Building Structures (250470)

General information

School:	ETSECCPB
Departments:	751 - Departament d'Enginyeria Civil i Ambiental
Credits:	5.0 ECTS
Programs:	1161 - MÀSTER UNIVERSITARI EN ENGINYERIA DE CAMINS, CANALS I PORTS (pla 2012), 872 - MÀSTER UNIVERSITARI EN ENGINYERIA DE CAMINS, CANALS I PORTS (pla 2012), 1140 - MÀSTER UNIVERSITARI EN ENGINYERIA ESTRUCTURAL I DE LA CONSTRUCCIÓ (pla 2015)
Course:	2015/2016
Course language:	English

Faculty

Responsible faculty: Climent Molins Borrell

Teachers: Climent Molins Borrell, Luca Pela, Pedro Roca Fabregat, Vicente Villalba Herrero

Generic objectives

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.

Skills

Specific skills

Knowledge of all kinds of structures and materials and the ability to design, execute and maintain structures and buildings for civil works.

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.

Generic skills of subject

INNOVATION, EMPLOYABILITY, DEVELOPMENT AND RESEARCH: The ability to develop one's creative and innovative tendencies with the ultimate aim of serving the development and

progress of society. The ability to work on a research topic. Employability in managerial posts in all types of companies and public authorities, coupled with initiative and decision-making abilities. The ability to develop one's creative and innovative tendencies with the ultimate aim of serving the development and progress of society. The ability to work on a research topic. Employability in managerial posts in all types of companies and public authorities, coupled with initiative and decision-making abilities.

SUSTAINABILITY AND THE ENVIRONMENT: The capacity for engineering development in the framework of globalisation, sustainability and environmental protection. The ability to analyse the entire life cycle of an engineering project.

KNOWLEDGE DEVELOPMENT: The ability to develop new analytical methods and processes at all levels: conception, design and development. The ability to propose and develop specifications, regulations and rules in engineering following safety and efficiency criteria and using sustainable resources.

ECTS credits: total hours of student work

		Dedication	
		Hours	**Percent**
Supervised Learning	**Theory**	24.00	53.3%
	Assignments	13.00	28.9%
	Laboratory	2.00	4.4%
	Supervised activities	6.00	13.3%
Self-Learning		80.00	

Contents

Functions and systems of the building

Dedication

3.0h. Theory

Description

Functions relating to building stability, protection and conditioning. Analysis of the subsystems. Relationship between subsystems and functions. Introduction to the protective system. Elements of the exterior of the building envelope (walls and roof) and specific functions. The compartmentalization of the interior spaces. Coatings. Devices to regulate. Introduction to system facilities and equipment. General layout of a network and differentiation between individual or centralized systems. General scheme of evacuation network. Introduction to the main facilities. Introduction to the structural system. Basic conditions that the structure must satisfy. Fundamental structural elements. Global View of the resistance mechanisms of actions against vertical and horizontal.

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.

Structural system: floor slabs

Dedication

8.0h. Theory + 4.0h. Assignments

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.

General types and range of use in terms of span and loading. Approach the method of virtual frames. Edge beams: important features and criteria for sizing. General criteria for reinforced two-way slabs. Punching: description of the mechanism of failure..

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.

Capacity and construction advantages of the use of post-tensioned slabs. Types of post-tensioned slabs. Design and analysis post-tensioned slabs. Specific technology for post-tensioned slabs of buildings. Solutions and specific construction details.

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

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 detailng.

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.

Knowledge of the advantages of ppost-tensioned in the formation of slabs for buildings. Design of post-tensioned slabs for buildings. Knowledge of technological aspects and construction.

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

Building physics

Dedication

4.0h. Theory + 2.0h. Assignments

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 concpetes of thermodynamics. Analysis of the thermal resistance of walls and roofs and their hygrometric behavior. Prescriptions on such elements.

Thermal behavior example

Nature and effects of the action of fire. Levels of activity before the occurrence of fires. Characterization of the action "fire" and the response of buildings and their elements. Effects and response to fire of different materials and structural elements. Presentation of the protective conditions. General and simplified methods for testing the fire resistance of structures. Treatment and prescriptions set out in regulations. Retardant coatings. 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.

Objectives

Review the basics of thermodynamics to study the energy performance of edificis.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 avacuació 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.

Structural system: lateral stability

Dedication

3.0h. Theory + 2.0h. Assignments + 1.0h. Laboratory

Description

Characteristics of horizontal wind and earthquake actions and impact on the building. Basic behavior of structural systems against horizontal actions: building with wall systems and buildings with frame structure. Stiffening by walls and cores. Nonsway systems provided by cross steel ties and reinforeced concrete walls. Problems arising from the interaction between frames and walls. Provision of walls and cores in plant. Characteristics of work and criteria for the calculation

of cores. Special solutions for tall buildings. Coupled walls. Stiffenning beams. Megaframes. Outer tubes. Tube in tube solutions. Analysis system consisting of simple walls constant in height.

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.

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.

Earthquake resistant design of buildings

Dedication

6.0h. Theory + 3.0h. Assignments

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.

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.

Special Buildings

Dedication

2.0h. Assignments + 1.0h. Laboratory

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.

Objectives

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

Activities

Exercise on one-way floor slabs

Dedication

1.0 h. Supervised activities

Exercise on two way slabs

Dedication

1.25 h. Supervised activities

Exercice on building physics

Dedication

1.25 h. Supervised activities

Exercise on lateral stability

Dedication

1.25 h. Supervised activities

Exercise on seismic design

Dedication

1.25 h. Supervised activities

Grading rules (*)

(*) The evaluation calendar and grading rules will be approved before the start of the course.

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.

Test rules

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

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.

Office hours

To consult the teachers, students will be assisted in and out of class, if possible. Otherwise, they have to arrange arrange an appointment with the teacher they want via email, on a schedule that is right for both.

Basic bibliography

- Calavera, J. **Proyecto y cálculo de estructuras de hormigón armado para edificios**. Intemac. Madrid. 1984-1985. ISBN 843981108X (V. 1) ; 8439840039 (V. 2).
- Marí, A.R.; Molins, C.; Bairán, J.M.; Oller, E. **Formigó armat i pretensat: exercicis curts de bases de càlcul i estats límits, adaptat a la Instrucció EHE-08**. Edicions UPC. Barcelona. 2009. ISBN 978-84-9880-390-7.
- Bozzo, L.M., Barbat, A.H.. Diseño sismorresistente de edificios: técnicas convencionales y avanzadas. Reverté. Barcelona. 2000.
- Ministerio de Fomento. **EHE-08: Instrucción para el proyecto y la ejecución del hormigón estructural.** . Madrid. 2008.
- Ministerio de la Vivienda. **Documento básico SE Seguridad Estructural.** . 2006.
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- Ministerio de Fomento. **Normativa construcción sismoresistente NCSR-02**. Madrid. 2002.
- Comisión Permanente del Hormigón. **Guía de la aplicación de la Instrucción de Hormigón Estructural. Edificación**. Ministerio de Fomento. Madrid. 2002.