacity to face the responsibility that raises awareness of the role that the profession of architect has in society, in particular by developing projects that take into account social and environmental factors.
- CT2: Self-confidence.
- CT4: Communication skills in the native language (both oral or written) and in the English language, in accordance with the principles of the *European University of Madrid*, any concept or specification for the development of the regulated profession of architect. This will include learning the specific vocabulary of the degree as well as the ability to manage information.
- CT5: Interpersonal skills.
- CT6: Flexibility.
- CT7: Teamwork: ability to work in teams of architects, or interdisciplinary teams (with shared responsibilities in many cases), managing and planning work groups that are necessary in the scheme of competencies and tasks that are defined for projects of a certain scale, in which various disciplines converge. This capacity includes interpersonal relations and team leadership.
- CT9: Planning and time management: ability to plan work in order to comply with delivery time and respect the limits imposed by budgets and building codes.
- CT10: Innovation and creativity: creativity, imagination and aesthetic sensitivity aimed applied to design in order to satisfy both aesthetic and technical requirements. This competence includes critical reasoning and historical culture.

Specific competencies: 12, 13, 14, 16, 17, 31, 32, 39, 44

- CE12: Ability to conceive, calculate, design, integrate buildings and urban units and execute building foundations.
- CE13: Ability to apply technical and constructive standards and regulations.
- CE14: Ability to maintain building structures, foundations and civil works.
- CE16: Ability to evaluate construction works.
- CE17: Ability to conceive, calculate, design, integrate buildings and urban complexes and execute building structures.
- CE31: Knowledge of measurement, assessment and survey methods.
- CE32: Knowledge of the on-site health and safety plan.
- CE39: Ability to design, put into practice, development site management.
- CE44: Ability to draft civil works projects.

Learning outcomes:

- RA1: Develop criteria to establish the most appropriate constructive or structural solution in each case
- RA2: Acquire a proper understanding of soil mechanics. Determines from a soil report or specific tests the design, calculations, construction and execution of the foundations.
- RA3: Design, calculates, budgets and provides a graphic representation of structural and foundation elements. Masters the use of technical standards.
- RA4: Understands the common pathologies in structural and building elements below ground.
- RA5: Master computer programs for analysis, dimensioning and verification, and critical interpretation of results.

The following table shows the relationship between the competencies developed during the course and the learning outcomes pursued:

Competencies	Learning outcomes
CB1, CB2 CG4, CG5 CT1, CT2, CT4, CT5, CT6, CT7, CT9, CT10 CE12, CE17	RA1: Develops criteria to establish the most appropriate constructive or structural solution in each case.
CB5 CG6 CE13	RA2: Has a proper understanding of soil mechanics. Determines from a soil report or specific tests the design, calculations, construction and execution of the foundations
CB2, CB3, CB4 CG6 CE16, CE31, CE32, CE39, CE44	RA3: Designs, calculates, budgets and provides a graphic representation of structural and foundation elements. Masters the use of technical standards.
CT1, CT2 CE14	RA4: Understands the common pathologies in structural and building elements below ground.
CG4 CE13	RA5: Masters computer programs for analysis, dimensioning and verification, and critical interpretation of results.

4. CONTENT

The subject is organized in FOUR Learning Units (U.A.), which in turn, are divided into lessons (depending on the units) that have been numbered not according to the UA to which they belong but in the chronological order that they follow.

UA1-Soils

Lesson 00: Ordering a soil report

Lesson 01: Soil report

01a: Types of soils

01b: Soils, parameters

01c: Soil reports, examples

UA2- Foundation and Retaining Design

Lesson 02: Foundation design

02a: Types of Foundations

02b: Election of types. Presizing

Lesson 03: Retaining design

03a: Types of retaining walls

03b: Election of types. Presizing

UA3- Foundation and Retaining Dimensioning

Lesson 04: Stresses on soils

04a: Stresses on natural soils.

04b: Stresses over retaining elements

Lesson05: Retaining and foundation stability and dimensioning.

05a: Shallow foundations stability and dimensioning.

05b: Deep foundations stability and dimensioning.

05c: Retaining elements stability and dimensioning.

Lesson 06: Reinforcing of foundation and retaining elements.

06a: Reinforcing of shallow foundation.

06b: Reinforcing of deep foundation.

06c: Reinforcing of retaining elements.

UA4- Structural Design and Project

Lesson 07: Structural Design

07a: Design and presizing of beams and floors

07b: Design and presizing of columns and bracings

07c: Design and presizing for long spans

Lesson 08: Structural Projects

08a: Work process: Design, analysis and dimensioning, documents

08b: Quality control

08c: Structural Project documents

Lesson 09: Structural problems in old buildings (rehabilitation)

5. TEACHING-LEARNING METHODOLOGIES

The types of teaching-learning methodologies used are indicated below:

- Lectures
- Guided studies, practical exercises and problem solving
- Independent study/work

- Tutoring, academic monitoring and assessment

6. LEARNING ACTIVITIES

Listed below are the types of learning activities, the number of hours the student will spend on each one and the course policy about the use of artificial intelligence (IA):

Learning activity	Number of hours	Use of IA
Lectures	12.5 h	Allowed
Guided studies, practical exercises and problem solving	62.5 h	Allowed
Presentation of projects	0 h	-
Team work	0h	-
Independent study/work	50 h	Allowed
Tutoring, academic monitoring and assessment	25 h	Allowed
Lab work	0	-
Internships	0	-
TOTAL	**150 h**	

7. ASSESSMENT

Listed below are the assessment systems used and the weight each one carries towards the final course grade:

Assessment system	Weight
Tests (SOIL, FOUNDATIONS AND RETAINING) • Understands the concepts of the mechanical behaviour of soils and foundations. • Understands the particularities of complex foundations and terrain improvements. Is able to organize the process and analyse the dimensioning of the foundation and containment of a structure.	40 %
Course works 1 to 5 (STRUCTURAL AND FOUNDATION DESIGN) • Remembers and applies the structural types to the case study. • Applies correctly the pre-dimensioning criteria of structures. • Creates a valid and coherent design of a structure. • Understands the behaviour of a structure and its dimensioning. • Applies and creates construction details according to the structural typology. • Makes use of the language of representation of concepts and structural elements. Is able to organize and create a structure project.	60 %

When you access the course on the *Campus Virtual*, you'll find a description of the assessment activities you have to complete, as well as the delivery deadline and assessment procedure for each one.

ASSESSMENT OF ACTIVITIES	100%	
1. FOUNDATIONS (Average minimun grade 4'0)	40%	Extraordinary call:
EXAM 1	20%	Extraordinary Exam
EXAM 2	20%	
2. STRUCTURE DESIGN (Average minimun grade 4'0)	60%	
GROUP WORKS (same value)	60%	...Complete or do for Extraordinary call
LABORATORY, VISIT TO SITE	Extra	Can not be recovered

7.1. First exam period

In order to pass the course in the first exam period, you must obtain a grade higher or equal to 5.0 out of 10.0 in the final grade (weighted average) of the course. In addition, you must have a minimum grade of 4.0 out of 10.0 in both parts of the course (Foundations/Structural Design).

7.2. Second exam period

The criteria for passing are the same as in the extraordinary exam: 5 out of 10 in the final grade and 4 out of 10 in each of the parts.
Exams 1 and 2 are grouped together in a single exam. The mark of this new exam replaces the average of the exams during the course (as long as it is higher).
Works 1 to 6 will be handed in again (or completed if they have been started). The mark for each paper handed in will replace the mark obtained during the course (whichever is higher).

8. SCHEDULE

The schedule with the dates of activities in the subject will be included in the Learning Guide uploaded on the Virtual Campus.

This schedule may be subject to changes for logistical reasons relating to the activities. The student will be notified of any change as and when appropriate.

9. BIBLIOGRAPHY

The following bibliography is recommended:

BUILDING CODES

- **Código estructural**. MINISTERIO DE TRANSPORTES, MOVILIDAD Y AGENDA URBANA, 2021.
- **Documento Básico SE-C: Seguridad Estructural, Cimientos**. MINISTERIO DE VIVIENDA, 2006.
- **Documento Básico SE-AE: Seguridad Estructural, Acciones en la edificación**. MINISTERIO DE VIVIENDA, 2006.

BOOKS

- CALAVERA, J. **Cálculo de estructuras de cimentación**. Madrid: Ed. Intemac, 2000.
- CALAVERA, J. **Muros de contención y muros de sótano**. Madrid: Ed. Intemac, 2000.
- CALAVERA, J. **Manual de detalles constructivos en obras de hormigón armado**. Madrid: Ed. Intemac, 2000.
- COSTET, J. y SANGLERAT, G. **Curso práctico de mecánica de suelos**. Barcelona: Ed. Omega, 1975.
- GARCÍA VALCARCE, A., SACRISTÁN FERNANDEZ, J.A. Y OTROS. **Manual de Edificación: Mecánica de los Terrenos y Cimientos**. Navarra: Ed. Departamento de Edificación. ETSA Navarra, 2000.
- GONZÁLEZ CABALLERO, M. **El terreno**. Barcelona: Aula D'Arquitectura / ETSAB. Ediciones UPC, 2001.

- JIMÉNEZ SALAS y otros. **Geotecnia y Cimientos** (3 vol, 4 libros). Madrid: Ed. Rueda. 1º Ed. 1980.
- MATIAS SANCHEZ, A. **Ejercicios resueltos de Geotecnia**. Madrid: Ed. Bellisco, 2008.
- MUZÁS LABAD, F. **Mecánica del Suelo y Cimentaciones** (Vol. I y II). Madrid: Ed. UNED Escuela De La Edificación. 1ª Edición 2007.
- OLMOS MARTÍNEZ P.J. **Cimentaciones Superficiales: diseño de zapatas. Arquitectura**. Manuales y textosuniversitarios. Ed. Universidad de Valladolid, 2003.
- RODRÍGUEZ ORTIZ. **Curso aplicado de Cimentaciones**. Madrid: Ed. Colegio de Arquitectos de Madrid, 1986.
- SUAREZ RIESTRA, F.L. **Estudio Geotécnico y Mecánica de Suelos**. La Coruña: Ed. Consejo Gallego de Colegios de Aparejadores, Arquitectos Técnicos e Ingenieros de la Edificación, 2009.

In the *Campus Virtual* you will find more bibliography available in the libraries of the UEM or the Community of Madrid, as well as references to websites.

10. DIVERSITY MANAGEMENT UNIT

Students with specific learning support needs:

Curricular adaptations and adjustments for students with specific learning support needs, in order to guarantee equal opportunities, will be overseen by the Diversity Management Unit (UAD: Unidad de Atención a la Diversidad).

It is compulsory for this Unit to issue a curricular adaptation/adjustment report, and therefore students with specific learning support needs should contact the Unit at unidad.diversidad@universidadeuropea.es at the beginning of each semester.

11. ONLINE SURVEYS

Your opinion matters!

The Universidad Europea encourages you to participate in several surveys which help identify the strengths and areas we need to improve regarding professors, degree programs and the teaching-learning process.

The surveys will be made available in the “surveys” section in virtual campus or via e-mail.

Your assessment is necessary for us to improve.

Thank you very much for your participation.