CONSTRUCTION SYSTEMS AND APPLICATIONS 4

IE University
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Academic year: 22-23
Degree course: FOURTH
Semester: 1º
Category: COMPULSORY
Number of credits: 6.0
Language: English

PREREQUISITES
Construction Systems earlier modules.

SUBJECT DESCRIPTION
Construction Systems and Applications 4 will complement earlier modules by proposing an integrated approach to the design of construction systems with sustainability at the core. The module will review the principles of sustainability and how they relate to the built environment, and will establish links with the materiality of architectural design. The course will expand earlier contents by considering other construction materials and typologies, with a particular focus on traditional construction and natural materials. Context-based design will be explored through the study of construction solutions throughout the globe and for a diversity of socio-economic contexts. A critical approach to sustainability will be fostered through group and individual research.

The core learning objectives are:
- Develop critical thinking: what is sustainability and how does it apply to building design?
- Explore diverse ways of building, through traditional and historic construction to modern and alternative systems.
- Skill up on the design of effective details to support the material and environmental sustainability of construction.

OBJECTIVES AND SKILLS
(per Ministerial Decree EDU/2075/2010, 29 of July; and the official accreditation request for the Bachelor in Architectural Studies, July 2015; see BOCYL, 14 March p. 10477-10481.)

2.1-BASIC AND GENERAL OBJECTIVES
- CB1: Students have demonstrated knowledge and an understanding of a given area of study, building upon the foundation of secondary education, supported by advanced texts, and including aspects that engage the latest advances in their area of study.
- CB2: Students know how to apply their knowledge professionally to their work or vocation and possess the competencies that are often demonstrated through elaboration and defense of arguments and the resolution of problems within their area of study.
- CB3: Students can gather and interpret relevant facts (usually within their area of study) in order to make judgments that include reflection on relevant social, scientific, and ethical topics.
- CB4: Students can transmit information, ideas, problems, and solutions to both specialized and non-specialized audiences.
- CB5: Students have developed the necessary learning skills to continue their studies with a high degree of autonomy.
- CG4: An understanding of the fundamental issues in structural design, construction, and engineering as related to building projects, as well as the techniques used to address these issues.
- CG5: Knowledge of the issues related to building physics, technologies, and programmatic uses, in order to create buildings that provide internal comfort and protection from the elements.
- CG6: Knowledge of the industries, organizations, regulations, and procedures needed in order to transform projects into buildings, and to integrate drawings into the planning process.

2.2-SPECIFIC COMPETENCIES
- Module: Technical Subject: Construction
  - CE18: Capacity to develop, calculate, design, and execute interior partitions, carpentry, stairs and other finished work, and to integrate them into buildings and urban complexes (Workshop Format).
  - CE19: Capacity to develop, calculate, design, and execute enclosure systems, roofs/coverings, and other structural work, and to integrate them into buildings and urban complexes (Workshop Format).
  - CE26: Adequate knowledge of the physical and chemical characteristics of the production process, building pathology, and use of building materials.

2.3-TRANSVERSE COMPETENCIES OF THE UNIVERSITY
- CT2: Ability to exercise professional behavior in accordance with constitutional principles and ethical values of the respective profession.
- CT4: Use disciplinary knowledge to analyze and evaluate current situations.
- CT5: Integrate oneself into interdisciplinary and multicultural teams to achieve common goals in a context of diversity.

METHODOLOGY
The module will be comprised of interactive lectures and workshops. Core contents will be presented in lectures that will incorporate opportunities for discussion and debate. Alongside lectures, students will work in small groups throughout the course to research different aspects of the use, sustainability and detailing of different construction materials. This group work will be channelled through 4 workshops, leading to group presentations at the end of the module. In parallel, students will develop independent work in connection with their Design Studio, with construction taking centre stage in an exercise to deeply explore the materiality and sustainability of their proposed construction.

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<tr>
<th>Teaching methodology</th>
<th>Weighting</th>
<th>Estimated time a student should dedicate to prepare for and participate in</th>
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<tbody>
<tr>
<td>Lectures</td>
<td>20.0 %</td>
<td>30 hours</td>
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<tr>
<td>Discussions</td>
<td>10.0 %</td>
<td>15 hours</td>
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PROGRAM

SESSION 1 (LIVE IN-PERSON)
Introduction, Course Overview and Learning Objectives
In this session we will present an overview of the module contents and structure, teaching methods and modes of assessment. The core learning objectives will be discussed. An outline of the course assignments will be shared.

SESSION 2 (LIVE IN-PERSON)
Construction for Sustainability: integrated thinking principles
This interactive lecture will aim to recap and reflect on the concept of sustainability and how architectural construction can embrace it
A group discussion on the meaning of sustainability will be followed by a presentation of key sustainability objectives and principles, reflecting on integrated approaches to sustainable building design. We will address fundamental concepts such as biodiversity, ecosystems or ecosystem services, and will reflect on the impact of humans and our built environment.
Technical note: Making our buildings fit for a greener future (2021, European Commission)
Article: Sustainable Development Goals (United Nations)
Book Chapters: Cradle to cradle: remaking the way we make things (A question of design) (Optional)

SESSIONS 3 - 4 (LIVE IN-PERSON)
Context-adapted design
How does construction adapt to different contexts in pursue of a sustainable built environment? Explore the concept of context-adapted design and its links to construction. Reflect on the design principles that are responsive and fair to the environment. We will inquire what is the environment and what is its value. Understanding the environment as a dynamic system, the session will consider fundamental concepts such as sustainable development and how it deploys in different contexts. The interaction between form, function, context and sustainability will be explored through participative exploration of practical examples. Through interactive discussion, a framework for environmentally and socially responsible construction will be developed.
Book Chapters: Environmental Design: an introduction for architects and engineers (Taylor & Francis, 2005) (Optional)

SESSION 5 (LIVE IN-PERSON)

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<tr>
<th>Exercises</th>
<th>10.0 %</th>
<th>15 hours</th>
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<tr>
<td>Group work</td>
<td>30.0 %</td>
<td>45 hours</td>
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<tr>
<td>Other individual studying</td>
<td>30.0 %</td>
<td>45 hours</td>
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<tr>
<td>TOTAL</td>
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06th September 2022
Construction through history: technological evolution

Gain an overview of the evolution of construction technology through the centuries, from the lens of context, form and function: technological milestones.

We will run through key technological achievements of the last 2,000 years, with a focus on structural and building comfort advancements. This session will focus on the advances up to the 19th century.

*Book Chapters: Building: 3000 years of design engineering and construction (Phaidon Press, 2007) (Optional)*
*Book Chapters: Engineers. A History of Engineering and Structural Design (Routledge, 2010) (Optional)*

SESSION 6 (LIVE IN-PERSON)

Research Workshop 1: Introduction to group project

Students will work in groups to gain in-depth understanding of a construction material, exploring its application and sustainability through a context-adapted lense. They will be asked to address a series of topics that will require academic and practical research, as well as the study and evaluation of relevant case studies. In this first workshop, students will inquire into their proposed case studies in order to document them and understand the different construction and detailing.

SESSIONS 7 - 8 (LIVE IN-PERSON)

Construction through history: technological evolution II

Gain an overview of the evolution of construction technology through the centuries, from the lens of context, form and function: technological milestones.

The second session on construction through history will focus on advances from the 19th century. The development of modern construction materials such as steel and concrete and the paradigm shift in construction practice in the early 20th century will be reviewed to understand the key differences between pre- and post-1919 buildings and the impact of modern technology in building design.

SESSIONS 9 - 10 (LIVE IN-PERSON)

Ways of Building: Traditional and natural materials I

These session will explore the main traditional construction materials and their most common uses in the production of buildings throughout the globe, paying attention to material availability, performance, durability and maintenance, and knowledge transfer.

*Book Chapters: Materials & Skills for Historic Building Conservation (Blackwell 2008) (Optional)*

SESSIONS 11 - 12 (LIVE IN-PERSON)

Ways of Building: traditional and natural materials II

We will explore natural construction materials, with a focus on earth and bamboo.

Many construction systems inspired by regional and vernacular architecture are full of potential as viable green and context-responsive solutions for new architecture. The session will explore some of these systems, focusing on the what, where and why and complemented by a review of case studies.

SESSION 13 (ASYNCHRONOUS)
Working with the existing: an introduction

It is increasingly accepted that working with the existing is crucial for addressing the present climate crisis from the construction sector. What are the most common technical challenges when working with the existing? How can we respond to these challenges? we will focus on ensuring material durability and environmental performance.

SESSION 14 (LIVE IN-PERSON)
Research workshop 2: Material characteristics and applications (group projects)

Students will work in their groups to explore their construction material, investigating its main properties and applications in architecture.

SESSIONS 15 - 16 (LIVE IN-PERSON)
Construction performance: adapting to climatic and socio-economic context

What does it mean for a construction to be high performing? How does that vary between different contexts? These essential questions will be explored through theory and built examples.

SESSIONS 17 - 18 (LIVE ONLINE)
Design workshop I: sustainability indicators (individual design)

The first workshop aimed at developing the students' individual construction design exercise. The exercise focuses on proposing a sustainable and integrated construction solution, in coordination with design studio. In this workshop, students will investigate how to measure sustainability in a construction project.

We will review and critique BREEAM and LEED sustainability certifications, leading on to students developing and prioritising their own sustainability indicators, as relevant to their designs.

SESSION 19 (LIVE IN-PERSON)
Ways of Building: Green Architecture

This session will review the theory of green architecture and will discuss the main strategies for obtaining environmentally high-performing architecture.

SESSION 20 (LIVE IN-PERSON)
Ways of Building: Advances in fabrication and construction processes

We will explore novel fabrication processes and their application to architecture and construction.

06th September 2022
In recent years, new fabrication processes have gained weight in architecture, with many sitting at the forefront of research and experimentation. This session will present and discuss a diversity of recent technologies that are having an impact on the way we build, ranging from 3D printing and digital cutting tools, to flat-packed construction or modular prefabrication.

Book Chapters: Prototyping for Architects (Thames & Hudson, 2017) (Optional)
Book Chapters: Manufacturing the Bespoke: Making and Prototyping Architecture (Wiley & Sons, 2012) (Optional)

SESSIONS 21 - 22 (LIVE IN-PERSON)

Design workshop II: Detailing for performance and durability (individual design)
Through guided individual research and design, students will explore construction detailing that is high-performing and durable for the required context and climatic conditions.


SESSIONS 23 - 24 (LIVE ONLINE)

Integrating fire design
Objective: Understanding the principles of building fire safety and their integration in the design of buildings, from concept to detail.

Contents: Fire safety is one of the leading design criteria for any building, with dedicated building codes implemented in most countries. It is therefore essential in the design of a building form to understand the principles behind fire safety in order to integrate them successfully from conceptual design, rather than as an ad-hoc addition at detail design. This session will present a comprehensive overview of fire safety in buildings, including a range of design case studies to exemplify successful practice from leading architectural designers. Guest lecturers: Prof. Jose Torero and Dr Michael Woodrow (UCL).

Article: The Building Envelope: Failing to Understand Complexity in Tall Building Design (PDF copy to be provided)

SESSION 25 (LIVE ONLINE)

Integrated construction: case studies discussion
Recapping on principles of integrated construction systems through critical exploration of case studies.

Integrated approaches to architecture and construction will be analysed through the interactive discussion of selected case studies exemplifying sustainable approaches that respond to the context of the design, including environmental and socio-cultural demands.

SESSION 26 (LIVE IN-PERSON)

Research workshop 3: Context-adapted sustainability (group projects)
Working in their groups, students will review selected case studies to evaluate the sustainability of their construction material.

Multimedia Documentation: Challenging Practice: Essentials for the Social Production of Habitat

06th September 2022
SESSIONS 27 - 28 (LIVE IN-PERSON)

Site Visit
An active building site will be visited to gain understanding of construction processes and management.

SESSIONS 29 - 30 (LIVE IN-PERSON)

Group Project Presentations
Presentation and review of group projects exploring diverse construction technologies. Groups will present their designs to a panel of academics and professionals.

BIBLIOGRAPHY

Compulsory

Recommended

EVALUATION CRITERIA

The final grade for this module will be comprised of separate grades for the group projects developed throughout the module (a total of 40%) and a piece of individual work (60%).

Group projects will involve a piece of research, evaluation and critique. The outputs will be presented orally to the class, which will be 15% of the course grade. In parallel, each group will have to generate written and graphic documentation that will be compiled together to form a class catalogue. The grade for the group contribution will be 25% of the course final grade.

An individual assignment involving the design of a sustainable construction system will comprise 60% of the course final grade.

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<tr>
<th>Criteria</th>
<th>Percentage</th>
<th>Comments</th>
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<tr>
<td>Group Presentation</td>
<td>15 %</td>
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PROFESSOR BIO

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E-mail: aalbuerne@faculty.ie.edu

Dr Alejandra Albuerne is an architectural engineer with a background in construction history and heritage management, urban resilience, international development and participatory design processes. She specialises in traditional and low-cost construction methods and their structural safety.

OTHER INFORMATION
Office hours: Wednesdays 15.00 to 16.00.
Contact details: alejandra.albuerne@ie.edu