Universidad de Navarra

***Management in digital prototyping (GEA)***

*Guía docente 2026-27*

**INTRODUCTION**

Architects of today navigate dual realms – the tangible world of the conventional-physical and the immersive dimension of the virtual. In architectural design and artistry, these spheres seamlessly blend, allowing for flexibility and creativity. Virtual reality has emerged as a powerful tool, often born of intricate computations, capable of addressing needs in the real world.

In parallel with Virtual and Augmented Reality, Artificial Intelligence (AI) has become an emerging instrument for the generation of image, concept, and form. Within architectural design, AI models expand the range of imagination, enabling designers to explore unprecedented formal, material, and conceptual scenarios. In this course, AI is understood not as a substitute for creativity but as an augmentative and critical tool—a new layer in the evolving dialogue between human intention and computational possibility.

The collaborative effort of CAD (Computer Aided Design) and CAM (Computer Aided Manufacturing) forms the cornerstone of modern industrial processes. These tools, including 3D printing, laser cutting, CNC, cutting plotter, mechanical arm, drones, etc., are multiplying and growing in their potential.

One groundbreaking example of these evolving technologies is the construction technique utilizing drones for stacking elements, which will undoubtedly become standard in the future. An illustrative study on drone-based Additive Manufacturing of Architectural Structures by MIT + UCL research group exemplifies this. Similarly, 3D printing through drones is explored in the project led by Robert Stuart Smith of AA DRL.

Modern product manufacturing necessitates the preliminary creation of virtual models for trial and testing purposes. BIM models, for instance, are a reflection of this technique. Sometimes, the virtual model becomes the final product, as seen in video games.

Absolute control over form in computational design is vital for these technological advancements. An approximate or imperfect form does not suffice. Virtual reality, underpinned by numerical codes, demands a precise form-code translation via a logical-mathematical process. The emergence of computational processes pertaining to iteration and recursion presents a new paradigm in architecture, design, and art.

**PREREQUISITES**

This course does not necessitate a specific disciplinary background. However, a solid general academic foundation and academic skills, such as synthesis, analysis, and comparison, will be instrumental. The ability to critically absorb academic material is also essential.

The course assumes a foundational understanding of contemporary issues and modern architectural history. A keen interest in digital design and fabrication, and basic competencies in oral and written communication are also expected. The course requires students to conduct independent research and produce high-quality academic projects.

**COURSE REQUIREMENTS**

Attendance and Participation

Full attendance is mandatory. Unexcused absences will affect the final grade. Participation grades will reflect the student's continuous engagement in class activities, reinforced by the timely completion of course readings.

**COURSE READINGS**

Students will receive a series of readings prior to seminars. Each seminar will include student-led presentations on the assigned readings.

Universidad de Navarra

**CREDITS**

This course holds a value of 4.5 ECTS credits. Course Semester: 1st Semester Instruction Language: English, Spanish

**FACULTY**

Course Coordinator: Fernando Alonso Faculty: Adam Jorquera, Fernando Alonso

# 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.

**SPECIFIC COMPETENCES**

**SC01** Ability to apply graphic procedures when representing spaces and objects (T).

**SC02** Ability to conceive and represent the visual attributes of objects and good mastery of proportion and drawing techniques, including computer techniques (T).

**SC67** Use of English, level B2, to a sufficient level for the scientific and academic terminology typically used in architecture.

**COURSE AIMS, OBJECTIVES, AND PROCEDURES**

This course is designed to acquaint students with key concepts and methodologies vital to the creation of modern prototypes. The central focus will be on understanding and applying additive manufacturing techniques for physical prototype production in the realm of architecture. Additive manufacturing, a robust and direct tool for design and innovation, enables rapid prototyping. We will explore and enhance skills required for prototype development via the iterative work process. Iteration and recursion are foundational mechanisms facilitating the generation and selection of an array of models, leading to the final solution.

Alongside additive manufacturing and parametric modeling, the course integrates AI-based generative workflows for conceptual and formal exploration. Students will experiment with diffusion models and image-to-form translation as part of the design process, reflecting on the ethical, aesthetic, and disciplinary implications of algorithmic creativity.

This part of the course draws on the instructor’s own research on architectural representation as mediation (Alonso Pedrero, Roquette and Naya, 2025). Students examine how digital fabrication, parametric modelling, BIM and generative AI have redefined the role of representation in design, from a means of projecting a finished object to a mediating environment that structures and

anticipates decisions. The course adopts the critical stance of that research: these tools are approached as amplifiers of architectural imagination, not as substitutes for it, and students are asked to identify, in their own prototyping work, the risks of standardisation and loss of critical agency that the article describes, balancing technical precision with symbolic and aesthetic criteria and with the experience of the user.

The course aims for a comprehensive understanding of the primary 3D printing technologies and their associated materials. It emphasizes a practical grasp of these technologies' mechanical properties and geometric limitations. Students will learn to operate and maintain printers autonomously, to apply finishing techniques and post-process parts, and familiarize themselves with the rules and regulations for preparing files for each technology and specific material production.

The course incorporates a collaborative project where students will design an artistic installation grounded in a contemporary concept. Digital printing will serve as a means of creating joints for large-scale precast elements, envisioning joints as both static elements and dynamic components like gears, hinges, and flexible joints. This inventive use of 3D printing is supplemented by specific exercises to hone software skills, utilizing Rhinoceros + Grashopper and Fusion 360.

Our teaching methodology fosters architectural research and knowledge production that will find its practical application in the 'prototype project.' Here, students will employ 3D-printing digital model making to design and fabricate a prototype matrix, reflecting its evolution through a similar taxonomic approach.

The course will pay particular attention to the following areas:

Theoretical Knowledge

# Encouraging critical thinking in the development of structures and concepts in contemporary architecture.

# Fostering critical analysis of the construction and building limitations of Computer Aided Manufacturing.

Practical Knowledge

# Offering an overview of the operational and managerial aspects of major 3D printing technologies.

# Imparting understanding of the benefits and limitations of each technology.

# Explaining the norms and rules for designing and preparing files for 3D printing in each technology.

# Providing tools to assist students in selecting the most appropriate technology for each phase and project.

**I. IN-CLASS ACTIVITIES**

Lectures

The instructor will deliver lectures based on the course syllabus using various pedagogical tools such as the blackboard, PowerPoint presentations, videos, and animations. After each lecture, the instructor will upload the PowerPoint presentation, notes for each topic, and recommendations for further reading on the ADI platform.

Seminars (Mandatory)

Seminars will encompass:

The professor and peers addressing students' questions.

The professor presenting contemporary scientific issues pertinent to the course.

Students delivering oral presentations on topics suggested by the professor. The class will be divided into groups of five students each. Each group will present a 7-10 minute talk, followed by a Q&A session.

One-to-one Consultations

Students can schedule individual meetings with the professor for personalized guidance with study and learning.

Assessments

Examinations will be conducted to gauge the successful attainment of course objectives.

**II. INDEPENDENT STUDY**

For students to grasp subsequent material, it is crucial to understand early course topics and integrate knowledge gained throughout the course. Hence, students should ensure they are up-to-date with the course material and allocate regular study times outside of class.

Students must familiarize themselves with the assigned reading for a topic before the corresponding lecture. This preparation will maximize learning during the lecture.

Students should engage in self-study using the professor’s notes, lecture notes, and recommended textbooks if required.

Students will prepare oral presentations in English.

ACTIVITY BREAKDOWN (4,5 ECTS = 112,5 hours, 25 hours/ECTS)

Lectures: 1 ECTS, 25 hours, 26.7%

Seminars: 0.2 ECTS, 5 hours, 10.0%

Evaluation/Assessments: 0.08 ECTS, 2 hours, 2.6%

Total In-Class Activities: 1.28 ECTS, 32 hours, 39.3%

One-to-one Consultations: 0.04 ECTS, 1 hour, 0.7%

Independent Study: 2.5 ECTS, 62.5 hours, 60.0%

Universidad de Navarra

Total Course Commitment: 4.5 ECTS, 112,5 hours, 100%

**Assessment and Evaluation**

The final course grade will be calculated based on the following components:

Attendance and Participation: 10%

Exercises and Submissions: 40%

Project Prototype Design for 'Joints Installation': 50%

Each seminar will be evaluated considering the content of the oral presentation as well as the students' English communication skills. Evaluation criteria will be posted on ADI in advance.

The concluding Jury session will be on X November. For those interested in improving their final grade, an optional essay question will be available during the final exam. This question will derive from recommended readings and has the potential to boost the final score by up to one point.

**Passing Criteria**

A minimum score of 5 points is required to pass the course. Those scoring below 5 points will receive a grade of 'Suspenso' (Fail). Absence from the final exam will result in a grade of 'No presentado' (Not Presented).

**Exam Review**

After the announcement of grades, students will have the opportunity to review their exams during a one-on-one session with the professor. The specific date and location will be communicated in due course.

**Special Assessment for Resit Exams**

For those who do not pass the course in May or fail to appear for the exam (graded 'Suspenso' or 'No presentado'), a resit opportunity will be provided in June. This typically involves enhancing and refining the projects undertaken during the semester.

**Accommodation for Students with Special Learning Needs**

We are committed to providing equal opportunities for all students. Students with special learning needs can expect accommodations concerning course methodology and/or evaluation. However, they will still be required to meet all course objectives. Please communicate your specific needs to the professor at the start of the course to arrange suitable accommodations.

**HORARIOS DE ATENCIÓN**

**Dr Fernando Alonso Pedrero falonsop@unav.es**

- Despacho B2 Edificio Arquitectura. Planta 2
- Horario de tutoria: Concertar Cita Previa.

**BIBLIOGRAPHY**

BOOK CHAPTERS


1. Aureli, P.V. "The Geopolitics of the Ideal Villa" in The Possibility of an Absolute Architecture. Find it in the Library Electrnic Version Find it in print version
2. Borges, J.L. "The Analytical Language of John Wilkins" in Other Inquisitions. Find it in the Library (Spanish version)
3. Forty, A. "Type" in Words and Buildings: A Vocabulary of Modern Architecture. Find it in the library
4. Foucault, M. "Preface" and "Classification" in The Order of Things: An Archaeology of the Human Sciences. Find it in the Library (Spanish version)
5. Mertins, D. "Same Difference" in Modernity Unbound.Find it in the Library
6. Quatremere de Quincy, A. "Type" in Hays, M. (ed.) Oppositions Reader Selected Readings from a Journal for Ideas and Criticism in Architecture 1973-1984. Find it in the Library
7. Tafuri, M. "Science, Politics, and Architecture. Advancements and Resistance in Venice During the Sixteenth Century." in Venice and the Renaissance.Find it in the Library


JOURNAL ARTICLES


1. Celedón, A. "Gabinetes de la Ciudad." Revista 180, 36, 42-47. Find it in the Library
2. Moneo, R. "On Typology." Oppositions, 13, 23-31. (1978) Find it in the Library
3. Olóriz, C. "The Unique Standard." Catwalk: The Journal of Fashion, Beauty and Style, 3, 2, 47-70.
4. Vidler, A. "The Idea of Type: The Transformation of the Academic Idea, 1750-1830." Oppositions, 8, 95-111.(1977) Find it in the Library
5. Vidler, A. "The Production of Types." Oppositions, 8, 93. (1977) Find it in the Library
6. Special Issue: Typological Urbanism: Projective Cities. Architectural Design. Volume 81, Issue 1.(2011) Find it in the Library
7. Alonso Pedrero, F.M., Roquette Rodríguez-Villamil, J.L. and Naya Villaverde, C. “Representación como mediación en arquitectura. Liturgias del proyecto, aggiornamento de la disciplina y comprensión espacial.” EGA Revista de Expresión Gráfica Arquitectónica, 30 (55), 82–97 (2025). doi:10.4995/ega.2025.23995. Open access copy: https://hdl.handle.net/10171/120257 Find it in the Library


BOOKS


1. Carpo, M. Architecture in the Age of Printing. [Find it in the Library electronic version Find it in the Library print version
2. Carpo, M. The Alphabet and the Algorithm. Find it in the Library electronic and print version
3. Didi-Huberman, G. (2011). Atlas. How to Carry the World on One’s Back?
4. Durand, J.N.L. Recueil et Parallèle des edifices de tout genre anciens et modernes remarquables par leur beauté, par leur grandeur ou par leur singularité et dessinés sur une même échelle. Find it in the Library
5. Foreign Office Architects. Phylogenesis: Foa’s Ark. Find it in the Library
6. Goethe, J.W. The Metamorphosis of Plants. Find it in the Library electronic version
7. Maki, F. Collective Form. https://openscholarship.wustl.edu/books/61/


DESIGN THESIS AND VIDEOS

1. Core 1 - Sally, Yorgos, Katya, Cesa
2. AA Em-Tech Biomimetics
3. Itech 2017 - University of Stuttgart Tailoring Self-Formation
4. Textile Hybrid M1: La Tour de l’Architecte
5. Self-assembly lab - MIT Active Shoes
6. Programmable Textiles
7. Iaac Fabricflation
8. KADK Simulating Textile Hybrid Structures

Universidad de Navarra

Please note that all the materials listed in the bibliography are suggested as resources for further reading and deeper understanding of the course topics. They are not mandatory but are highly recommended for students aiming to excel in the course. The availability of the resources in the library is indicated with a "[Library Access]" tag.