CONSTRUCTION SYSTEMS AND APPLICATIONS 2

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

PREREQUISITES
Students enrolled in this course should have successfully completed Construction Systems and Applications 1.

SUBJECT DESCRIPTION
The course introduces a conceptual framework for the design of building assemblies. The basis of construction systems will be presented theoretically first, and afterwards, will be analysed through the dissection and drawing of case studies, in order to understand their materials and materials attributes, their detailing, their logics of manufacture and assembly, and their performance throughout their whole life cycle.

Assignments will explore the detailing of systems and the integration of building parts/components into a coherent and coordinated whole. Emphasis will be placed on the interrelationship between the technical detail and the overall building expression. For that purpose, some common activities will be carried out in coordination with Design Studio.

The students’ practical training will take place both in the university’s own facilities as well as in external facilities, including visits to construction sites and to the Eduardo Torroja Institute for Construction Science.

OBJECTIVES AND SKILLS
2.1. Course objectives and acquired skills

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.
- CB5: Students can transmit information, ideas, problems, and solutions to both specialized and non-specialized audiences.
- CB6: Students have developed the necessary learning skills to continue their studies with a high degree of autonomy.

**SPECIFIC COMPETENCIES**

Per the Ministerial Decree EDU/2075/2010, 29 of July:

**TECHNICAL MODULE (CE 12-33)**

(W: Workshop Format)

- CE12: Ability to devise, calculate, design and implement foundation solutions, and to integrate them into buildings and urban assemblies (W).
- CE13: Ability to apply technical and constructive codes and regulations.
- CE14: Ability to preserve building structures, foundations and public works.
- CE15: Ability to preserve finished work.
- CE16: Ability to create cost estimates for built work.
- CE17: Capacity to develop, calculate, design, and execute building structures, and to integrate them into buildings and urban complexes (W).
- 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 (W).
- 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 (W).
- CE20: Capacity to develop, calculate, design, and execute the supply, treatment, and drainage of heating and cooling fluids, and to integrate this into buildings and urban complexes (W).
- CE21: Capacity to preserve structural work.
- CE22: The capacity to design building and urban installations of electrical transformation and power supply, audiovisual communication, acoustic conditioning, and artificial lighting.
- CE23: The capacity to preserve mechanical and electrical systems.
- CE24: Adequate knowledge of the mechanics of solids, continuous media and soil, as well as the plastic, elastic, and resistance qualities of heavy building materials.
- CE25: Adequate knowledge of conventional construction systems and their pathology.
- CE26: Adequate knowledge of the physical and chemical characteristics of the production process, the pathology, and use of building materials.
- CE27: Adequate knowledge of industrial construction systems.
- CE28: Knowledge of professional ethics, professional organizations, professional structures and civil liability.
- CE29 Knowledge of administrative and management procedures and professional processes.
- CE30: Knowledge of general office organization.
- CE31: Knowledge of techniques for measurement, budgeting, and evaluation.
- CE32: Knowledge of project safety and hygiene on site.
- CE33: Knowledge of real estate management.

**TRANSVERSE COMPETENCIES OF THE UNIVERSITY CT4**

Use disciplinary knowledge to analyze and evaluate current situations.

**2.2. Specific objectives and skills**

Specific emphasis will be placed upon achieving the following competencies:
To understand the basic principles and suitable application and performance of construction materials, products, components and assemblies, as well as their environmental impact.

To understand conventional building systems and the potential problems associated with them.

To be able to design elements and systems of foundations, walls, floors, roofs, stairs and fenestration, understanding the building as a whole, in which all the parts are integrated.

To illustrate through drawing and modelling the relationship of various materials and elements that make up a building construction assembly.

To understand the principles of sustainability in making building construction decisions in order to conserve natural and built resources.

To understand the building codes and standards and to familiarize with current code (CTE) development processes.

**METHODOLOGY**

The subject consists of 6 ECTS credits to be divided between school hours, which are the responsibility of the teacher, and free work hours, which are the responsibility of the student. The course is structured into 6 different thematic modules that will be explained at the PROGRAM further on.

Covid-19 has brought us a world that we thought only lived in fiction. In the School of Architecture and Design, we understand the current crisis as an opportunity to imagine a new pedagogy, one that explores new paths in architecture education that go beyond any contingency. Concomitant with this idea, IE University introduced the concept of Liquid Learning as a response to the times we live at as well as strengthening the quality of education. In this new Liquid Learning environment, students on-site and online, and considering status changes throughout time, will receive the same quality of education due to the revision of our pedagogical methods and application of new technologies to make the new environment feasible to ensure the best experience.

In order to execute this plan, some changes will be introduced within the teaching methodology, the most important of them, the organization of the courses through Synchronous and Asynchronous sessions. To make definitions clear, **Synchronous sessions (S)** refer to those sessions where students and professors coincide in time, although they might or might not, coincide in space. This means that during these sessions the students might be sharing Studio with the professor, or might be remote although present at the same time thanks to the technologies that will allow those students to be part of the Studio activities. **Asynchronous sessions (A)** will be those where professors and students do not coincide in time nor space. During these sessions, the interaction between professors and students, and among students, will be produced in different ways, such as theoretical lectures, discussions, individual and collective work and research carried out by each student, as well as the peer revision and criticism of that work.

This teaching methodology lends itself to different working environments, as outlined below:

**Lectures (S):** The instructor will present each module in the theoretical sessions. These presentations will include lectures outlining the most relevant aspects of each topic.

**Discussions (S):** The lectures will be followed by a discussion in which diverse case studies will be provided and commented on, illustrating the specific constructive aspects.

**Presentation / critical sessions (A & S):** The instructors will introduce the assignments or exercises thoroughly, appointing a delivery date and describing the required material for the eventual discussion and grading. Students will be demanded certain material, and will be asked to present it in front of their fellow classmates, outlining their intentions and results. This is both instructive for the presenting students, who must organize their thoughts and representative material, as well as for the rest of their classmates, who may compare, contrast and learn from a wide range of approaches to the assignment and their eventual critique. These critical sessions will be done **on site** or via **forums**.
Forums (A): Forums are an asynchronous class-wide discussion chat, curated by the Professor, and integrated on the Campus (Blackboard) platform. During the forums, the students will be required to actively participate in responding to questions, offering feedback to classmates or reacting to the feedback received. This tool aims to develop the students' critical and analytical thinking.

Desk-Crits (S): At times, the students may work one-on-one with the professor at their desks. This desk-critique is the time for the students to work on the specifics of their projects that, for reasons of time, might not be address during the pin-up sessions.

Seminars / various (S): presentation of a specific work or lecture of a professional guest.

Field work (S): A construction site visit will be schedule during the course (if possible).

Project Portfolio Reviews (A): This tool will work as a way for professors to give feedback on the process of design and development of the project. For this tool the students will be asked to prepare a “portfolio” of the documentation produced at given times, and after the time established, they will receive comments in order to progress the project.

<table>
<thead>
<tr>
<th>Teaching methodology</th>
<th>Weighting</th>
<th>Estimated time a student should dedicate to prepare for and participate in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>20.0 %</td>
<td>30 hours</td>
</tr>
<tr>
<td>Discussions</td>
<td>20.0 %</td>
<td>30 hours</td>
</tr>
<tr>
<td>Exercises</td>
<td>20.0 %</td>
<td>30 hours</td>
</tr>
<tr>
<td>Group work</td>
<td>20.0 %</td>
<td>30 hours</td>
</tr>
<tr>
<td>Other individual studying</td>
<td>20.0 %</td>
<td>30 hours</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100.0 %</td>
<td>150 hours</td>
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</tbody>
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PROGRAM

SESSIONS 1 - 2 (LIVE IN-PERSON)

Introduction
An overview of the subject content and the basic concepts, definitions and methods of analysis and instruction. Explanation of the competencies and learning outcomes that the student must acquire. General structure of the course.

Lecture: Introduction to current building code: CTE
Core Project: Introduction.
Assignment #1: Introduction.

SESSION 3 (LIVE IN-PERSON)

Lecture: Foundation systems
Physical characteristics of soil as it relates to building design and the requirements for soil testing and a geotechnical report. Planning and design considerations related to site excavation and the structural principles and methods for constructing deep and shallow foundations.
MODULE 1. FOUNDATION SYSTEMS

SESSION 4 (LIVE IN-PERSON)
Core Project: Introduction
Presentation and critical session.

SESSION 5 (LIVE IN-PERSON)
Lecture: Foundation systems - Case studies
Presentation and discussion on several case studies, focusing on the analysis of the topic of the module.

SESSION 6 (LIVE IN-PERSON)
Assignment #1: Review.

MODULE 2. WALL SYSTEMS

SESSION 7 (LIVE IN-PERSON)
Lecture: Wall systems

SESSION 8 (LIVE IN-PERSON)
Core Project: Projection
Presentation and critical session.

SESSION 9 (LIVE IN-PERSON)
Lecture: Wall systems - Case studies
Presentation and discussion on several case studies, focusing on the analysis of the topic of the module.

SESSION 10 (LIVE IN-PERSON)
Assignment #1: Due.
Assignment #2: Introduction.

MODULE 3. FRAME SYSTEMS
SESSION 11 (LIVE IN-PERSON)
Lecture: Frame Systems
Frame systems types. Concrete systems. Masonry systems. Steel systems. Wood systems. CTE-SE.

SESSION 12 (LIVE IN-PERSON)
Core Project: Projection.
Presentation and critical session.

SESSION 13 (LIVE IN-PERSON)
Lecture: Frame systems - Case studies
Presentation and discussion on several case studies, focusing on the analysis of the topic of the module.

SESSION 14 (LIVE IN-PERSON)
Assignment #2: Review.

MODULE 4. FLOOR SYSTEMS

SESSION 15 (LIVE IN-PERSON)
Lecture: Floor systems.
Linear beams and joists overland with a plane of sheathing or decking: wood and steel. Homogeneous slabs of reinforced concrete.
Concrete slabs - Concrete formwork and shoring. Metal decking. Wood floor systems. CTE-SE.

SESSION 16 (LIVE IN-PERSON)
Core Project: Projection.
Presentation and critical session.

SESSION 17 (LIVE IN-PERSON)
Lecture: Floor systems - Case studies
Presentation and discussion on several case studies, focusing on the analysis of the topic of the module.

MODULE 5. ROOFING SYSTEMS

SESSION 18 (LIVE IN-PERSON)
Core Project: Detail.
Assignment #2: Due.

20th July 2022
SESSION 19 (LIVE IN-PERSON)
Lecture: Roofing systems
Flat and pitched roofs. Concrete systems. Structural steel roof framing. Rafter framing. CTE-SE, CTE-HS.

SESSION 20 (LIVE IN-PERSON)
Core Project: Detail.

SESSION 21 (LIVE IN-PERSON)
Lecture: Roofing systems - Case studies
Presentation and discussion on several case studies, focusing on the analysis of the topic of the module.

SESSION 22 (LIVE IN-PERSON)
Assignment #3: Review.

SESSIONS 23 - 24 (LIVE IN-PERSON)
SITE VISIT

MODULE 6. MOISTURE AND THERMAL PROTECTION

SESSION 25 (LIVE IN-PERSON)
Lecture: Moisture and Thermal Protection
Thermal insulation: Insulating materials; Insulating foofs and floors; insulating walls.
Moisture control: Vapor retarders; Ventilation.
Waterproofing: Pitched roofs; Flat roofs; Flashing. CTE-HS.

SESSION 26 (LIVE IN-PERSON)
Core Project: Detail.

SESSION 27 (LIVE IN-PERSON)
Lecture: Moisture and Thermal Protection - Case Studies
Presentation and discussion on several case studies, focusing on the analysis of the topic of the module.

SESSION 28 (LIVE IN-PERSON)
Core Project: Model.
FINAL PRESENTATION

SESSIONS 29 - 30 (LIVE IN-PERSON)

Final Review

BIBLIOGRAPHY

Compulsory

null

Recommended

null

null

null

null

EVALUATION CRITERIA

Assignments for this course will include 3 (short) assignments and 1 project. Coursework will focus on built case studies and will include both analytical and design exercises corresponding with content taught in class. Additionally, weekly case studies will be discussed. Student groups will be assigned with presenting each case study and leading a discussion in which all attending students are expected to participate. The course will culminate in several individual and group deliverables including drawings, physical models and prototypes, as well as a final review.

ASSESSMENT TOOLS

According to the University’s concept of comprehensive education, the assessment will consider not only the student’s level of knowledge, but also the perception of those general or particular skills for each area.

The instructor will use the following assessment models or a combination thereof:
Assignments: The students will complete all the assignments proposed during the course. Failure to complete any one of them without a justifiable cause will result in the failure of the course. The final deadlines for these assignments are non-negotiable. This can only be postponed due to extraordinary circumstances which must be properly justified. Non-justified delays will imply the dismissal of the given assignments as evaluation materials, resulting in an assignment score of 0.0.

Presentation: Individual and group presentations of practical work and research.

Participation: Assessment of student's active participation in their own learning process and in the practical workshop.

In order to give the students an insight into their level of fulfilment of the course requirements, a provisional grade will be assigned individually by the instructor upon reaching the end of the 15th session. This grade will be used for orientation purposes only, and will not necessarily be related with the final course grade.

Final Exam: Due to the specific organization of the course (continuous evaluation), a final exam does not provide enough information regarding the fulfillment of the course requirements in those students whose work has not been positively evaluated.

For this reason, those students with a course score between 4.0 and 4.9 will be given the opportunity to improve their coursework. The instructor will determine individually whether the student should improve an assignment handed in during the course or work on a new assignment.

This coursework improvement will be handed in on the day of the final exam. If the result of this improvement, combined with the existing coursework, is satisfactory, the student will pass the subject.

The same procedure will be followed for the students interested in improving his/her overall grade.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Percentage</th>
<th>Comments</th>
</tr>
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<tbody>
<tr>
<td>Class Participation</td>
<td>10 %</td>
<td>Active participation during the classes, the construction workshop and the programmed activities.</td>
</tr>
<tr>
<td>Presentation of readings and case studies</td>
<td>15 %</td>
<td>Quality of analysis and discussion</td>
</tr>
<tr>
<td>Individual assignment</td>
<td>35 %</td>
<td>Analytical skills; graphic clarity and precision; Innovation</td>
</tr>
<tr>
<td>Group assignment</td>
<td>40 %</td>
<td>Analytical skills; graphic clarity and precision; Innovation</td>
</tr>
</tbody>
</table>

GRADING AND ATTENDANCE NOTES:
1. Students have access to a total of four enrolments, in two consecutive academic years.
2. Students must attend at least 70% of all class sessions. Students who do not meet this minimum percentage automatically fail both first and second enrolments, and pass directly to the third enrolment. Within the new Liquid Learning environment this policy remains the same, considering equally synchronous and asynchronous sessions. The attendance to asynchronous sessions will be specifically determined by each activity produced in that particular format and it will be explained for each specific session.
It is highly recommended that students who are in Madrid/Segovia attend the synchronous sessions on Campus. It is at the student’s discretion to attend classes on campus or remotely. It is very important that students remain consistent in their decision of on campus or remote learning, so that the professor and students benefit from the possibility to plan activities in advance, knowing which students will be available in each type of session. Whether a student decides to follow their classes either on campus or remotely, they must commit to that mode, except for exceptional circumstances in which the change is for justified reasons. The behavior of the students during the sessions must comply with IE University’s standards on education, respect for peers and professors, and commitment to joint learning. Students who connect remotely must keep their cameras on, and they must demonstrate the courtesy and online respect necessary in the digital environment.

3. Grading of students in the extraordinary enrolments will follow the following guidelines: Students that have failed the subject in first enrolment pass to the second enrolment, except those who do not meet the minimum attendance percentage, and that therefore pass directly to the third enrolment.

4. The maximum grade that a student may achieve in second enrolment is an 8.

PROFESSOR BIO

Professor: RUTH VEGA CLEMENTE
E-mail: rvega@faculty.ie.edu

Ruth Vega holds a Ph.D. Cum Laude in Architecture from the Polytechnic University of Madrid and obtained her architectural degree from the same University. Since 2004 she has been a professor at the IE School of Architecture. Her teaching and professional activities try to surpass the borders of conventional architectural practices motivated by the research of new and more open working methods conceived from interdisciplinarity.

Her research projects include several publications and collaborations, most notably in the field of Construction Technology and Sustainability. Her doctoral thesis focuses on the sustainability assessment of industrialised and prefabricated construction systems and components. Based on the belief that environmental aspects should be a major part of the construction process, her thesis holds that industrialisation is the only way to fight against economic crisis and that the future balance between social needs and the market should be built up through the new construction industry.

She has worked in her own architectural practice Colectivo Cuartoymitad since 2003, a flexible structure based on a continuous exchange and collaborative work with professionals coming from multiple fields of knowledge. The members of Colectivo Cuartoymitad have given various national and international public lectures about their work and its relationship with contemporary urban cultures. Their designs and articles have also been published in magazines, books and catalogues related to the fields of art, architecture and urban culture. Their work was exhibited at the XI Venice Biennale (2008), and has also be shown at the IVAM Museum in Valencia (“Construir, habitar, pensar” exhibition), in Madrid, Bogotá, Brussels, Buenos Aires, Montevideo and Barcelona (“Freshmadrid” exhibition), at the Museum of Contemporary Art in Badajoz, and in Lima, Madrid and Barcelona (“Panorama Emergente” IV Iberoamerican Architecture Biennial).

OTHER INFORMATION

20th July 2022