Universidad de Navarra

Structural Design (GEA)
Teaching guide 2026-27

INTRODUCTION

Course description:

This final course provides students with an insight into the fundamentals of structural design and analysis. The student will be taught structural modelling and structural checks using a commercial software package (AutoDesk Robot).

- Basics of structural analysis software;
- Basics of matrix analysis;
- Structural modelling with structural software (AutoDesk Robot);
- Basics of timber structural design.

- **Degree**: Studies in Architecture
- **Module in the Degree Program**: Intensification on Technical Management.
- **Number of credits**: 4,5 ECTS
- **Year**: Fifth, winter semester
- **Type of course**: Elective
- **Instructors**:
  - Jose Manuel Cabrero, course director (jcabrero@unav.edu)
  - Wen-Shao Chang, invited professor. Lincoln University
- **Language**: English
- **Department**: Building Construction, Services and Structures
- **Lecture schedule:** Mondays, 15-18 h, Aula 2 *(there's an intensive initial workshop from Monday, September 28 to Thursday, October 1. It will be held in Aula 2: Monday and Tuesday in the afternoons, from 15-18h; Wednesday, 11-14h; Thursday, 9-12h)*

LEARNING OUTCOMES (Competencies)

BASIC COMPETENCIES

- **BC02** Students must know how to apply their knowledge professionally to their job or career and have the skills that are 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 COMPETENCIES

- **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 COMPETENCIES

- **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.

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PROGRAM

The course introduces you to structural design assisted by structural analysis software. We use Dlubal RFEM 6, which you may obtain free of charge through the Dlubal Education portal.

You will first take a four-day intensive workshop on the software (28 September – 1 October). After that, lectures follow a regular schedule. Each lecture is typically followed by its application in the software.

The main topics are:

MODULE 1: Structural design with structural analysis software

- Theory:
  - Modelling basics: 2D members
  - 3D geometry and load combinations
  - Steel element checks: necessary data and procedure
  - Timber properties. Differences from steel and concrete
  - Timber element checks: necessary data and procedure
  - Concrete element checks: necessary data and procedure
  - Documentation of results
- Practice:
  - Beam, portal frame and plane truss (Day 1)
  - 3D model and load combinations (Day 2)
  - Steel and timber member design (Day 3)
  - Concrete member design and documentation (Day 4)

MODULE 2: Basics of structural analysis

- Theory:
  - Matrix structural analysis: truss, beam and frame elements (direct stiffness method)
  - Geometric non-linear analysis (2nd-order analysis, P-delta effect)
  - Design standards: how the Eurocodes are organised and used
- Practice:
  - Application of matrix concepts in RFEM: trusses, beams and 2D frames (01/03)
  - Non-linear analysis in RFEM. Comparison to linear analysis (02/03)
  - Use of the design standards in the project (03/03)

MODULE 3: Structural analysis project

- Project in pairs: topic proposal, preliminary analysis, review and final presentation
- Lectures by guest speakers from engineering offices [TBC]

EDUCATIONAL ACTIVITIES

Structure of the course

You will be given an intensive **Workshop on Autodesk Robot and structural modelling** on the use of the software's basic concepts in late September. The dates will be in the week from ***Monday, September 28, til Thursday, October 1.***

After that, we will have lectures on a regular schedule. Lectures will usually consist of a talk followed by an application to the software.

In the final weeks, while you are developing your project, you will be able to meet with the professors for tutorials at designated times.

Educational activities	Total hours	
AF1	Attendance and participation in theoretical face-to-face & online classes	22.5
AF2	Attendance and participation in practical face-to-face & online classes	22.5
AF3	Carrying out directed work (individual and group)	45
AF5	Participation in tutorials	0.5
AF6	Study and personal work	22

ASSESSMENT

EVALUATION OF THE ORDINARY CALL

To calculate the final grade, course performance and grading will be determined as follows:

Weekly assignments and project (80% +10%)

Weekly assignment (30%)

During the first weeks (Modules 1 & 2) you will be given learn the basics of the structural modeling by means of different assignments (typically, one each week) You will have the opportunity to discuss them on the online sessions, before submission.

These weekly assignments will count for 20% of your final grade.

Project (60% + 10% -oral presentation-)

During the last weeks of the course, you will choose your own project to develop in pairs. The theme must be agreed upon in advance with the course professors. Some possible ideas are the structural design of your Design Studio assignment, the analysis of the structural system of an existing building, comparison of alternative structural designs (materials, system) for a given building.

This is a compulsory activity. You will not pass the course if you do not fulfil it.

The project will count 60% of your grade.

You will present your project in the last course session, and this presentation will count within your grading (10%).

Attendance in lectures (10%)

You must attend at least 80% of the face-to-face activities. If you are exempted, you will be given an alternative way to follow the course while you cannot come. There'll be a short question at the beginning of the lectures, to verify your progress and grade this part.

Exams

There are no exams in this course.

ASSESSMENT SYSTEMS	
Attendance and participation in lectures, practices, and lectures	10%
Individual and team practical assignments	80%
Oral defence of the project	10%
Exams (partial and final)	0%

EVALUATION OF THE EXTRAORDINARY CALL

For those who do not pass the course, did not present the project, or did not attend at least 80% of the face-to-face sessions (grades *Suspenso* or *No presentado*) there will be **NO extraordinary exam in June.**

They will have to prepare a new project, which will be assigned by the professors in due time, and it will count as 100% of the grade.

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.

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.

OFFICE HOURS

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

- Office A1112. School of Architecture.

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BIBLIOGRAPHY AND RESOURCES

Matrix Analysis of Structures:

- Sennet, R. E. Matrix analysis of structures. Prentice Hall, 1994 Localízalo en la Biblioteca
- McGuire W., Gallagher R.H., Ziemian R. D. Matrix structural analysis. Wiley, 1999 Localízalo en la Biblioteca
- Sack, R. L. Matrix structural analysis. PWS-Kent Pub. Co., 1989. Localízalo en la Biblioteca

Design Standards

- Eurocode 2: Design of Concrete Structures
- Eurocode 3. Design of Steel Structures
- Eurocode 5: Design of Timber Structures

Timber Structural Design

- Blaß, H.J; Sandhaas, C. Timber Engineering - Principles for Design, 2017. Download it here.
- Wood Handbook, Wood as an Engineering Material, 2010. Download it here

Software

- AutoDesk ROBOT Structural Analysis Professional. Available free for download and installation at the AutoDesk Student Community

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