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250124 - MATCONST - Construction Materials

Coordinating unit: 250 - ETSECCPB - Barcelona School of Civil Engineering

Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering

Academic year: 2018

Degree: BACHELOR'S DEGREE IN CIVIL ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN CIVIL ENGINEERING (Syllabus 2017). (Teaching unit Compulsory)

ECTS credits: 6 Teaching languages: Catalan, Spanish, English

Teaching staff

Coordinator: DIEGO FERNANDO APONTE HERNÁNDEZ, MARILDA BARRA BIZINOTTO

Others: VICENTE ALEGRE HEITZMANN, DIEGO FERNANDO APONTE HERNÁNDEZ, MARILDA BARRA BIZINOTTO

Opening hours

Timetable: Tuesdays from 16:00 to 18:00

Degree competences to which the subject contributes

Specific:

3024. Ability to apply knowledge of construction materials to structural systems. Knowledge of the relation between the structure of materials and the mechanical properties resulting from them.

3025. Understanding of the physico-chemical mechanisms that determine the stages in the lifecycle of construction materials (manufacture, use, elimination and recycling), their durability and their impact on the environment.

Transversal:

588. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 1. Analyzing the world¿s situation critically and systemically, while taking an interdisciplinary approach to sustainability and adhering to the principles of sustainable human development. Recognizing the social and environmental implications of a particular professional activity.

591. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 1. Planning oral communication, answering questions properly and writing straightforward texts that are spelt correctly and are grammatically coherent.

598. EFFECTIVE USE OF INFORMATION RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.

601. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

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Teaching methodology

The course consists of: 42 hours of theory classes, 4 hours of troubleshooting and 8 hours laboratory (small group), a technical visit and 4 hours of classroom exam.
It involved 42 hours of lectures (large group), in wich the teacher explains the concepts and discusses the questions prepared by students at home.
4 hours are dedicated to solving specific problems of fracture mechanics, and mix design of concrete. Practical exercises to consolidate learning objectives.
8-hour practices are held at the Materials Laboratory (B1 basement), divided into four sessions:
• 2 hours dedicated to the characterization of aggregates.
• 2 hours dedicated to the manufacture of concrete and study their properties in the fresh state.
• 2 hours dedicated to the study of the properties of hardened concrete.
• 2 hours dedicated to the study of bituminous mixtures.
Support materials used in the form of detailed educational plan through the virtual campus ATENEA: content, programming and evaluation activities directed learning and literature.

Learning objectives of the subject

Students will learn to apply knowledge of construction materials in structural systems. They will also develop an understanding of the relationship between the structure of materials and the resultant mechanical properties.

Upon completion of the course, students will have acquired the ability to: 1. Relate the materials used in a construction project to their mechanical and physical properties and to the structural needs of each specific case. 2. Organise and plan an analysis of the properties of the materials used in a construction project, by means of either field tests or laboratory tests. 3. Carry out a life-cycle energy analysis of construction materials.

Data analysis; Regression models, parameter estimation; Probability and uncertainty; Random variables: definition and interpretation; Operations on random variables; Probability models: Bernoulli, Poisson and other distributions; Asymptotic probabilistic models that start with the normal distribution and end with transformations of the normal distribution; Estimation of return period; Parameter estimation, method of maximum likelihood, interval estimation; Hypothesis testing and goodness-of-fit testing; Bayesian estimation and statistical analysis of regression models

Study load

Total learning time: 150h	Hours large group:	42h	28.00%
	Hours medium group:	4h	2.67%
	Hours small group:	14h	9.33%
	Guided activities:	6h	4.00%
	Self study:	84h	56.00%

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Content

Impact and management of building materials

Learning time: 7h 11m

Theory classes: 1h
Practical classes: 1h
Laboratory classes: 1h
Self study : 4h 11m

Description:
Life cycle and parameters for assessing the environmental impact
Environmental protection of soils and water: leaching study
Environmental protection of soils and water: leaching study

Mechanical behavior of materials

Learning time: 7h 11m

Theory classes: 2h
Practical classes: 1h
Self study : 4h 11m

Description:
Basic concepts of fracture mechanics
Fracture mechanics

Rocks

Learning time: 9h 36m

Theory classes: 1h
Laboratory classes: 3h
Self study : 5h 36m

Description:
Quarries. Products for construction. Works in stone. Properties and testing. Alterations of the stone works. Repairs.
Aggregates for concrete.
Aggregates for bituminosas mixtures.
Aggregates

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Concrete

Learning time: 50h 24m

Theory classes: 12h
Practical classes: 4h
Laboratory classes: 5h
Self study : 29h 24m

Description:
Materials, structure and microstructure
Properties of hardened concrete
Fresh concrete
Production, transportation, placing, compacting and curing
Mix design
Mix design
Mix design
Properties of hardened concrete
Admixtures and additions
Durability. Chemical and physical deterioration of the concrete.
Interpretation and application of EHE for structural concrete

Metals

Learning time: 21h 36m

Theory classes: 9h
Self study : 12h 36m

Description:
Steel and castings. SAC. Forming processes. Thermal and mechanical treatments.
Steel for reinforced and prestressed concrete
Steels for metallic structures. Carbon steels, stainless steels and other alloy steels.
Corrosion of steel.
Nonferrous metals. Copper and cooper alloys. Nickel and nickel alloys. Aluminum,

Polymers

Learning time: 4h 48m

Theory classes: 2h
Self study : 2h 48m

Description:
The polymers of general interest in construction. Properties, tests and specific regulations.

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Bituminous mixtures	Learning time: 21h 36m Theory classes: 7h Laboratory classes: 2h Self study : 12h 36m

Description:
Bituminous binders
Mix design of bituminous mixtures.
Dosage of bituminous mixtures. Properties and testing of bituminous mixtures
Manufacturing, extension, compaction and control of bituminous mixtures. Properties and tests of bituminous mixtures.
Manufacturing, extension, compaction and control of bituminous mixtures

Ceramics and glasses	Learning time: 9h 36m Theory classes: 2h Laboratory classes: 2h Self study : 5h 36m

Description:
Glasses: Production, properties and applications in civil engineering. Introduction to ceramics. Manufacture of ceramic products. Properties. Regulations. Defects. Durability.

Composite materials	Learning time: 4h 48m Theory classes: 2h Self study : 2h 48m

Description:
Organic matrices. Fibers. Properties. Applications in Construction

Paints and varnishes	Learning time: 2h 24m Theory classes: 1h Self study : 1h 24m

Description:
Paints and varnishes applied in the construction. Tests of paintings and films

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Wood	Learning time: 4h 48m Theory classes: 2h Self study : 2h 48m

Description:
Wood. Structure and properties. Type of wood used in construction. Essays and regulations. Durability.

Qualification system

The mark of the course is obtained from continuous assessment and their corresponding laboratory.
Continuous assessment consist in several activities, both individual and group additive and training characteristics, carried out during the course (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 on concepts associated with the learning objectives of the course with regard to knowledge or understanding, and a part with a set of application exercises.
Grade mark:

Grade mark=0,75×((E1+E2)/2)+0,25((P1+P2+P3+P4+V)/5)

2 Exam: (E1 and E2)
1 Activity: (V)
4 Laboratory practices: (P1, P2, P3 and P4)

Criteria for re-evaluation qualification and eligibility: Students that failed the ordinary evaluation and have regularly attended all evaluation tests will have the opportunity of carrying out a re-evaluation test during the period specified in the academic calendar. Students who have already passed the test will not be admitted to the re-evaluation test. The maximum mark for the re-evaluation exam will be five over ten (5.0). The non-attendance of a student to the re-evaluation test, in the date specified will not grant access to further re-evaluation tests. Students unable to attend any of the continuous assessment tests due to certifiable force majeure will be ensured extraordinary evaluation periods.

These tests must be authorized by the corresponding Head of Studies, at the request of the professor responsible for the course, and will be carried out within the corresponding academic period.

Regulations for carrying out activities

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

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Bibliography

Basic:

Callister, W.D. Materials science and engineering: an introduction. 8th ed. Reino Unido (Inglaterra): John Wiley & Sons, 2010. ISBN 9780470419977.

Neville, A.M. Properties of concrete. 5th ed. Reino Unido (Inglaterra): Addison Wesley Longman, 2011. ISBN 9780273755807.

Fernández Cánovas, M. Hormigón. 9a ed. Madrid: Colegio de Ingenieros Caminos Canales y Puertos. Servicio de Publicaciones, 2011. ISBN 9788438003640.

Kraemer, C ... [et al]. Carreteras, vol. 2. Explanaciones, firmes, drenaje, pavimentos. Madrid: Colegio de Ingenieros de Caminos, Canales y Puertos, 1999. ISBN 8438001491.

Collepardi, M.; Collepardi, S.; Troli, R. Concrete mix design. Villorba: Grafiche Tintoretto, 2007. ISBN 8890146982.

Smith, M.R.; Collins, L. (eds.). Aridos: áridos naturales y de machaqueo para la construcción. 2a ed. Madrid: Colegio Oficial de Geólogos de España, 1994. ISBN 8492009705.

Domone, P.; Illston, J.M. Construction materials: their nature and behaviour. 4th ed. London ; New York: Spon Press, 2010. ISBN 9780415465151.

Complementary:

Bye, G.C. Portland cement. 3rd ed. London: ICE Publishing, 2011. ISBN 9780727736116.