8.8 CE0822 – Deep Excavations and Earth Retaining Systems

(1) GENERAL

SCHOOL	ENGINEERING SCHOOL		
ACADEMIC UNIT	CIVIL ENGINEERING DEPARTMENT		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**CE0822**	**SEMESTER**	**8**
COURSE TITLE	**Deep Excavations and Earth Retaining Systems**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	4	5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialization Course
PREREQUISITE COURSES:	Geotechnical Engineering (CE0620) English level B2 or higher is required for Erasmus incoming students
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek (English/Erasmus)
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/CIV174/

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course aim is the student to understand and be able to apply principles of design and analysis of open deep excavations and to calculate – design the retaining structure elements.

Upon the successful accomplishment of the course the student will be able to:

- Know the difference between active and passive earth pressures and the partial or complete development of passive pressures influence the retaining structure design.

- To design and analyse deep excavation works (gravity walls, cantilever, diaphragm, stuted retaining walls)
- To propose monitoring methods and interpret their results.
- To evaluate the geotechnical properties that are included in the problem.
- To apply the design and analysi normative documents (e.g. Eurocode)

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?;.

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Search for, analysis and synthesis of data and information, with the use of the necessary technology*
Adapting to new situations	*Adapting to new situations*
Decision-making	*Decision-making*
Working independently	*Working independently*
Team work	*Team work*
Working in an international environment	*Working in an international environment*
Working in an interdisciplinary environment	*Working in an interdisciplinary environment*
Production of new research ideas	*Production of new research ideas*

The course aims that the student acquires - practice the following general skills:

- Search for, analysis of, and synthesis of data and information, implementing appropriate technologies
- Independent work - Team work - Working in an international / interdisciplinary environment
- Design of geotechnical works
- Proact free, creative and inductive thinking

(3) SYLLABUS

Theory

1. Introduction. Required knowledge from Soil Mechanics. Retaining methods and types. Gravity wall, embedded walls, struted walls, reinforced earth walls, examples.
2. Earth pressures. Rankine passive and active pressures. Inclined ground surface solution. Application. Coulomb passive and active pressures solutions. Solution with friction at the wall – soil interface, with inclined ground surface and with general trapezoidal wall cross section. Rankine and Coulomb comparison. Examples solution. The concept of the mobilized earth pressure depending on the displacement magnitude. Vertical excavation and tension crack.
3. Gravity Walls. Gravity wall types and failure mechanisms. Calculation of safety factor against sliding and overturing failure mechanisms. Examples solution.
4. Embedded retaining walls . Construction methods. Failure mechanisms. Calculation of earth pressures and forces and moments: cantilever walls and single anchor walls. Calculation methodology of limit stability considering a deformation pattern of the structure. Critical design measures. Examples solution.
5. Struted retaining walls. Construction methods. Failure mechanisms. Calculation of earth pressures and forces and moments: simplified calculation. Base failure mechanism due to hydraulic gradient in sands and due to undrained conditions in clays. Examples solution.
6. External loads. Influence on the horizontal pressures of concentrated, linear and distrubuted surface load.
7. Groundwater: influence of the groudwater flow on the pressures, simplified solution.
8. Calculation of support systems. Struts, active and passive anchors. Calculation and design.
9. Geotechnical Applications. Eurocode 7 requirements, examples.

Exercises

1. Calculation of gravity wall and programming in spreadsheet.
2. Calculation of cantilever sheet wall and programming in spreadsheet.
3. Calculation of single anchor sheet wall and programming in spreadsheet.
4. Calculation of struted wall and programming in spreadsheet.
5. Calculation and design of anchors and struts.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-face in-class teaching. When needed, distance teaching (synchronous/asynchronous)</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of I.C.T. in Teaching and Student Communication</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non- directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>In Class (/Distance) Teaching</td><td>52</td></tr>
<tr><td>Literature Study</td><td>35</td></tr>
<tr><td>Exercises / Paradigms</td><td>32</td></tr>
<tr><td>Project assignment / Essay</td><td>31</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
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<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open- ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Language of evaluation: Greek (English/Erasmus)

Written examination, 2,5-hours
Problem solving, Multiple choice test, Questions and Answers,
Written Essay / Project

The evaluation criteria are announced to the students well before the examination; weights per subject /exercise are explicitly indicated.

The examination results (including total / partial grading) are announced on the web. Students may require to have access to their tests, they may ask for clarifications on mistakes, grading etc.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

Greek Bibliography:

1. Komodromos A. M. Foundations – Retaining Walls: Limit Equilibrium – Numerical Methods. (in Greek)
2. Kostopoulos Spyros D. Geotechnical Structures I. (in Greek)
3. Anagnostopoulos C, Chatzigogos T., Anastasiadis A., Pitilakis D. 2012. Foundations – Retaining Structures and Geotechnical Works. (in Greek)

Foreign Bibliography:

1. Foundations & Earth Structures DESIGN MANUAL 7.02, NAVFAC, 1986
2. Retaining and Flood Walls, Engineer Manual, U.S. Army Corps of Engineers, 1989