Structural Systems (GEA)
Teaching guide 2025-26

INTRODUCTION

The structure is an integral part of the building. An adequate understanding of the resistance mechanisms present in any structure is, therefore, basic. Only then the structure will no longer be an addition but integral to the architectural design. In this course, the student will understand how a structure behaves, and the basic principles of structural design.

- **Degree**: Studies in Architecture
- **Module in the Degree Program**: Technical design. Structures
- **Year**: Second
- **Semester**: Spring
- **Number of credits**: 3 ECTS
- **Type of course**: Required
- **Language**: English
- **Instructors**:
    - Jose Manuel Cabrero, course director (jcabrero@unav.edu)
    - Rufino Goñi
- **Department**: Building Construction, Services and Structures
- **Lecture schedule:** Tuesdays, 15.00-16.45
- **Office Hours:** You may make an appointment as required, here https://meet.boomerangapp.com/jcabrero.unav.es/tutorial

LEARNING OUTCOMES (Competencies)

BASIC COMPETENCES

- BC02 Students must know how to apply their knowledge professionally to their job or career and have the skills that usually demonstrated by writing and supporting their arguments, and problem-solving within their area of study.
- BC04 Students are able to convey information, ideas, problems and solutions to specialist and non-specialist audiences.
- BC05 Students have developed the learning skills necessary to undertake further studies with a high degree of autonomy.

GENERAL COMPETENCES

- GC01 Understand the history and theories of architecture and related arts, technologies and human sciences.
- GC04 Understand the structural, construction and engineering design problems associated with building design as well as the techniques for solving them.
- GC06 Understand the industries, organisations, regulations and procedures involved in translating design concepts into buildings and integrating plans into overall planning.

SPECIFIC COMPETENCES

- SC12 Ability to conceive, calculate, design, integrate into buildings and urban complexes, and execute foundation solutions (T).
- SC13 Ability to apply technical and construction standards.
- SC14 Ability to preserve building structures, foundations and civil engineering works. SC15 Ability to preserve finished works.

- SC17 Ability to conceive, calculate, design, integrate into buildings and urban complexes, and execute building structures (T).
- SC67 Use of English, level B2, to a sufficient level for the scientific and academic terminology typically used in architecture.

PROGRAM

Below you can find the different subjects, described in brief. For a more detailed enumeration, please refer to the Schedule Section.

- Introduction to the concept of stress
  - Stress
  - Type of loads and corresponding stress
- Introduction to structural modelling
- Introduction to structural design
  - Actions, loads
  - Structural requirements (deformation, resistance, stability)
- Structural systems:
  - Behaviour
  - Size estimation
  - Functional footprint

EDUCATIONAL ACTIVITIES

Classroom activities

Most of the course will follow a typical classroom methodology, in which, after the lecture, you work by yourself on the material. Each week, after the lecture, you will be given reference material to read and watch. You must prove your understanding by realising a comprehension test on the given topics, and a weekly assignment,

All the weekly material will be made available in the corresponding section.

Seminar (Required)

The seminars involve related knowledge, which is interesting for the student but which, due to the nature of the activity, is better performed in a different environment. This year, there will be a single seminar, with a duration of 3 hours. The topics will be seismic design and structural software, and we will count on a guest professor.

Seminar date: February 9, 2026.

One-to-one tutorials

Each student may have personal interviews with the professor to help him/her with personal study and learning. You may appoint a one-to-one tutorial through the dedicated link: https://meet.boomerangapp.com/jcabrero.unav.es/tutorial

Personal work

Students must understand themes covered early in the course to be able to comprehend information presented later in the course. They will have to be able to integrate material learned throughout the course. Weekly activities have been devised to help you with this.

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Therefore, they mustn't fall behind and try to set aside regular times outside of class to work on the course material regularly, as described above.

Credits/hours distribution of the activities.

Educational activities	Total hours	
AF1	Attendance and participation in theoretical face-to-face & online classes	15
AF2	Attendance and participation in practical face-to-face & online classes	15
AF3	Carrying out directed work (individual and group)	29
AF5	Participation in tutorials	1
AF6	Study and personal work	15

ASSESSMENT

EVALUATION IN THE ORDINARY CALL

To calculate the final grade, course performance and grading will be determined on the basis of 1004 pts, as follows:

- **Attendance: 99 pt.**
- **Projects: 605 pts.**
- **Exam: 300 pts.**

There are 100 additional points, which will be based on your development of notes and schemas from the covered material (both lectures, videos and readings).

Once the exam has been passed (which means obtaining a grade above 120pts -comparable to 4 over 10-) and all activities have been graded, the instructor may apply a normalization of scores—similar to the technique used in standardized tests such as the SAT, ACT, or GRE—in order to ensure that, regardless of the difficulty of the assignments or the strictness of the grading, students' scores are mapped into a compatible and fair range.

There's a **common graded activity with Taller de Proyectos 2 (275 pts, i**n the projects section). **If you are not enrolled at Taller de Proyectos 2,** you will be given two alternatives (see corresponding section below).

All students, independently of their actual examination period, are expected to attend the lectures as regular students. There are no alternative paths to pass the course during the examination period, apart from that mentioned for those students not enrolled at Taller de Proyectos 2.

Attendance & participation: 99 pts.

Each week, during the lecture we will carry out a **wooclap test** to promote your active participation and improve your understanding of the explained material.

Your grade in this part will be based on:

- the correct answers to the first 5 questions, which will cover previous material: **45 pts** *(5 pts x 9 sessions)*
- the total number of answered questions (no matter if right or wrong) of the remaining questions (used as an icebreaker during the lecture): **54 pts** *(6 pts x 9 sessions)*

Projects (assignments): 605 pts.

The projects introduce you to the role of structural design in architecture. Altogether encompass a holistic view of the covered topics and their actual relation and interest for architects. On some occasions, they will be done in collaboration with other subjects from the second year of the degree. If you are not enrolled in the other subject, you will be provided with an alternative task.

This part comprises three different activities:

- **Weekly comprehension tests: 90 pts.** *(10 pts x 9 tests)*
  - These weekly tests help you to study the material of the course. They will be done within Aula Virtual.
  - **Due date: before the following lecture.**
- **Weekly challenges: 90 pts.** *(10 pts x 9 tests)*
  - The weekly challenge will ask you to apply the developed knowledge to a particular situation. It will consist on a very brief activity.
  - **Due date: before the following lecture.**
- **Spaghetti structure: 150 pts.**
  - Within this assignment, you will build your first structure ever with spaghetti, and you will submit it to an earthquake. This activity will allow you to take part in a national competition for spaghetti structures.
  - **Due date: March 20, 2026.**
  - **Competition date: a Saturday in April, 2026** *(it will be held at the School of Architecture).*
- **Design the structure. Structural concept and architectural integration: 275 pts.**
  - There's no building without structure. You are asked to design a building, in which the structural design will play a key role in the architectural concept.
  - This is a common graded activity with **Taller de Proyectos II.** This last project will correspond to the last design made in Taller de Proyectos II.
  - If you are not enrolled at Taller de Proyectos II, you will develop either an alternative assignment accounting for the same value or the value of your exam will be increased by the same quantity.
  - **Due date: April 30, 2026.**

Any late submission will be automatically zero-graded (0 pts).

Exam: 300 pts.

You will be asked about structural terms in English, and your understanding of structural systems applied to buildings. All the questions will be related to the material covered in lectures, class discussions, and projects.

The exam will consist of a test, comprised of 60 questions (5 pts. each; 5 pts x 60 questions), on the following topics:

- structural terms (and their translation into Spanish);
- application of concepts of structural design;
- load assessment;
- structural system of a building, namely:
  - the type of structural system,
  - loads to be considered in the structural design,
  - load path of the vertical loads,
  - lateral stability,
  - design issues.

To pass the course, it is **compulsory both** to answer the exam and obtain a **minimum grade of 4 over 10 (that is, 120 pts).** If you do not, you will fail in May and will have to attend the exam in June.

The exam will be held on **April 14, 2026, during the lecture hours (3 pm-5 pm).**

Additional activity (+ 99 pts.)

Additionally, there's the possibility of obtaining 99 extra points. These points will be awarded by submitting photographs or scans of your handwritten notes and schemas of both the lectures and the course material (videos and readings).

There will be 9 possible submissions for each course week, adding up to a total of **99 points** (*11 points x 9 sessions).*

Students with special learning needs

Accommodation will be provided for students with special learning needs, either regarding the methodology and/or evaluation of the course, but they will be expected to fulfil all course objectives.

Students not enrolled at Taller de Proyectos 2

You will be given an alternative assignment instead of the common activity with Taller de Proyectos 2, accounting for the same amount of 275 pts. You will be asked in advance to either

- develop an **alternative assignment**, with the same amount of points as the common activity (275 pts), or
- add 275 pts to the **exam**, so the exam value will be 575 pts.

Criteria to pass the ordinary call

The course will be graded over 10, as it is the standard in Spain. The conversion from the 1004 points is straightforward, you just divide by 100 your punctuation.

If the **exam has been passed** (which means obtaining a *grade above 120pts -comparable to 4 over 10-*), the instructor may apply a **normalization of scores**—similar to the technique used in standardized tests such as the SAT, ACT, or GRE—in order to ensure that, regardless of the difficulty of the assignments or the strictness of the grading, students' scores are mapped into a compatible and fair range.

Students whose final grade is 5 or more *(500 pts or more)* will pass the course.

Students whose final grade is below 5 *(less than 500 points)* will not pass the course and will be graded as *Suspenso.*

Students who do not take the final exam will not pass the course and will be graded as *No presentado.*

EVALUATION OF THE EXTRAORDINARY CALL

For those students who do not pass the course in May (grades *Suspenso* or *No presentado*) there will be an additional re-sit exam (similar to that in the ordinary call) in June which will account for 100% of the final grade.

Be aware that only the exam grade will be taken into consideration.

As stated in the General Evaluation Regulations of the University of Navarra approved in May 2019, *"Students who request it may be evaluated in the re-sit examination call, even if they have passed the course. To do this they must request to be included at least five days before the start of the exam period of that call. The final grade of the subject will be that of the extraordinary call, even if it is lower than the one obtained previously "* Therefore, the grade obtained in the extraordinary call will be the valid one, regardless of that obtained in the ordinary call, even the student may not pass the subject if he or she fails to attend.

Summary

ASSESSMENT SYSTEMS	
Attendance and participation in lectures, practices, and lectures	10%
Individual and team practical assignments	60%
Exams (partial and final)	30%

OFFICE HOURS

Prof. Jose M. Cabrero (jcabrero@unav.edu)

- Office A1112. School of Architecture.
- You may appoint a one-to-one tutorial through the dedicated link below.
  https://meet.boomerangapp.com/jcabrero.unav.es/tutorial

BIBLIOGRAPHY AND RESOURCES

Textbook

- **Structure systems.** *Heino Engel.*
  - Find it in the library (only available in Spanish/Portuguese)
- **Building structures. Understanding the basics.** *Malcolm Millais (*Routledge, 3rd edition, 2017)
  - Read on line

Additional readings

- Schodek. **Structures.** It is one of the most classical and considered textbooks on the subject. It has been the course textbook in past years.
  - Find it in the library
- Allen and Zalewski. **Form and forces: designing efficient, expressive structures.** John Wiley and Sons, 2010.
  - Find it in the library
- Levy and Salvadori. **Why buildings fall down.** Norton, 2002.
  - Find it in the library
- Salvadori **Why buildings stand up.** Norton & company, 2002.
- Salvadori and Heller. **Estructuras para Arquitectos.** 1991.
  - Find it in the library
- Torroja. **Razón y Ser de los Tipos Estructurales.** C.S.I.C., 1991
  - Find it in the library

Software

- https://www.easyciv.com/EasyCivApp.html