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: 2017
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: MARILDA BARRA BIZINOTTO, SERGIO HENRIQUE PIALARISSI CAVALARO
Others: VICENTE ALEGRE HEITZMANN, DIEGO FERNANDO APONTE HERNÁNDEZ, MARILDA BARRA BIZINOTTO, SERGIO HENRIQUE PIALARISSI CAVALARO, SUSANA VALLS DEL BARRIO

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 which 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:
* 1 hour dedicated to steel test.
* 2 hours dedicated to the characterization of aggregates.
* 2 hours dedicated to the manufacture of concrete and study their properties in the fresh state.
* 1 hour 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

<table>
<thead>
<tr>
<th>Total learning time:</th>
<th>150h</th>
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<tbody>
<tr>
<td>Hours large group:</td>
<td>42h</td>
</tr>
<tr>
<td>Hours medium group:</td>
<td>4h</td>
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<tr>
<td>Hours small group:</td>
<td>14h</td>
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<tr>
<td>Guided activities:</td>
<td>6h</td>
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<tr>
<td>Self study:</td>
<td>84h</td>
</tr>
</tbody>
</table>

Total hours: 150h

Total hours large group: 42h (28.00%)
Total hours medium group: 4h (2.67%)
Total hours small group: 14h (9.33%)
Total guided activities: 6h (4.00%)
Total self study: 84h (56.00%)

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## Content

<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impact and management of building materials</strong></td>
<td>7h 11m</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
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<tr>
<td>Life cycle and parameters for assessing the environmental impact</td>
<td></td>
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<tr>
<td>Environmental protection of soils and water: leaching study</td>
<td></td>
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<tr>
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<td></td>
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<tr>
<td><strong>Mechanical behavior of materials</strong></td>
<td>7h 11m</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
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<tr>
<td>Basic concepts of fracture mechanics</td>
<td></td>
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<tr>
<td>Fracture mechanics</td>
<td></td>
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<tr>
<td><strong>Rocks</strong></td>
<td>9h 36m</td>
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<tr>
<td><strong>Description:</strong></td>
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<tr>
<td>Aggregates for concrete.</td>
<td></td>
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<tr>
<td>Aggregates for bituminosas mixtures.</td>
<td></td>
</tr>
<tr>
<td>Aggregates</td>
<td></td>
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</tbody>
</table>
### Concrete

**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

**Learning time:** 50h 24m  
- Theory classes: 12h  
- Practical classes: 4h  
- Laboratory classes: 5h  
- Self study: 29h 24m

### Metals

**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,

**Learning time:** 21h 36m  
- Theory classes: 9h  
- Self study: 12h 36m

### Polymers

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

**Learning time:** 4h 48m  
- Theory classes: 2h  
- Self study: 2h 48m
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<table>
<thead>
<tr>
<th><strong>Bituminous mixtures</strong></th>
<th><strong>Learning time:</strong> 21h 36m</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 7h</td>
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<tr>
<td></td>
<td>Laboratory classes: 2h</td>
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<tr>
<td></td>
<td>Self study: 12h 36m</td>
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</tbody>
</table>

**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.
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<table>
<thead>
<tr>
<th><strong>Ceramics and glasses</strong></th>
<th><strong>Learning time:</strong> 9h 36m</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
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<tr>
<td></td>
<td>Laboratory classes: 2h</td>
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<td>Self study: 5h 36m</td>
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**Description:**

<table>
<thead>
<tr>
<th><strong>Composite materials</strong></th>
<th><strong>Learning time:</strong> 4h 48m</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
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<tr>
<td></td>
<td>Self study: 2h 48m</td>
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**Description:**

<table>
<thead>
<tr>
<th><strong>Paints and varnishes</strong></th>
<th><strong>Learning time:</strong> 2h 24m</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 1h</td>
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<tr>
<td></td>
<td>Self study: 1h 24m</td>
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</tbody>
</table>

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

\[
\text{Grade mark} = 0.75 \times \left( \frac{E_1 + E_2}{2} \right) + 0.25 \left( \frac{P_1 + P_2 + P_3 + P_4 + V}{5} \right)
\]

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 or were qualified as non-attending 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.
Bibliography

Basic:


Complementary: