Teaching Guide				
Identifying Data				2023/24
Subject (*)	Foundations		Code	630G02043
Study programme	Grao en Estudos de Arquitectura			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	Fifth	Obligatory	6
Language				
Teaching method	Face-to-face			
Prerequisites				
Department	Construcións e Estruturas Arquitectónicas, Civís e Aeronáuticas			
Coordinador	Freire Tellado, Manuel Jose	E-mail	manuel.freire.tellado@udc.es	
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General description	After completing the course on foundations, the student will be able to effectively identify, confront and assess the usual problems that the usual foundation and containment structures may present within the context of the new architectural work. In order to develop these capacities, the necessary knowledge regarding the mechanics of the soil and the basic techniques of projecting and calculating the foundation and containment elements will be provided, complementing this knowledge with the existing bibliography and regulations. These contents will be exposed in the theory classes. To guarantee that the student is able to apply this knowledge adequately, a series of practical classes are proposed that will deal with the project, design and calculation of foundation elements, complemented by carrying out specific work on the subject. These works will be related to the professional activity of the architect within the specific content of this subject.			

Study programme competences / results	
Code	Study programme competences / results
A15	Ability to conceive, calculate, design, integrate in buildings and urban units and execute foundation solutions (T)
A17	Ability to apply technical and construction standards and regulations
A18	Ability to maintain building structures, foundations and civil works
A24	"Adequate knowledge of solid mechanics, continuous media and soil, as well as plastic and elastic qualities and strength of materials in heavy construction "
B2	Students can apply their knowledge to their work or vocation in a professional way and have competences that can be displayed by means of elaborating and sustaining arguments and solving problems in their field of study
B4	Students can communicate information, ideas, problems and solutions to both specialist and non-specialist public
B9	Understanding the problems of the structural design, construction and engineering associated with building design and technical solutions
C1	Adequate oral and written expression in the official languages.
C3	Using ICT in working contexts and lifelong learning.
C6	Critically evaluate the knowledge, technology and information available to solve the problems they must face
C7	Assuming as professionals and citizens the importance of learning throughout life

Learning outcomes			
Learning outcomes	Study programme competences / results		
Domain of CTE-SE-C and CE-21	A15 A17	B4 B9	C3 C6 C7

Foundation and / or containment structure project	A15 A17 A18 A24	B2 B4 B9	C1 C3 C6 C7
Direction of Foundations and Containments works	A17 A18 A24	B2 B4 B9	C1 C3
Maintenance and conservation of foundations	A15 A17 A18 A24	B2 B4 B9	C1 C3 C6 C7
Foundations and Containment Execution Project	A15 A17 A18 A24	B2 B4 B9	C1 C3 C6 C7
Knowledge of the soil as a support for the building	A15 A17 A24	B2 B4 B9	C1 C3 C6 C7

Contents	
Topic	**Sub-topic**
1. INTRODUCTION	1.1 Basic Concepts 1.2 Foundations Structures and Retaining Structures 1.3 Regulations: CTE-SE-C (EC-7)
2. LIMIT STATE	2.1 Limit States Concept: ULS and SLS 2.2 Design analysis process. Partial design factors in foundations and retaining structures analysis 2.3 Design process in CTE-SE-C and EC-7
3. SOIL MECHANICS	3.1 Soil Classification 3.2 Soil Physical Properties: density, particle size, consistency, permeability. 3.3 Water and Soil: wáter table, fluid, siphoning, Terzagui´s Law 3.4 Soil Consolidation 3.5 Soil Compresibility. Oedometer test. Oedometer Graphics. 3.6 Shear Strength. Direct Shear Test and Triaxial Compression Test. Soil Stress States
4. SOIL BEARING CAPACITY	4.1 Stress and Settlement. 4.2 Bearing Pressure. Efective Surface 4.3 Determination of Ultimate Beareing Capacity 4.4 Simplified Method 4.5 Foundations on rocks 4.6 Soil Elastic Response: Ballast Modulus 4.7 Geotechnical Stress and Structural Stress
5. GEOTECHNICAL REPORT	5.1 Basic Concepts 5.2 Scope and Contents 5.3 Types of Tests. Borehole, Soil Soundings, Penetration Test 5.4 Laboratory Analysis 5.5 Evaluation 5.6 Reference Tables

6. SPREAD FOUNDATIONS: FOOTINGS (PADS)	6.1 Introduction. Types of Spread Foundations 6.2 Continuos footing 6.3 Isolated footing 6.4 Strap footing. Strap beam 6.5 Particular Solutions 6.6 Constructive Details
7. SPREAD FOUNDATIONS: FLOATING FOUNDATIONS	7.1 Introduction. Types. Peculiarities 7.2 Combined footing 7.3 Beam Foundations 7.4 Grillage Foundations 7.5 Mat or Raft foundations 7.6 Constructive Details
8. TRENCH FILL FOUNDATIONS	8.1 Basic Concepts 8.2 Trench fill foundations 8.3 Constructive Details
9. PILE FOUNDATIONS	9.1 Introduction. Types 9.2 Piles 9.3 Micropiles 9.4 Pile Cap 9.5 Tie Beam 9.6 Constructive Details
10. LATERAL PRESSURE OF SOIL	10.1 Types: Active Pressure, Passive Pressure. Rest Earth Pressure 10.2 Coulomb´s Formula. CTE considerations 10.3 Propped Walls. 10.4 Water Table and Pressure. 10.5 Loads
11. RETAINING WALL DESIGN	11.1 Introduction. Types 11.2 Retaining Walls. Gravity Walls. Cantilevered Tilt-up Walls. Countefort Retaining Walls. Shelves Retaining Walls. 11.3 Basement Walls 11.4 Anchored Retaining Walls 11.5 Slurry or Diaphragm Walls 11.6 Pile Retaining Walls 11.7 Other Solutions: muros ecológicos y tablestacas.
12. EXCAVATION TECHNIQUES	12.1 Soil Interventions 12.2 Techniques in compact soils 12.3 Water and excavation 12.4 Slope Design 12.5 Soil Slope Stability 12.6 Rock Slope Stability
13. SOIL IMPROVEMENT TECHNIQUES	13.1 Soil Improvement Techniques: Vibro Replacement, Vibro Compaction, Jet-Grouting, Deep Mixed 13.2 Soil Replacement

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Introductory activities	A15 C7	0	1	1
Guest lecture / keynote speech	A15 A17 A18 A24 B9	30	0	30

Problem solving	A15 A24 B2 B4 B9 C1	18	9	27
Case study	A15 B9 C6 C7	0	3	3
Workbook	A15 C6 C7	0	6	6
Objective test	A15 A17 A18 A24 B2 C1	4	36	40
Supervised projects	A15 B2 B9 C1 C3 C6 C7	2	24	26
Workshop	A15 B2 B4 B9 C1	6	6	12
Events academic / information	A15 C6 C7	0	2	2
Personalized attention		3	0	3
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	**Description**
Introductory activities	Based on the contents of the teaching guide and the presentation of the subject, the student reviews his previous knowledge and recovers the previous teaching material related to the subject.
Guest lecture / keynote speech	Set of classes and conferences in which the expository work of the rapporteur (teacher and / or lecturer) is essential, work that is carried out with the support of the T.I.C. They consist of the development of the various topics on the agenda. The student must get used to handling the recommended bibliography of the subject, which can be found in the ETSA library (and partially also on the internet) with the support of the outlines of the classes available in the virtual faculty, as well as in reprography. The continuous monitoring of the theoretical classes is a requirement of the subject that is considered fulfilled with the attendance at least 80% of the classes that are developed in person.
Problem solving	The student will solve exercises oriented towards future professional practice under the tutelage of the teacher. We will insist on presenting the result in a way that is clearly visible, indicating the numerical value with the corresponding precision and units. The most common mistakes that are usually made will be explained, evaluating them according to their severity, both conceptual and numerical. Later, similar exercises will be proposed for their development by the students. The delivery of 80% of the properly resolved practices proposed is required.
Case study	The student is confronted with a specific real case, with an important structural content, which describes a real situation in professional life. The student must be able to analyze a series of facts, referring to the intervention on foundation structures to reach a reasoned decision through a process of discussion and critical reasoning, propose an action and confront it with the one carried out in reality.
Workbook	Acquisition of a general conceptual framework by reading texts about soil mechanics and foundations, as well as deepening on the various topics of the program and others that may be specifically interesting, due to the particular conditions of the work to be carried out.
Objective test	The student must pass two eminently practical tests that may include theoretical content on the different aspects of the subject presented in class.
Supervised projects	Throughout the course, the student will have to carry out work that involves the design of the structures and foundations of a building, as well as the dimensioning and elaboration of the appropriate plans of the foundations made at a professional level. This work is part of the development of an architectural project, progressively incorporating the different themes that are developed in theory. Those students who are not linked to the workshop will design a concrete porticoed building in the first three weeks of the course and will progressively develop all the aspects that will allow the design and calculation of the foundation, which will be organized in partial deliveries that will be recast in a final delivery. Monitoring is required throughout the course and its delivery on the date specified for it, not admitting delivery at the second opportunity.

Workshop	The student must project the structure and foundation of the projected building in a workshop regime, size the foundation and represent it adequately at a professional level. Starting with the building designed in the workshop, the methodology set forth in supervised work will be followed. The workshop, in accordance with the provisions of the current Curriculum, is subject to a process of continuous evaluation since it is also an interdisciplinary task. The revisions and deliveries that are made throughout the course are those that allow to guarantee the authorship of the work and to contrast its evolution. For this reason, follow-up is required throughout the course and its delivery on the date specified for it, not admitting its delivery at the second opportunity.
Events academic / information	Activities carried out by the student that involve attendance and participation in scientific and informative events (congresses, conferences, symposia, courses, seminars, conferences, exhibitions, visits to works, etc.) with the aim of deepening the knowledge of topics related to The matter. These activities provide the student with current knowledge and experiences that incorporate the latest developments in the field of study.

Personalized attention	
Methodologies	**Description**
Supervised projects Problem solving Workshop	During the practical classes, in which the resolution of problems related to the competences of the subject will be faced, under the supervision of the teacher. This contact will allow personalized attention to the student's doubts. The student will demonstrate the effective monitoring of the subject by attending tutorials in which the evolution of the development of the proposed works will be controlled, doubts will be clarified in carrying out the proposed exercises, and the contents will be related to the basic bibliography and / or complementary. Attendance and activity carried out will be controlled. Personalized attention will also be provided via the virtual forum on the Moodle page f the subject, which will remain open during the whole academic period, as well as responding during tutorial hours to queries made by e-mail.

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**
Supervised projects	A15 B2 B9 C1 C3 C6 C7	Evaluation of the developed project	30
Objective test	A15 A17 A18 A24 B2 C1	Test Results	70
Others			

Assessment comments

Attendance Assessment, as a system for gathering information aimed at issuing value judgments (and, where appropriate, merit) about the learning process, requires continuous development with constant student involvement. With this premise, attendance and participation are understood as fundamental, so that an unjustified and repetitive absence has a negative impact on the grade obtained per course, in a similar proportion as a lack of participation or a negative attitude.

In order to carry out the objective tests, it will be necessary to have an attendance of at least 80% to theory classes (expository) in face-to-face mode, along with 80% to practical classes (interactive) of the subject, as well as adequately delivering 80% of the weekly practices. Evaluation The continuous evaluation system is configured with two objective tests, which will be carried out during the course, and a supervised work that will be developed throughout the semester and whose follow-up will require partial deliveries. The mixed tests represent 70% of the global grade and the remaining 30% corresponds to the grade of the supervised work that includes the workshop work. This work consists of a workshop part and a specific part of the subject. Passing the subject requires obtaining a minimum overall grade, considering both the mixed tests and the supervised work, of 5 out of 10. To obtain this grade, a minimum value of 3/10 must be obtained in each of the evaluated parts (theoretical questionnaires, problems on mechanics, problems on foundatiosn and practical work).

The correction criteria include not only the accuracy of the results, but also the clarity of the presentation, the structuring of the analysis carried out, the use of units, the correct application of the normative criteria, and the terminology used. First and Second Chance Students who have not passed the subject per course will re-examine the pending parts in the two opportunities of the same course. In both cases, the note of the supervised work is kept.

The possibility of improving the works presented is not contemplated due to the impossibility of guaranteeing the authorship of the student. Therefore, the student who has not delivered this work at the time will not be able to compute this section. Advance Chance

In this call the students will examine the entire subject. The mark obtained previously in the supervised work is maintained, but in this case the students can choose to modify it by attending the workshop classes of the subject. Its delivery will be made one week before the exam period of this opportunity. Plagiarism

The detection of plagiarism, as well as the fraudulent performance of tests or evaluation activities, once verified, will directly imply the grade of failing "0" in the subject in the corresponding call, thus invalidating any grade obtained in all evaluation activities. ahead of the extraordinary call. Special situations: students with recognition of part-time dedication and academic dispensation Part-time: Dedication measures are not contemplated for part-time students because the subject is part of the workshop methodology Academic Waiver of Attendance Exemption: It is not contemplated because the subject participates in the workshop methodology Evaluation: no change.

Sources of information

Basic	- AA.VV. (2006). Código Técnico de la Edificación. Documento Básico de Seguridad Estructural: Cimientos CTE SE-C. Ministerio de Vivienda, Madrid - AA.VV. (2021). Código estructural CE-21. Ministerio de Fomento, Madrid - AA.VV. (2008). Guía para el proyecto y la ejecución de micropilotes en obras de carreteras.. Ministerio de Fomento - Ayuso, J. et Alt. (2009). Fundamentos de ingeniería de cimentaciones. Universidad de Córdoba. - Braja M. Das (2011). Principios de Ingenieria de Cimentaciones 7 Ed.. Calfornia State University. - Calavera, J. (2001). Muros de contención y muros de sótano. 3ª Ed. (De acuerdo con EHE). INTEMAC, Madrid - Calavera, J. (2015). Cálculo de estructuras de cimentación. 5ª Ed.. INTEMAC, Madrid - Comisión Permanente del Hormigón (2014). Guía de aplicación de la Instrucción del Hormigón Estructural l (EHE-08): edificación. Ministerio de Fomento, Madrid - Fiol Femenia, Francisco; Fiol Oliván, Francisco (2006). Manual de Cimentaciones. Diseño y Cálculo de cimentaciones superficiales y muros, geotecnica y patología.Conforme con el CTE.. Burgos - Freire Tellado, M.; Aragón Fitera, J.; Pérez Valcárcel J.B. (2015). Mecánica del Suelo y Cimentaciones: Ejercicios Resueltos. Reprografía do Noroeste (ISBN978 84 16294 15 2) - Lahuerta Vargas, Javier (). Mecánica del Suelo. Pamplona - Muzás Labad, F (2007). Mecánica del suelo y cimentaciones. Vol I y II. Escuela de la Edificación, Madrid - Pérez Valcárcel, JB. (2004). Excavaciones urbanas y estructuras de contención. C.O.A.G. - C.A.T. / Santiago - Pérez Valcárcel, J. B.; Freire Tellado, M. (2014). Introducción a la Mecánica del Suelo. Reprografía do Noroeste (ISBN 978-84-92794-99-7) - Rodriguez Ortiz - Serra Gesta - Oteo Mazo (1989). Curso Aplicado de Cimentaciones 7 Ed.. Colegio Oficial de Arquitectos de Madrid, COAM - Suárez Riestra, Félix L. (2009). Estudio Geotécnico y Mecánica de Suelos. Acercamiento al Concepto de Terreno como elemento estructural en el mundo de la edificación.. C.G.C.A.A.T.E.E. ISBN: 978-84-612-8003-2 - Aysen,A. (2002). Soil Mechanics: basic concepts and engineering applications.. Balkema Publishers Ed. ISBN-10: 978-0-415-38393-6 - Budhu, M. (2011). Soil mechanics and foundations.. John Wiley&Sons Inc. ISBN-10: 0470556846 - Curtin, W.G.; Shaw, G.;Parkinson, G.I.; Golding, J.M. (2006). Structural foundations designer´s manual.. Curtins Consulting&Blackewll Publishing. ISBN-10:1-4051-3044-X. - Fellenius, B.H. (2006). Basics of foundation design.. Electronic Edition (www.fellenius.net) - Kameswara, N.S.V. (2011). Foundation design, theory and practice.. Wiley Ed. ISBN:978-0-470-82535-1 - Verruijt, A. (2007). Soil Mechanics.. Delft University of Technology. Electronic Edition. (https://www.kau.edu.sa/Files/0001553/files/Soil
Complementary	

Recommendations
Subjects that it is recommended to have taken before
Structures 1/630G01019 Construction 2/630G01020 Structures 2/630G01023 Structures 4/630G01034
Subjects that are recommended to be taken simultaneously
Construction 7/630G01045
Subjects that continue the syllabus
Final Year Project/630011502
Other comments

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.