Course guide
250473 - DISAVESTFO - Advanced Design of Concrete Structures

Last modified: 03/10/2023

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: 2023 **ECTS Credits:** 5.0 **Languages:** Spanish, English

LECTURER

Coordinating lecturer: ALBERTO DE LA FUENTE ANTEQUERA

Others: JESÚS MIGUEL BAIRÁN GARCÍA, ALBERTO DE LA FUENTE ANTEQUERA, JUAN MURCIA DELSO, EVA MARIA OLLER IBARS

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 3 hours a week of face-to-face classes (or not, depending on the circumstances)

Approximately two hours of each class session is devoted to exposing the basic concepts of the subject and to present examples that help to consolidate the general and specific learning objectives. In addition, questions to be answered and exercises to be read/solved by the students will be proposed, that will be discussed and covered the following week.

Sufficient material will be provided to the students so that they can deep into the subject and answer the questions and understand/solved the proposed problems.

The remaining hour of each session will be devoted to solving students' doubts about the subject explained, the problems proposed and the questions asked the previous week.

The distribution of this time (2h + 1h) will depend on the subject and the availability of time, according to the development of the subject.

Support material in detailed teaching plan format is used through the ATENEA virtual campus: contents, programming of assessment and directed learning activities and bibliography.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

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.

The course on "Advanced design of concrete structures" intends to supplement a basic course of reinforced and prestressed concrete structures and provide a knowledge at the level of structural specialist. One of the objectives is to strengthen the projectual capacity of students by introducing concepts related to design and construction systems. Particular emphasis is made on the "Strut and tie" model as a general method of design, especially suitable for areas of discontinuity. This method is applied to the study of structural elements with geometric or mechanical discontinuity, such as corbels, deep beams or anchorage zones

Related to structural analysis, some aspects studied are the effects of prestressing in statically indeterminate structures as well as long term and nonlinear behaviour, construction effects, and the design of structures partially prestressed, taking into account the service and ultimate limit states.

Limit states not studied in a basic course, such as punching, instability or fatigue are taught.

STUDY LOAD

Type	Hours	Percentage
Hours large group	25,5	20.38
Hours medium group	9,8	7.83
Self study	80,0	63.95
Hours small group	9,8	7.83

Total learning time: 125.1 h

CONTENTS

Method of struts and ties

Description:
Struts and ties
Struts and ties. Exercise

Full-or-part-time: 14h 23m
Theory classes: 3h
Practical classes: 3h
Self study : 8h 23m

Structural Elements

Description:
Corbels and deep beams
Short corbels and beams of great depth. Exercise
Anchors in prestressed elements
Plates
Shells

Full-or-part-time: 26h 24m
Theory classes: 8h
Practical classes: 3h
Self study : 15h 24m

Analysis of concrete structures

Description:
Nonlinear behavior of Concrete Structures. Internal forces redistributions
Secondary prestressing moments. Concordant tendon layout
Structural analysis of prestressing. Exercise
Time dependent effects of creep, shrinkages and construction process. Forces redistributions
Time dependent analysis. Exercise
Partially prestressed
Partial prestressing. Exercise

Full-or-part-time: 28h 47m
Theory classes: 8h
Practical classes: 4h
Self study : 16h 47m

Limit States

Description:
ULS of Shear and Punching
ULS shear and punching. Exercises
Ultimate limit state of instability
Ultimate limit state instability. Exercise
Fatigue
Exercise of fatigue strength verification
Fatigue. Exercise

Full-or-part-time: 28h 47m
Theory classes: 7h
Practical classes: 5h
Self study : 16h 47m

Laboratory

Description:
Virtual analysis Lab and Tests at the LTE

Full-or-part-time: 4h 48m
Laboratory classes: 2h
Self study : 2h 48m

Evaluation

Full-or-part-time: 4h 48m
Laboratory classes: 2h
Self study : 2h 48m

GRADING SYSTEM

The evaluation will be continued and will have two components: 1) the course work and 2) the final exam.

The course work will consist of a design or verification of a structure, of limited entity where the concepts discussed within the course are applied. The final exam will be done at the end of the course by means of questions and / or short conceptual problems, but which require demonstrating the ability to apply the fundamental concepts of the subject

A final grade equal to or greater than 5 is required to pass the course. Those students that do not pass the course with this evaluation system, will have right to an extraordinary exam.

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:
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- 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. 2a ed. Barcelona: Edicions UPC, 2009. ISBN 978-84-9880-390-7.
- Comisión Permanente del Hormigón. Instrucción de hormigón estructural: EHE: con comentarios de los miembros de la Comisión Permanente del Hormigón. 5a ed. rev. Madrid: Ministerio de Fomento, 1999. ISBN 8449803969.
- Comité Européen de Normalisation (CEN). Eurocode 2: design of concrete structures: ENV 1992. Brussels: European Comittee for standardization, 1995.
- Jiménez Montoya, P. [et al.]. Hormigón armado [on line]. 15a ed. Barcelona: Gustavo Gili, 2009 [Consultation: 08/03/2021]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=3209549. ISBN 9788425223075.
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- Paulay, T.; Priestley, M.J.N. Seismic design of reinforced concrete and masonry buildings. New York: Wiley & Sons, 1992. ISBN 0471549150.
- Park, R.; Gamble, W.L. Reinforced concrete slabs. 2nd ed. New York: John Wiley & Sons, 2000. ISBN 0471348503.
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