Course guides
310720 - 310720 - Underground Construction

Unit in charge: Barcelona School of Building Construction
Teaching unit: 753 - TA - Department of Architectural Technology.

Degree: BACHELOR’S DEGREE IN ARCHITECTURAL TECHNOLOGY AND BUILDING CONSTRUCTION (Syllabus 2019). (Compulsory subject).

Academic year: 2021  ECTS Credits: 4.5  Languages: Catalan, Spanish, English

LECTURER

Coordinating lecturer: Gómez Soberón, José Manuel Vicente
Others: Ruiz Gandullo, Javier

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. FE-7 Ability to identify the constructive elements and systems, define its function and compatibility, and its implementation to construction in the construction process. Plan and solve constructive details.
2. FE-13 Ability to apply the technical regulation to the construction process, and generate documents of technical specification in the constructive procedures and methods of buildings.
3. FE-4 Knowledge of the materials and traditional or prefabricated construction systems used in construction, their varieties and physical and mechanical features which define them.
4. FE-17. FE-17 Ability to schedule and organise the constructive processes, the construction teams, the technical and human means for its execution and maintenance.

Transversal:
4. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
5. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.

TEACHING METHODOLOGY

The in-person, directed and autonomous methods will be used.

With the combination of the three methods, the students must achieve the knowledge, comprehension, application, synthesis and evaluation levels.

In the in-person method, special attention will be made in the clarity, precision and order aspects by the faculty. These classes will be done by the whole group (big group), and the professor will develop the course topics at class. Theory contents will be exposed in classic theory classroom sessions (big group) or, alternatively complemented by project-oriented sessions (medium group).

In theory contents developed by projects work will be carried out in small teams (three / four members) promoting interactions between members, self-learning inside and outside the classroom, and the implementation of the theoretical teaching contents of the subject. Practices will be developed usually in small groups, by solving exercises related to the specific learning objectives of each of the contents of the subject.

Students will find all the required documentation in ATENEA including classroom presentations, selected open access textbooks and norms and some small software tools. Teaching performed in classrooms that allow the mobility of students (for medium group work), with access to WWW resources and with use of personal computer equipment or occasionally in computer rooms.
LEARNING OBJECTIVES OF THE SUBJECT

At the course end, students should be able to:
- Determine most appropriate construction options to solve a specific problem of underground part of buildings.
- Explain the meaning of the basic concepts and parameters of soil mechanics related to architectural constructions.
- Determine the most appropriate construction options to solve a specific underground building problem
- Knowledge of basic concepts and parameters of soil mechanics related to architectural building and relate knowledge of soil properties with construction processes.
- Define uses, potentialities and limitations of construction solutions related to underground construction.
- Identify relations cause-effect of soils in order to avoid and correct pathologies.
- Select and evaluate alternatives of open excavation techniques and required equipment.
- Define alternative construction techniques that provide most appropriate solution for underground constructions.
- Adequately consideration of environmental aspects, using energy saving techniques and management and enhancement of construction waste.

In the course, following transversal competences will be promoted and evaluated:
- Self-learning
- Team work
- Oral, written and graphic technical presentations.
- Use of software tools

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>27,0</td>
<td>24.00</td>
</tr>
<tr>
<td>Self study</td>
<td>67,5</td>
<td>60.00</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>18,0</td>
<td>16.00</td>
</tr>
</tbody>
</table>

Total learning time: 112.5 h

CONTENTS

Module 1 Spread foundations

Description:
In this contents students work:
- Basic foundations concepts
- Typologies and design procedures
- Detailed design of spread foundation elements (Footings, centering beams, slabs, etc)

Related activities:
ACT 1 on-line test in Atenea
ACT7 (General knowledge). Team home Works in a written solution of practical cases focused in detailed engineering design

Full-or-part-time: 15h
Theory classes: 15h
Module 2 Deep foundations.

Description:
- In this contents students work:
- Conditions for pile usage.
- Types of piles and compatibility.
- Pile reinforcement and construction control.
- Construction design of pile caps and bracing beams.

Related activities:
ACT 2 on-line test in Atenea
ACT 8 (General knowledge). Team home Works in a written solution of practical cases focused in detailed engineering design.

Full-or-part-time: 15h
Theory classes: 15h

Module 3 Earth retaining structures.

Description:
In this contents students work:
- Earth pressure and related contents.
- Different types of retaining walls. Stability and mechanical requirements and design.
- Formwork solutions and design for retaining wall construction.

Related activities:
ACT 3 on-line test in Atenea
ACT 9 (General knowledge). Team home Works in a written solution of practical cases focused in detailed engineering design.

Full-or-part-time: 20h
Theory classes: 20h

Module 5 Excavations, earth works and related equipment.

Description:
In this content we work:
- Soil properties and earth works.
- Earth works procedures.
- Excavation details.

Related activities:
ACT 5 on-line test in Atenea
ACT 11 (Team home Works in a written solution of practical cases focused in practical excavation design.

Full-or-part-time: 5h
Theory classes: 5h
Module 4 Subsurface flow and soil improvement

Description:
In this contents students work:
- Groundwater flow.
- Ground improvement techniques.
- Wall and slab waterproofing techniques.

Related activities:
ACT 4 on-line test in Atenea
ACT 10 Team home Works in a written solution of practical cases focused in detailed engineering design

Full-or-part-time: 5h
Theory classes: 5h

ACTIVITIES

ACT 1 (M1) CLASSROOM ON-LINE TEST.

Description:
At end of M1 theory sessions, individually, students will complete a 30-minute test.

Specific objectives:
After ACT1 completion, student should be able to:
- Identify soil properties and comportment based on type of foundations.
- Define main elements used in spread foundations.
- Interpret detailed engineering drawings used in spread foundations
- Design and draw adapted detailed engineering drawings and specifications

Material:
On-line multi option test in ATENEA.

Delivery:
Test completion is 5% of final grading.

Full-or-part-time: 0h 30m
Self study: 0h 30m

ACT 2 (M2) CLASSROOM ON-LINE TEST.

Description:
At end of M2 theory sessions, individually, students will complete a 30-minute test.

Specific objectives:
After ACT2 completion, student should be able to:
- Identify soil properties and comportment based for deep foundations.
- Define main elements used in deep foundations.
- Interpret detailed engineering drawings used in pile foundations
- Design and draw adapted detailed engineering drawings and specifications

Material:
On-line multi option test in ATENEA.

Delivery:
Test completion is 5% of final grading.

Full-or-part-time: 0h 30m
Self study: 0h 30m
### ACT 3 (M3) CLASSROOM ON-LINE TEST.

**Description:**  
At end of M3 theory sessions, individually, students will complete a 30-minute test.

**Specific objectives:**  
- After ACT3 completion, student should be able to:  
  - Identify necessary conditions to use different earth retaining solutions.  
  - Define main elements in required cantilever or flexible retaining walls.  
  - Solve detailed engineering problems for earth retaining walls and formworks.

**Material:**  
On-line multi option test in ATENEA.

**Delivery:**  
Test completion is 5% of final grading.

**Full-or-part-time:** 0h 30m  
Self study: 0h 30m

### ACT 4 (M4) CLASSROOM ON-LINE TEST.

**Description:**  
At end of M4 theory sessions, individually, students will complete a 30-minute test.

**Specific objectives:**  
- After ACT4 completion, student should be able to:  
  - Identify soil behavior and required foundation.  
  - Select soil improvement method based in real situations.  
  - Compare and differentiate the different dewatering systems.  
  - Identify the different waterproofing systems for walls.  
  - Solve construction problems related with soil improvement, dewatering and waterproofing.

**Material:**  
On-line multi option test in ATENEA.

**Delivery:**  
Test completion is 5% of final grading.

**Full-or-part-time:** 0h 30m  
Self study: 0h 30m
**ACT 5 (M5) CLASSROOM ON-LINE TEST.**

**Description:**
At end of M5 theory sessions, individually, students will complete a 30-minute test.

**Specific objectives:**
After ACT5 completion, student should be able to:
- Determination of soil stability in earth works.
- Select most appropriate sequence of excavation phases required for building foundations.
- Determine required equipment for excavation, fill and transport of materials.
- Determine detailed engineering aspects of earth works.

**Material:**
On-line multi option test in ATENEA.

**Delivery:**
Test completion is 5% of final grading.

**Full-or-part-time:** 0h 30m
Self study: 0h 30m

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**ACT 6 (M1, M2, M3, M4 and M5) INDIVIDUAL CLASSROOM WORK**

**Description:**
Individual work on compression and analysis of a technical or scientific text.

**Specific objectives:**
After ACT6 completion, student should be able to analyze a technical text identifying:
- Starting hypothesis
- Data used
- Models used
- Solutions analyzed
- Conclusions

**Material:**
On-line multi option test in ATENEA and written document.

**Delivery:**
ACT6 completion is 5% of final grading.

**Full-or-part-time:** 6h
Self study: 6h
ACT 7 (M1) TUTORED TEAM HOMEWORK

Description:
Teamwork on M1 content topics. Teams will consist of three students. Detailed practical development work of the contents of M1

Specific objectives:
- Teamwork
- Application of theoretical content
- Written and oral expression

Material:
Atenea documentation, construction codes and bibliography

Delivery:
ACT7 completion is 5% of final grading.

Full-or-part-time: 8h
Guided activities: 8h

ACT 8 (M2) TUTORED TEAM HOMEWORK

Description:
Teamwork on M1 content topics. Teams will consist of three students. Detailed practical development work of the contents of M2

Specific objectives:
- Teamwork
- Application of theoretical content
- Written and oral expression

Material:
Atenea documentation, construction codes and bibliography

Delivery:
ACT8 completion is 5% of final grading.

Full-or-part-time: 8h
Guided activities: 8h

ACT 9 (M3) TUTORED TEAM HOMEWORK

Description:
Teamwork on M1 content topics. Teams will consist of three students. Detailed practical development work of the contents of M3

Specific objectives:
- Teamwork
- Application of theoretical content
- Written and oral expression

Material:
Atenea documentation, construction codes and bibliography

Delivery:
ACT9 completion is 5% of final grading.

Full-or-part-time: 8h
Guided activities: 8h
## ACT 10 (M4) TUTORED TEAM HOMEWORK

**Description:**
Teamwork on M1 content topics. Teams will consist of three students. Detailed practical development work of the contents of M4

**Specific objectives:**
- Teamwork
- Application of theoretical content
- Written and oral expression

**Material:**
Atenea documentation, construction codes and bibliography

**Delivery:**
ACT10 completion is 5% of final grading.

**Full-or-part-time:** 8h
Guided activities: 8h

## ACT 11 (M5) TUTORED TEAM HOMEWORK

**Description:**
Teamwork on M1 content topics. Teams will consist of three students. Detailed practical development work of the contents of M2

**Specific objectives:**
- Teamwork
- Application of theoretical content
- Written and oral expression

**Material:**
Atenea documentation, construction codes and bibliography

**Delivery:**
ACT11 completion is 5% of final grading.

**Full-or-part-time:** 8h
Guided activities: 8h

## ACT 12 MIDTERM EXAMINATION (M1 y M2 TOPICS).

**Description:**
Student knowledge and skills will be evaluated individually in a graphic and written examination based on exercise resolution based on concepts associated with M1 and M2 topics.

**Specific objectives:**
- Evaluate student learning process

**Material:**
Course documentation and bibliography.

**Delivery:**
ACT12 completion is 15% of final grading.

**Full-or-part-time:** 2h
Self study: 2h
ACT 13 FINAL EXAMINATION (M3, M4 and M5 topics).

**Description:**
Student knowledge and skills will be evaluated individually in a graphic and written examination based on exercise resolution based on concepts associated with M1 and M2 topics.

**Specific objectives:**
- Evaluate student learning process

**Material:**
Content notes available in ATENEA.

**Delivery:**
ACT13 completion is 30% of final grading

**Full-or-part-time:**
2h
Self study: 2h

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**GRADING SYSTEM**

Individual evaluation
- Tests (Activities ACT1 to ACT5 5% each) 25%
- Midterm examination 15%
- Final examination 30%

Small group evaluation in tutored activities:
- Understanding and analysis (Activity ACT6) 5%
- Tutored activities (ACT7 to ACT11 5% each) 25%

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**EXAMINATION RULES.**

If any of the activities of the continuous evaluation are not carried out, it will be considered as not scored.

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**BIBLIOGRAPHY**

**Basic:**
- Rodríguez Ortiz, J.M. Curso aplicado de cimentaciones. 7a ed. Madrid: Servicio de publicaciones del Colegio Oficial de Arquitectos de Madrid, 1996.

**Complementary:**
- Bárbara, J; García Ferrer,M.; Oliveras, J. Ma. Muros pantalla, métodos constructivos y descripciones generales. [S.l.]: [S.n.], 197?.
RESOURCES

Other resources:
Audiovisual:
- Virtual Guide

WWW links:
- Library. https://bibliotecna.upc.edu/
- Virtual Campus: https://atenea.upc.edu/ Above links require student UPC identification