



Course guide

210350 - CF - Form Finding

Last modified: 16/06/2025

Unit in charge: Barcelona School of Architecture
Teaching unit: 752 - RA - Departamento de Representación Arquitectónica.
Degree: DEGREE IN ARCHITECTURE STUDIES (Syllabus 2014). (Optional subject).
Academic year: 2025 **ECTS Credits:** 3.0 **Languages:** Catalan, Spanish, English

LECTURER

Coordinating lecturer:

Others: Segon quadrimestre:
MARILENA CHRISTODOULOU - 2SM
LUIS GIMÉNEZ MATEU - 2SM

TEACHING METHODOLOGY

The course methodology combines active learning, physical experimentation, and computational design through a progressive structure divided into three main phases.

Learning by doing (hands-on experimentation):

In the first phase, students work in groups conducting physical experiments using traditional form-finding techniques. Direct observation, material manipulation, and empirical analysis form the foundation for understanding structural and geometric principles.

Critical analysis and case studies:

In parallel, students analyze relevant architectural projects through case studies. This approach bridges theory and practice, encouraging critical thinking, technical documentation, and structural awareness.

Transfer to digital environments:

In the second phase, students use digital tools such as Rhino and Grasshopper to digitize, replicate, and optimize the physical forms. This stage combines lectures, technical tutorials, and practical exercises to build proficiency in parametric design.

Development of a final project:

In the final phase, students integrate physical and digital knowledge into a conceptual architectural proposal. This synthesis encourages skills in representation, technical justification, and formal design.

Collaborative work and critical reflection:

Group work, interim presentations, collective critiques, and open discussions promote peer learning, defensible design choices, and improvement through dialogue.

This methodology supports transversal and experimental learning, reinforcing the connection between structural logic, formal creativity, and intelligent use of digital tools.



LEARNING OBJECTIVES OF THE SUBJECT

The course aims to introduce students to the process of parametric design through physical models and the use of visual programming.

The specific objectives are as follows:

- **Manipulation of dynamic geometries:** Students will learn to create both physical and digital models in which modifying a single parameter (such as an angle, radius, or length) changes the entire system. This allows them to explore geometric principles in an interactive way.
- **Connecting theory with real-world applications:** Students will apply geometric theories learned in previous courses to real architectural examples. Concepts such as rotation, scaling, symmetry, or three-dimensional intersections will be incorporated using parametric design tools such as Grasshopper and Rhino, within flexible and practical frameworks.
- **Stimulating creativity through algorithmic thinking:** Through parameter-based experimentation, students will discover new dimensions of creativity, helping them overcome the fear of the "blank page." They will be encouraged to explore a broader range of formal possibilities using controlled algorithms.
- **Mathematical and algorithmic foundations:** Students will gain a basic understanding of algorithmic thinking alongside traditional mathematical concepts. This will allow them to become familiar with visual programming and the creation of simple scripts. Visual programming platforms, by enabling the manipulation of graphic elements rather than relying solely on text, broaden the scope for design and experimentation.

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	40.00
Self study	45,0	60.00

Total learning time: 75 h

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Introductory Workshop on the Form-Finding Technique

Description:

In the first phase of the course, and during the first three weeks, students will carry out a series of physical experiments using form-finding techniques. The strategies they may apply include minimal surfaces, pneumatic structures, catenaries, or thrust surfaces.

Students will work in groups. Each group will begin by creating a cube (benchmark), which will serve as the foundation for a series of tests. This benchmark plays a fundamental role by enabling a systematic approach to experimentation. It acts as a control mechanism to understand the principles that govern the self-organization of materials.

In addition, it allows for detailed geometric analysis, which will support further experimentation and encourage exploration through the use of advanced digital tools introduced later in the course.

During these first three weeks, students must document and catalog their models through rigorous photography, including plan and elevation views.

Full-or-part-time: 1h

Practical classes: 1h

Architectural Case Study

Description:

During the first two weeks, in order to engage students and help them better understand the logic of architectural systems and the course objectives, students will conduct a case study of a building that shows significant interest in its generative design process or structural behavior.

The selected case must relate to the principles and methodologies explored in the course. This project will involve a focused research study, accompanied by an in-depth analysis of the building's construction and structural systems.

Students will explore various aspects, including the logic behind the design and construction process, the formalization of ideas, fabrication techniques, and implementation strategies. The analysis will also emphasize key factors such as structural efficiency, material lightness, resource optimization, and overall sustainability.

Examples of case study analyses:

- Eden Project. Nick Grimshaw, Anthony Hunt
- Multihalle Mannheim. Frei Otto
- Olympic Stadium Beijing 2006. Herzog & de Meuron
- Olympic Stadium Munich. Günter Behnisch, Frei Otto
- Exhibition Hall Turin and Aula Paolo VI. Pier Luigi Nervi
- River Basento Bridge. Sergio Musmeci

Full-or-part-time: 1h

Self study : 1h

Digital Parameterization of Geometries

Description:

Students will learn to parameterize dynamic geometries using Grasshopper's native tools in combination with the Kangaroo plugin, introducing real-time physical simulations into the design process. This approach merges geometric logic with physical behavior to build parametric models that respond to forces, constraints, and optimization goals.

They will construct systems that incorporate form-finding processes through algorithms that simulate physical behaviors such as catenary curvature, tensioned surfaces, mesh structures, and equilibrium force distribution. Kangaroo allows real-time visualization and adjustment of form, enabling students to better understand the interaction between geometry and physics.

Key variables such as point distribution, internal tension, and geometric relationships will be explored using planes, vectors, and constraint systems. This method provides insight into both the mathematical structure and the physical logic behind complex forms.

Through hands-on exercises—such as generating active catenaries, equilibrium membranes, or relaxed structural meshes—students will gain skills in constructing and optimizing parametrized geometries that meet specific structural and design criteria. The integration of Kangaroo enhances understanding of physical and geometric behavior and prepares students to tackle advanced design challenges with a rigorous computational mindset.

Full-or-part-time: 1h

Laboratory classes: 1h

GRADING SYSTEM

The course follows a continuous assessment model, in which students are evaluated through their ongoing work across the three course phases. Assessment will be based on the timely submission of assignments, physical and digital models, and written and/or oral presentations, in accordance with the schedule and criteria defined by the teaching staff.

If a student does not achieve a positive result through continuous assessment, a final assessment may be offered. This will consist of a comprehensive evaluation (oral and/or written) and/or the submission of a final integrated assignment, as determined by the course instructors.

Participation, regular attendance, punctuality, and engagement in class discussions are evaluated and contribute to the final evaluation. The assessment criteria equally weigh conceptual development, technical process and communication, and attitude and involvement throughout the course.

BIBLIOGRAPHY

Basic:

- Burry, Jane, and Mark Burry. The New Mathematics of Architecture. London: Thames & Hudson, 2010. ISBN 9780500342640.
- Burry, Mark. Scripting Cultures: Architectural Design and Programming. Chichester: Wiley, 2011.
- Hensel, Michael, Achim Menges, and Michael Weinstock. Emergent Technologies and Design: Towards a Biological Paradigm for Architecture. Oxon, New York: Routledge, 2010. ISBN 9780415493437.
- Johnson, S. Emergence: The connected lives of ants, brains, cities, and software. Simon and Schuster, 2002. ISBN 0684868768.
- Menges, Achim, and Sean Ahlquist. Computational Design Thinking. Chichester: John Wiley & Sons, 2011. ISBN 9780470665657.
- Taylor, M.C.. The Moment of Complexity Emerging Network Culture, Culture. Chicago: The University of Chicago Press, 2003.

Complementary:

- Jabi, Wassim. Parametric Design for Architecture. London: Laurence King, 2013. ISBN 9781780673141.
- Menges, Achim. "Material Computation: Higher Integration in Morphogenetic Design". Architectural design. 2012-03, Vol.82 (2), p.14-21.
- Peters, Brady, and Xavier De Kestelier. Computation Works: The Building of Algorithmic Thought. Chichester: Wiley, 2013.
- Peters, Brady. Inside Smartgeometry: Expanding the Architectural Possibilities of Computational Design. Chichester: Wiley, 2013. ISBN 9781118522479.
- Pottmann, Helmut, and Daryl Bentley. Architectural Geometry. Exton: Bentley Institute, 2007. ISBN 9781934493045.

RESOURCES

Other resources:

- Arturo Tedeschi (2014). AAD_Algorithms-Aided Design - ISBN 978-88-95315-30-0
- Issa, R. (2010). Essential Mathematics for computational design. Lulu. com.
- Khabazi, Z. (2011). Generative algorithms. Accessed on, 3.
- McNeel B., Davidson S., The Grasshopper Primer, V3.3