

Course guide

310720 - 310720 - Underground Construction

Last modified: 15/05/2023

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: 2023 **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.
- 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

Teaching praxis will be developed through the use of theoretical learning and practical problem solving. Work in small teams (three members) will be encouraged, promoting interaction between them, self-learning inside and outside the classroom, and putting into practice the theoretical teaching content of the subject.

The content of the subject will consist of establishing the constructive-structural solutions for the foundations of construction buildings, of the earth retention systems, of their excavation and earth transport process, and of the indirect construction techniques related to the construction processes to perform in works below ground

Teaching is expected to take place in classrooms that allow student mobility, with access to the WEB network, the use of computer equipment (specifically in computer rooms), and the use of software currently available at the EPSEB.

The directed learning hours consist, on the one hand, of giving theoretical classes (large group) in which the teacher makes a brief presentation to introduce the general learning objectives related to the basic concepts of the subject. Subsequently, and through practical exercises, try to motivate and involve the student body so that they actively participate in their learning.

Support material is used in the format of the detailed teaching plan, through ATENEA: learning objectives by content, concepts, examples, programming of evaluation and test activities, and bibliography. There will be practice classes (medium group) in which work is done, in general, in groups of three members, by solving exercises related to the specific learning objectives of each of the contents of the subject.

In these exercise sessions it is intended to incorporate some generic skills, such as teamwork skills. For this reason, cooperative learning techniques are developed in the classroom. In general, after each session tasks are proposed outside the classroom, which must be worked on either individually or in groups and which are the basis of the evaluable activities. Other hours of autonomous learning must also be considered, such as those dedicated to guided reading, the resolution of the proposed problems or the self-learning questionnaires of the different contents through the ATENEA virtual campus.

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

Type	Hours	Percentage
Hours medium group	18,0	16.00
Hours large group	27,0	24.00
Self study	67,5	60.00

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:

The ACT 1 (test) is carried out, which corresponds to an individual test of continuous evaluation in the classroom during the sessions of the medium or small group.

ACT7 (General knowledge) is carried out, which corresponds to group work with dedication to work outside the classroom. Special emphasis is placed on the development, by the student, of constructive details and written resolution of works.

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 (test) is carried out, which corresponds to an individual test of continuous evaluation in the classroom during the medium or small group sessions.

ACT 11 (General Knowledge) is carried out, which corresponds to a group work with dedicated work outside the classroom. Special emphasis is placed on the development, by the student, of constructive details and written resolution of works.

ACT 6 (test) is carried out, which corresponds to an individual test of evaluation of the third language competence in the classroom during the medium or small group sessions.

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:

The ACT 4 (test) is carried out, which corresponds to an individual continuous assessment test in the classroom during the medium or small group sessions.

ACT 10 (General Knowledge) is carried out, which corresponds to group work with dedication to work outside the classroom. Special emphasis is made on the development, by the student of construction details and written resolution of work.

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 behavior 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 behavior based on 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.
- Identify the different waterproofing systems for walls.
- Solve construction details according to the specific need.

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

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

Description:

Individually students will take a 30-minute test at the end of the content topics M1, M2, M3, M4 and M5. THIRD LANGUAGE PROFICIENCY TEST.

Specific objectives:

At the end of the activity, the student should be able to:

- Express themselves in writing and speaking appropriately, with terms and lexicons typical of the contents of the subject.
- Identify the real construction processes of the construction site or industry.
- Identify words in the English language relevant to the scope of the subject and its contents.

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:

At the end of the activity, the student should be able to:

The Directed Learning Activity (AD), will have a weight on the final grade of the subject of 5%, and will be composed of the following works:

- It will be done in a group of three people.
- Realization of a document reading pertaining to the module of contents of the subject.
- Completion of drafting requested in the AD.
- Answer to the questions asked.

Material:

Atenea documentation, construction codes and bibliogarphy

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:

At the end of the activity, the student should be able to:

The Directed Learning Activity (AD), will have a weight on the final grade of the subject of 5%, and will be composed of the following works:

- It will be done in a group of three people.
- Realization of a document reading pertaining to the module of contents of the subject.
- Completion of drafting requested in the AD.
- Answer to the questions asked.

Material:

Atenea documentation, construction codes and bibliogarphy

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:

At the end of the activity, the student should be able to:

The Directed Learning Activity (AD), will have a weight on the final grade of the subject of 5%, and will be composed of the following works:

- It will be done in a group of three people.
- Realization of a document reading pertaining to the module of contents of the subject.
- Completion of drafting requested in the AD.
- Answer to the questions asked.

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:

At the end of the activity, the student should be able to:

The Directed Learning Activity (AD), will have a weight on the final grade of the subject of 5%, and will be composed of the following works:

- It will be done in a group of three people.
- Realization of a document reading pertaining to the module of contents of the subject.
- Completion of drafting requested in the AD.
- Answer to the questions asked.

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:

At the end of the activity, the student should be able to:

The Directed Learning Activity (AD), will have a weight on the final grade of the subject of 5%, and will be composed of the following works:

- It will be done in a group of three people.
- Realization of a document reading pertaining to the module of contents of the subject.
- Completion of drafting requested in the AD.
- Answer to the questions asked.

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:

At the end of the activity, the student should be able to:

- Correctly deduce the proposed construction system.
- Identify and use with examples the different techniques of shallow and deep foundations.

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 M3, M4 and M5 topics.

Specific objectives:

At the end of the activity, the student should be able to:

- Correctly deduce the proposed construction system.
- Identify and use with examples the different techniques of retaining wall systems.

Material:

Content notes available in ATENEA.

Delivery:

ACT13 completion is 30% of final grading

Full-or-part-time: 2h

Self study: 2h

GRADING SYSTEM

The evaluation system that will be applied is continuous evaluation throughout the course; All evaluations will have rubrics that will establish the weighting criteria of the type: formal and format, as well as technical and content. The rubrics will have a progressive minimum scale of three levels for each item.

The types of evaluations will be:

- Multiple choice test, paired, true/false, etc. They will be done individually.
- Delivery work carried out in small groups of three people
- Partial and final written exam to be done individually

- Each content will be evaluated individually with a test (TEST). The set of tests contribute 30% of the final grade, and will be distributed with the following proportion:

The content test M1 (ACT 1) will contribute 5%.

The M2 content test (ACT 2) will contribute 5%.

The M3 content test (ACT 3) will contribute 5%.

The M4 content test (ACT 4) will contribute 5%.

The M5 content test (ACT 5) will contribute 5%.

Third Language Proficiency (ACT 6) will contribute 5%

- The work (TRAB) will be evaluated in small groups, which will consist of 5 activities (it will contribute 25% of the final grade, and will be divided as follows:

ACT7 General Knowledge M1 (will contribute 5% of the grade)

ACT8 General Knowledge M2 (will contribute 5% of the grade)

ACT9 General knowledge M3 (will contribute 5% of the mark)

ACT10 General knowledge M4 (will contribute 5% of the mark)

ACT11 General Knowledge M5 (will contribute 5% of the grade)

- It will be assessed individually (ACT 12) through an exam or graphic and written test (EP) that will be a general application of the subject and will contribute 15% of the final grade. It will be carried out during the academic period of classes.

- It will be assessed individually (ACT 13) through an exam or graphic and written test (EF) that will be a general application of the subject and will contribute 30% of the final grade. It will be carried out during the academic period of classes.

FINAL MARK = TEST x 30% + WORK x 25% + EP x 15% + EF x 30%.

Students who obtain as FINAL MARK a grade between 3.5 and 4.9 may, if they wish, take the re-evaluation exam; the grade that will prevail will be the higher of both exams.

SPECIAL NOTE:

1.- The partial and final exam evaluations will be carried out on the last scheduled day of classes (inside the classroom)

2.- For the proper functioning and teaching quality, it will NOT be accepted that a student has enrolled in the subject in a group; and attend classes, submit work or take assessments in a different group.

EXAMINATION RULES.

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

Demonstrable attendance is required during face-to-face classes (80% minimum to validate grade)

BIBLIOGRAPHY

Basic:

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- Graux, D. Fundamentos de mecánica del suelo, proyectos de muros y cimentaciones, geotecnia aplicada. 2a ed. Barcelona: Técnicas asociados, 1975.
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- Rodríguez Ortiz, J.M. Curso aplicado de cimentaciones. 7a ed. Madrid: Servicio de publicaciones del Colegio Oficial de Arquitectos de Madrid, 1996.
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- Terrenos y movimiento de tierras. Madrid : Tornapunta, 2013. ISBN 9788415977018.
- Calavera Ruiz, José. Muros de contención y muros de sótano . 3ª ed. [Madrid] : Instituto Técnico de Materiales y Construcciones, DL 2001. ISBN 9788488764102.

Complementary:

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- Bárbara, J; García Ferrer,M.; Oliveras, J. Ma. Muros pantalla, métodos constructivos y descripciones generales. [S.l.]: [S.n.], 197?.
- Reimbert, Marcel; Reimbert, André. Presiones y asentamientos de las cimentaciones superficiales, cálculo de las zapatas, estado elasto-plástico de los suelos. Barcelona: Editores Técnicos Asociados, 1978.
- Maquinaria de movimiento de tierras : procedimientos y técnicas operativas . Madrid : Tornapunta Ediciones, 2013. ISBN 9788415205784.
- Yepes Piqueras, Víctor. Procedimientos de construcción de cimentaciones y estructuras de contención . València : Universidad de Politécnica de Valencia, cop. 2016. ISBN 9788490484579.
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- Espanya. EHE-08 : instrucción de Hormigón Estructural : con comentarios de los miembros de la Comisión Permanente del Hormigón. Madrid : Ministerio de Fomento, Secretaría General Técnica, 2008. ISBN 978-8449808999.
- DB SE, seguridad estructural, bases de cálculo; DB SE-AE, acciones en la edificación. Madrid: Agencia Estatal Boletín Oficial del Estado, 2008. ISBN 8434017393.

RESOURCES

Other resources:

Audiovisual:

- Virtual Guide
- Visual dictionary of construction. <http://www.artifexbalear.org/diccon.htm> />

WWW links:

- Library. <https://biblioteca.upc.edu/> />- Virtual Campus: <https://atenea.upc.edu/> Above links require student UPC identification