Course guides
250470 - ESTREDIF - Building Structures

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.

Degree: MASTER'S DEGREE IN CIVIL ENGINEERING (PROFESSIONAL TRACK) (Syllabus 2012). (Optional subject).
MASTER'S DEGREE IN STRUCTURAL AND CONSTRUCTION ENGINEERING (Syllabus 2015). (Optional subject).

Academic year: 2020  ECTS Credits: 5.0  Languages: English

LECTURER

Coordinating lecturer: CLIMENT MOLINS BORRELL
Others: DANIEL ALARCÓN FERNÁNDEZ, CLIMENT MOLINS BORRELL, PEDRO ROCA FABREGAT, MIQUEL RODRIGUEZ NIEDENFÜHR

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
8162. Knowledge of all kinds of structures and materials and the ability to design, execute and maintain structures and buildings for civil works.
8228. Knowledge of and competence in the application of advanced structural design and calculations for structural analysis, based on knowledge and understanding of forces and their application to civil engineering structures. The ability to assess structural integrity.

Transversal:
8559. ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding the mechanisms on which scientific research is based, as well as the mechanisms and instruments for transferring results among socio-economic agents involved in research, development and innovation processes.
8560. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.
8561. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

TEACHING METHODOLOGY

The course consists of 1,8 hours per week of classroom activity (large size group) and 0,8 hours weekly with half the students (medium size group).

The 1,8 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 0,8 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

The rest of weekly hours devoted to laboratory practice.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.
LEARNING OBJECTIVES OF THE SUBJECT

Specialization subject in which knowledge on specific competences is intensified.

Knowledge and skills at specialization level that permit the development and application of techniques and methodologies at advanced level.

Contents of specialization at master level related to research or innovation in the field of engineering.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours medium group</td>
<td>9,8</td>
<td>7.83</td>
</tr>
<tr>
<td>Self study</td>
<td>80,0</td>
<td>63.95</td>
</tr>
<tr>
<td>Hours large group</td>
<td>19,5</td>
<td>15.59</td>
</tr>
<tr>
<td>Hours small group</td>
<td>9,8</td>
<td>7.83</td>
</tr>
<tr>
<td>Guided activities</td>
<td>6,0</td>
<td>4.80</td>
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</tbody>
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Total learning time: 125.1 h

CONTENTS

Functions and systems of the building

Description:

Specific objectives:
Knowledge of the functions, elements and systems that make up the building. Knowledge of structural systems and subsystems to the horizontal and vertical actions, and the main elements involved.

Full-or-part-time: 7h 11m
Theory classes: 3h
Self study : 4h 11m
### Structural system: floor slabs

**Description:**
Fundamental types of concrete slabs. Analysis of resistant characteristics with constructive aspects, specific types and common uses. Elements of composite slabs and conditions to be fulfilled. Geometric conditions required. Methods based on the distribution of plastic moments. Concept deformation and check the active deformation. Construction details eg supports, types of support elements. General lay-out of the reinforcement.

Presentation on the practical process of designing and verifying of a complete one way composite slab.


Presentation of the process on the practical design and verification of a two-way slab.

Composite steel and concrete slabs: basic characteristics. Types. Major structural possibilities and applications. Strength analysis.

Details for the improvement of acoustic and fire behavior. Calculation of basic criteria. Construction details.

Presentation of an example of sizing of a composite slab.


Presentation of the process on the practical design and verification of a post-tensioned slab.

**Specific objectives:**
Knowledge of the types of slabs of reinforced concrete or prestressed concrete. Familiarization with the criteria and the calculation process in service and ultimate conditions. Knowledge of detailing.

Practical demonstration of the design process and verification of a one way composite slab.

Knowledge of the types of two-way reinforced concrete slabs. Presentation of the criteria and verification process in service and ultimate conditions. Knowledge of construction details. Analysis of the resistance to punching of column slab connections.

Practical demonstration of the design process and verification of a two-way slab.

Knowledge of the main characteristics and applications of composite slabs of steel or timber and concrete. Structural analysis and sizing.

Knowledge of the process of sizing of a composite slab.


Practical demonstration of the design process and verification of a post-tensioned slab.

**Full-or-part-time:** 28h 47m

Theory classes: 8h
Practical classes: 4h
Self study: 16h 47m
Building physics

Description:
The envelope of the building with different systems of closures and roofs with a combination of materials and thicknesses is studied. In particular, the energetic behavior is studied from the review of key concepts of thermodynamics. Analysis of the thermal resistance of walls and roofs and their hygrometric behavior. Prescriptions on such elements.

Thermal behavior example

Presentation of the protective conditions. General and simplified methods for testing the fire resistance of structures. Treatment and prescriptions set out in regulations. Division in the building sector and analysis of the conditions of evacuation of the building in case of fire.

Practice developed in the classroom on the practical implementation of methods and normative criteria related to the verification of the fire resistance of structural elements of the building.

Specific objectives:
Review the basics of thermodynamics to study the energy performance of edifices. Capacity to apply different types of enclosures and covers for buildings. Knowledge of the code requirements and checkings. Analyze the energy performance of buildings. Understanding the effects of fires in buildings and levels and solutions that are applicable for protection. Knowledge of the behavior of various structural materials resistant to fire. Presentation of the basic techniques of analysis of the buildings before the fire. Approach the conditions and requirements evacuació derived for the design of the building.

Demonstration of practical application of concepts and methods related to verification of the fire resistance of the structure of buildings.

Full-or-part-time: 14h 23m
Theory classes: 4h
Practical classes: 2h
Self study: 8h 23m

Structural system: lateral stability

Description:


Practical application of methods for analysis of building systems horizontally braced through simple RC walls. Determination of center of torsion of the plant structure and distribution of the forces between the different walls.

Specific objectives:
Discussion of the behavior of buildings against horizontal actions. Knowledge of various specific solutions to improve the capacity of the building facing horizontal actions and their use depending on the height of the building. Methods for calculating the structural system to horizontal actions.

Knowledge and practical application of available methods for the analysis of structural systems based on simple walls of constant height. Analysis of the efficiency of different systems depending on the geometrical arrangement of the walls.

Full-or-part-time: 14h 23m
Theory classes: 3h
Practical classes: 2h
Laboratory classes: 1h
Self study: 8h 23m
**Earthquake resistant design of buildings**

**Description:**
Characteristics of the seismic action. Effects of earthquakes on buildings. Definition and importance of ductility of structures. Considerations on the seismic behavior of concrete constructions, metal and composite walls and masonry. Conception and design of buildings in seismic zone. Construction details specific beams, pillars, frame connections, walls and concrete slabs. Seismic failures. Seismic isolation. Application of regulations. Analysis of the seismic action. Determination of the seismic action to be considered for the design and verification of a resistant building located in a certain area of seismicity. Determination of the seismic acceleration calculation based on the seismic zone, importance of building and ground. Determination of equivalent static seismic forces and the forces generated in the structure of the building. Selection of appropriate construction details.

**Specific objectives:**
Knowledge of the effects of earthquakes on structures and aspects to consider when designing a building earthquake resistant. Ability to check the earthquake resistance of a building structure. Demonstration of the practical application of the current earthquake resistant regulations for determining the seismic action to be considered in designing a building.

**Full-or-part-time:** 21h 36m
Theory classes: 6h
Practical classes: 3h
Self study : 12h 36m

**Special Buildings**

**Description:**
In tall buildings and in buildings with some aspects that are unimportant in conventional buildings, acquire great importance. Such aspects as: the effect of natural frequencies of vibration on the dynamic behavior under the action of wind on tall buildings, importance of vertical transport, structural systems for buildings of great light and its main application.

**Specific objectives:**
Knowledge of the specific aspects of tall buildings or high light, which are different from conventional buildings.

**Full-or-part-time:** 7h 11m
Practical classes: 2h
Laboratory classes: 1h
Self study : 4h 11m

**GRADING SYSTEM**

The mark of the course is obtained from the ratings of continuous assessment and their corresponding laboratories and/or classroom computers.

Continuous assessment consist in several activities, both individually and in group, of additive and training characteristics, carried out during the year (both in and out of the classroom).

The teachings of the laboratory grade is the average in such activities.

The evaluation tests consist of a part with questions about concepts associated with the learning objectives of the course with regard to knowledge or understanding, and a part with a set of application exercises.

**EXAMINATION RULES.**

Failure to perform a laboratory or continuous assessment activity in the scheduled period will result in a mark of zero in that activity.
BIBLIOGRAPHY

Basic: