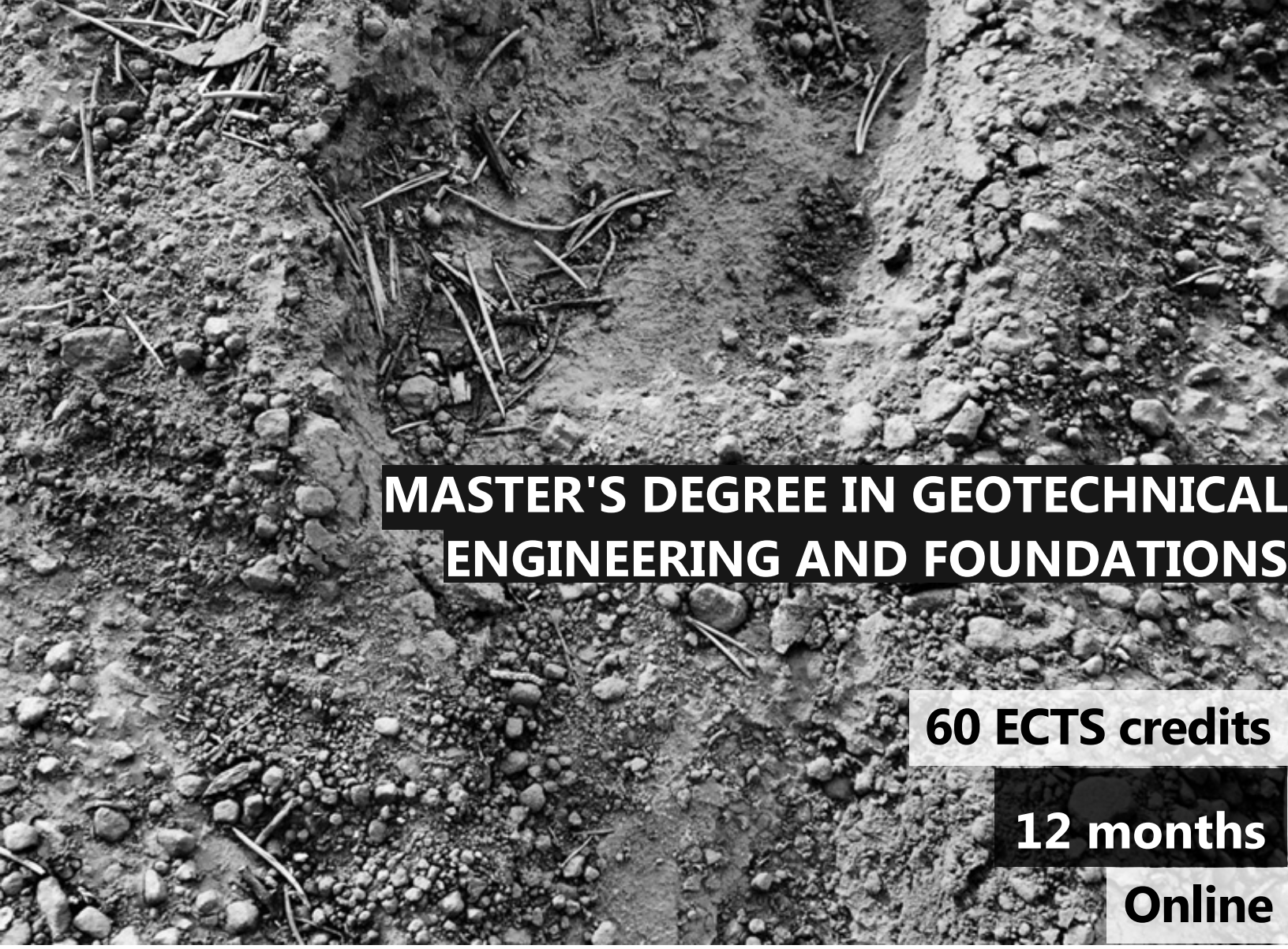

MASTER'S DEGREE IN GEOTECHNICAL ENGINEERING AND FOUNDATIONS

60 ECTS credits

12 months

Online

UCAM
UNIVERSIDAD
CATÓLICA DE MURCIA

Structuralia

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STRUCTURALIA

Structuralia is an online school specialized in graduate engineering, infrastructure, construction, energy, building, new technologies, and digital transformation programs and courses. We are dedicated to providing high-quality education for engineers, architects, and STEM (science, technology, engineering, and mathematics) professionals.

Since our creation in 2001, over 200,000 students from more than 90 countries have participated in our virtual classrooms as we disseminate knowledge and guide professionals toward success.

To this effect, we collaborate with leading international experts in each field, which enables our students to specialize under the guidance of active professionals. Our constant interaction with major companies in each sector, as their specialized training provider, enables us to tailor high-quality academic material to meet the current job requirements of our students.

Our master's programs are certified by our partner universities, such as the Universidad Católica San Antonio de Murcia, UDAVINCI, or Universidad Isabel I.

Every day we strive to provide the best training for engineers, architects, and STEM professionals with a clear goal: your professional success.

INTRODUCTION

The Master's degree in Geotechnical Engineering and Foundations at Structuralia aims at strengthening, increasing and consolidating the knowledge and skills of construction, geology and civil engineering professionals in the field of Geotechnical Engineering through a total of 9 modules. In addition to the main general concepts, the program focuses special attention on numerical modeling applications by means of a solid theoretical framework and practical exercises.

OBJECTIVES

The students who successfully complete the Master's degree in Geotechnical Engineering and Foundations will have knowledge and skills to perform specialized tasks and develop their professional career in the field of geotechnical engineering in civil engineering and construction companies, as well as in architecture firms.

- Strengthen and increase the student's knowledge of geotechnical engineering.
- Provide solid theoretical and practical foundations for geotechnical engineering tasks.
- Provide indispensable tools for further professional and/or academic development in geotechnical engineering.
- Initiate students into numerical modeling and advanced constitutive models for soils and rocks in geotechnical engineering

CAREER OPPORTUNITIES

- Project Consultant Engineer
- Project Manager in engineering consulting
- Project and Research Engineer in construction companies.
- Project and Research Manager in construction companies.
- Numerical Modelling Experts

WHO IS IT INTENDED FOR?

- Civil engineering and construction professionals
- Civil engineers (Roads, ports and canals)
- Geologists
- Geological engineers
- Mining engineers
- Industrial engineers (specialized in construction)
- Architects

PROGRAM

1. INTRODUCTION TO GEOTECHNICS. SOIL AND ROCKS

Unit 1: Description of Soils.

- Session 1: Soils. Concept and Formation
- Session 2: Soil. Types and Sedimentary Deposits.
- Session 3: Granular Soils. Gravels and Sands
- Session 4: Cohesive Soils. Silts and Clays
- Session 5: Cohesive Soils. Structure, Types and Properties of Clays

Unit 2: Properties and Classification of Soils.

- Session 6: Basic Properties. Volumes and Weights
- Session 7: Basic Properties. Soil Granular Structures
- Session 8: Basic Properties. Cohesive Soils.
- Session 9: Soil Classification. Unified Soil Classification System - ASTM
- Session 10: Soil Classification. AASHTO System

Unit 3: Description of Rocks.

- Session 11: The Geological Cycle. Plate Tectonics and Crustal Deformations.
- Session 12: Igneous Rocks
- Session 13: Sedimentary Rocks
- Session 14: Metamorphic Rocks
- Session 15: Rock, Rock Matrix and Rock Mass.

Unit 4: Properties and Classification of Rocks.

- Session 16: Rock Matrix Properties.
- Session 17: Rock Mass Properties. Discontinuities.
- Session 18: Geomechanical Classifications. RMR (Bieniawski)
- Session 19: Geomechanical Classifications. Q-System (Barton)
- Session 20: The GSI System: Geological Strength Index

2. GROUNDWATER. EFFECTS ON SOIL AND ROCKS

Unit 1: Fluid Flow in Porous Media.

- Session 1: Groundwater. Aquifer Types.
- Session 2: Darcy's Law. Hydraulic Head and Hydraulic Gradient. Permeability.
- Session 3: Mechanics and Theory of Fluid Flow in Porous Media.
- Session 4: Flow Nets.
- Session 5: The Method of Fragment.

Unit 2: Effective Stress and Pore Pressures. Water Effects on Soil and Rocks.

- Session 1: The Effective Stress Principle. Application in Soil and Rocks.
- Session 2: Soil Stress Distribution
- Session 3: Hydraulic Heave, Uplift, Internal Erosion and Piping.
- Session 4: Filters. Concept, Use and Preliminary Design.
- Session 5: Water Effects on the Rock Matrix and the Rock Mass.

Unit 3: Soil Consolidation.

- Session 1: Introduction.
- Session 2: The Magnitude of the Consolidation Settlement.
- Session 3: The Evolution of the Consolidation Settlement.
- Session 4: The Parabolic Isochrones Theory.
- Session 5: Preloading and Mixed and Radial Consolidation.[CM1]

Unit 4: Wells and Pumping Systems.

- Session 1: Well Construction
- Session 2: Well Design. Analytical Solutions for Individual Wells.
- Session 3: Design of Groups of Wells. Analytical Solutions for Groups of Wells.
- Session 4: Wellpoint Construction.
- Session 5: Wellpoint Design.

3. GROUND CHARACTERIZATION, INSTRUMENTATIONS AND MONITORING

Unit 1. Geotechnical and soil investigation campaigns

- Session 1. Preliminary Works
- Session 2. Design and Planning of Soil Investigation
- Session 3. Soil Investigation and Preliminary Research
- Session 4. Drilling Techniques [2] and Sampling methods
- Session 5. *In Situ* Testing for Soils and Rock Masses

Unit 2. Laboratory Tests in Geotechnical Engineering - I

- Session 1. Identification and State Tests I
- Session 2. Identification and State Tests II
- Session 3. Resistance Tests I
- Session 4. Resistance Tests II
- Session 5. Interpretation of Triaxial

Unit 3. Laboratory Tests in Geotechnical Engineering - II

- Session 1. Deformability Tests
- Session 2. Interpretation of Oedometer Tests
- Session 3. Compaction and Reuse Tests
- Session 4. Rocks Tests I
- Session 5. Rocks Tests II

Unit 4. Geotechnical Auscultation

- Session 1. Introduction to Geotechnical Auscultation
- Session 2. Instrumentation Equipment I
- Session 3. Instrumentation Equipment II
- Session 4. Instrumentation Equipment III
- Session 5. Real case studies

4. CONTINUUM MECHANICS AND CONSTITUTIVE MODELS. APPLICATIONS TO SOIL AND ROCKS

Unit 1: Elasticity and Continuum Mechanics.

- Session 1: The Stress Tensor: Total, Effective and Pore Stresses. Mohr's Circle for Stresses.
- Session 2: Strain Tensor. Mohr's Circle for strains.
- Session 3: Continuum Mechanics: Definition of the Mathematical problem..
- Session 4: Elasticity Equations and Parameters.
- Session 5: Main Elastic Solutions in Soil and Rock Mechanics.

Unit 2: Plasticity Theory.

- Session 1: Introduction to Plasticity.
- Session 2: Yield Criterion. Types of Plastic Behavior.
- Session 3: Yield surface and Plastic Potential.
- Session 4: Main Theorems and Postulates of the Plasticity Theory
- Session 5: The Mohr-Coulomb Elastoplastic Model.

Unit 3: Soil Constitutive Models

- Session 1: Rheological Models.
- Session 2: The Hardening Soil Model.
- Session 3: The Hardening Soil Small Model.
- Session 5: The Cam-Clay Model.

Unit 4: Rock Constitutive Models

- Session 1: The Hoek and Brown Constitutive Model.
- Session 2: The Barton-Choubey Constitutive Model for Joints and Discontinuities.
- Session 3: Viscosity, Viscoelasticity and Viscoplasticity.
- Session 4: Extension of Rheological Models.
- Session 5: Viscoelastic Constitutive Models.

5.EARTH PRESSURES AND RETAINING STRUCTURES

Unit 1: Theory

- Session 1: Classical Theory of Earth Pressures 1. Coulomb
- Session 2: Classical Theory of Earth Pressures 2. Rankine, Terzaghi
- Session 3: Classical Theory of Earth Pressures 3. Earth Pressure Coefficient.
- Session 4: Classical Theory of Earth Pressures 4. Winkler's Model.

- Session 5: Other Calculation Methods: Numerical Models and Equivalent Fluid Theory.
- Session 6: Theory. Seismic Considerations.

Unit 2: Rigid Walls

- Session 7: Rigid Walls I: Gravity Retaining Walls
- Session 8: Rigid Walls II: Reinforced Earth Walls
- Session 9: Rigid Walls 3: Breakwater Walls
- Session 10: Rigid Walls 4: Masonry, Precast Segmental and Berlin-type Retaining Walls.

Unit 3: Flexible Cantilevered Walls

- Session 11: Flexible Cantilevered Walls 1: Gabion and Crib Walls
- Session 12: Flexible Cantilevered Walls 2: Earth Reinforced Walls
- Session 13: Flexible Cantilevered Walls 3: Slurry Walls
- Session 14: Flexible Cantilevered Walls 4: Sheet Pile Walls
- Session 15: Flexible Cantilevered Walls 5: Anchors in Diaphragms Walls
- Session 16: Other Excavations: Trenches. Sheet-pilings

Unit 4: Design Considerations.

- Session 17: Design Considerations 1: Construction Procedures.
- Session 18: Design Considerations 2: Ground Movements and Monitoring.
- Session 19: Design Considerations 3: Special ground conditions
- Session 20: Design Considerations 4: Standard Sections and Filtering System Selection.

6. SLOPE STABILITY ANALYSES

UNIT 1: SLOPE STABILITY ANALYSIS

- Session 1: Landslides Classification
- Session 2: Geotechnical Concepts to Address a Slope Stability Problem
- Session 3: Soil Slope Stability
- Session 4: Rock Mass Slope Stability
- Session 5: Rock Slope Stability based on Geomechanical Indices

UNIT 2: SOIL SLOPE STABILITY

- Session 1: Soil Slope Stability Analysis. Classic Methods
- Session 2: Soil Slope Stability Analysis. Charts
- Session 3: The Slice Method
- Session 4: Corrective Measures for Soil Slope Stability
- Session 5: Finite Element Analysis of Soil Slopes

UNIT 3: ROCK SLOPE KINEMATIC ANALYSES

- Session 1: The Stereographic Projection
- Session 2: Planar Failure Kinematic Analysis
- Session 3: Wedge Failure Kinematic Analysis
- Session 4: Toppling Kinematic Analysis
- Session 5: Rock Mass Slope Kinematic Analysis

UNIT 4: ROCK SLOPE STABILITY ANALYSIS

- Session 1: Factor of Safety for Planar Rock Slope Failure
- Session 2: Factor of Safety for Wedge Rock Slope Failure
- Session 3: Factor of Safety for Toppling Rock Slope Failure
- Session 4: Rock Slope Stability and Sustainment Measures
- Session 5: Finite Element Analysis of Rock Slopes

7. SHALLOW FOUNDATIONS

Unidad 1: Determinants and Study of Failure Modes

- Introduction and Design Determinants
- Stress Distribution below Rigid Foundations
- Failure Mode Verification for ULS (Other than subsidence)
- Subsidence and bearing capacity
- General formula correction factors

Unidad 2: Additional Notes on Bearing Capacity

- Bearing Capacity in Non-homogeneous Soils
- Bearing Capacity from In situ Test
- Bearing capacity in Particular Soils
- Rock Bearing Capacity I
- Rock Bearing Capacity II

Unidad 3: Serviceability Limit State (SLS)

- Definitions and Concepts
- Soil Stress Distribution
- Settlement Estimates in Granular Soils
- Settlement Estimates in Cohesive Soils
- Other Methods and Other Deformations

Unidad 4: Slabs, Wells, Dynamic Aspects and Offshore Applications

- Slabs
- Caissons
- Dynamic Aspects. Vibrating Machine Foundations
- Dynamic Aspects. Foundation in Earthquake-Prone Areas and Ground Properties
- Shallow Foundations and their Maritime and Offshore Applications

8. DEEP FOUNDATIONS

Unit 1: Basic Concepts and Soil Piling

- Session 1: Deep Foundation Types. Definitions. Design Bases on Deep Foundations.
- Session 2: Basic Formulation. Ground Resistance Calculation against Vertical Actions in Soil
- Session 3: Pile Tip Resistance in Granular Soils. Analytical Solutions
- Session 4:Pile Tip Resistance in Cohesive Soils. Analytical Solutions

- Session 5: Pile Tip Resistance in Soils through in Situ Testing

Unit 2: Floating Piles in Soil, Piles in Rock and Pile Groups

- Session 6: Pile Shaft Resistance in Granular Soils. Analytical Solutions
- Session 7: Pile Shaft Resistance in Cohesive Soils. Analytical Solutions
- Session 8: Pile Shaft Resistance in Soils through in Situ Testing
- Session 9: Soil Resistance against Vertical Actions in Rocks
- Session 10: Pile Group Resistance

Unit 3: Workloads and Pile Settlement

- Session 11: Subsidence Safety. Factor of Safety
- Session 12: Pile Structural Capacity
- Session 13: Pile Settlement
- Session 14: Resistance to Pile Extraction
- Session 15: Pile Driving Formulas

Unit 4: Pile Selection and Unusual Situations

- Session 16: Lateral Load on Piles
- Session 17: Negative Skin Friction on Piles
- Session 18: Pile Load Tests
- Session 19: Pile type selection
- Session 20: Micropile Geotechnical Calculation

9. NUMERICAL MODELLING IN GEOTECHNICS. PLAXIS 2D

Unit 1: Numerical Modelling and its Application in Geotechnics. Introduction to Plaxis 2D.

- Session 1: Introduction to Numerical Modelling.
- Session 2: The Finite Element Method.
- Session 3: Numerical Modelling in Geotechnics.
- Session 4: Introduction to Plaxis 2D. Basic Concepts.
- Session 5: Organization and Structure of Plaxis 2D. User Interface.

Unit 2: Applications with Plaxis 2D – Geometry and Finite Element Mesh Construction

- Session 1: Definition of Soil Geometry and Structure.
- Session 2: Geometrical Elements, Loads and Movements Imposed on Plaxis 2D.
- Session 3: Definition of Soil Behavior. Constitutive Models.
- Session 4: Plaxis 2D Structural Elements
- Session 5: Definition of Finite Element Mesh.

Unit 3: Applications with Plaxis 2D – Calculation, Water and Result Analysis.

- Session 1: Definition of Calculation Phases.
- Session 2: Plaxis 2D Calculation Types .
- Session 3: Water in Plaxis 2D.
- Session 4: Calculation Methodology and Control Parameters.
- Session 5: Results Display and Analysis.

Unit 4: Applications with Plaxis 2D – Practical Cases.

- Session 1: Shallow Foundation.
- Session 2: Slope Stability Analysis.
- Session 3: The Modelling of an Excavation between Retaining Walls.
- Session 4: Embankment Construction and Consolidation.
- Session 5: Study of Groundwater Flow

MASTER´S FINAL PROJECT

The program is subject to possible variations / updates of the contents to improve their quality

PROFILE AUTHORS

Ángel Francisco Silvestre Ordaz

Ángel Francisco Silvestre Ordaz is a Civil Engineer (Roads, Canals and Ports) by the Polytechnic University of Valencia (UPV), Executive MBA from the ICADE Business School (Comillas Pontifical University ICAI-ICADE) and with a Master's degree in Project Management of International Constructions by EI CESI. Angel has developed his professional career both nationally and internationally by working in engineering (Terrasol – Grupo Setec and Intecsa-Inarsa) and construction companies (Ferrovial Agromán). His field of expertise is geotechnical engineering, especially tunnels and underground works. He is currently working as a freelance consultant engineer, providing consulting services on geotechnics and ground engineering.

Gonzalo Gómez Burgaz

Gonzalo Gómez is a Civil Engineer (Roads, Canals and Ports) from the Polytechnic University of Madrid (UPM) with an MSc in Structural Engineering (H-W University) and a Master's degree in Tunnels and Underground Works (AETOS).

He has focused his career on the field of geotechnical engineering, and has more than 15 years of experience in construction and first-tier consulting firms (ACS, Dragados, FCC, Isolux, Ferrovial and Sacyr). He currently works as Senior Geotechnical Engineer in Engineering Management at Sacyr.

Alejandro Fernández

Alejandro Fernández has a degree in Geology from the University of Oviedo, a Master's degree in Geological Engineering from the University of Leeds, and another in Tunnels and Underground Works from AETOS/UPM, as well as the Project Management Professional certificate from the Project Management Institute. Alejandro started his professional experience in the Foundations and Geotechnics Department at Mott MacDonald in London. In 2007, he joined the technical office at Ferrovial Agromán, where he is currently working as Project Manager. He has fifteen years of

international experience in large scale “design and built” projects in the United Kingdom, USA, Canada and Ireland.

Julio Garzón Roca

Dr. Julio Garzón-Roca holds a PhD in Civil Engineering by the Technical University of Valencia, Spain (Universidad Politécnica de Valencia, UPV), a MSc. in Concrete Engineering (UPV) and a Diploma in Higher Education Teaching (UPV). He has developed his academic career by researching and teaching during more than 10 years in the Geotechnical Engineering and Construction/Structural Engineering areas. He is the author of more than 45 scientific publications and 6 teaching publications. He worked at the Technical University of Valencia and the University of Minho (Portugal) and he is currently a postdoctoral researcher at the University of Surrey (UK). Likewise, during that time, he has also worked as a Geotechnical and Structural Advisor for different construction and independent companies.

Romain Goumy

Roman Goumy is a Civil Engineer (Roads, Canals and Ports) from the Polytechnic University of Valencia and an Ingénieur ETP from the ESTP in Paris. Roman developed his professional career in the field of geotechnics and started at the consulting firm Atkins in the United Kingdom, and then continued at the Geotechnics Department of the TYPSA in Valencia, where he is presently working. His experience covers design, field reconnaissance monitoring and processing, geotechnical element design (deep and shallow foundations, slopes, retaining and supporting structures) through analytical and soil-structure interaction calculations, as well as ground works and ground improvement.

Javier Torrijo

Francisco Javier Torrijo is a Geologist, with a Master’s degree and a PhD in Geology from the University of Zaragoza (UZ); EDP from the Industrial Organization Institute (EOI). He is also a civil engineer from the Atlantic International University (AIU); Gemologist from the University of Barcelona (UB); Master’s degree in Business Management and Administration, and Expert in University Pedagogy from the Polytechnic University of Valencia (UPV).

Francisco started his professional experience (since 1997) at Proyex and GeoPayma in their Geology and Geotechnics Department for 11 years.

Since 2002, he has been working as a Professor, and since 2017, as Deputy Head of the Ground Engineering Department at the Polytechnic University of Valencia (UPV), as well as a consultant and advisor on research and construction projects related to Ground Engineering in countries such as Ecuador, England, Peru, Brazil, Algeria, Angola, Andorra and Spain.

METHODOLOGY

At Structuralia, we apply a modern methodology adapted to the process of change we live in today. Our educational environment is based on an online learning system, that is, learning by observing, reflecting, and practicing with an organized and carefully programmed study pace, which comes along with the constant support from our team. Our learning solution is designed to facilitate learning at the student's own pace, with a uniform structure that includes continuous evaluations and practical exercises to reinforce knowledge.

Our program's calendar consists of 9 monthly modules, which are divided into 4 weekly teaching units. In addition, there are 3 months for the Master's Final Project (MFP). This structure may be adjusted depending on the innate complexities of the program.

Each of these units contain introductory videos on concepts, syllabus prepared by our experts (which can be viewed online or downloaded in PDF), and self-assessments. Some units may even have practical exercises or examples, if required by the expert. At the end of each module, there will be a compulsory exam in order to complete the module.

The Director will ask all students to complete a Master's project, in which they will apply everything they have learnt in the previous modules, to practical cases. Students will have 3

months to complete and submit the project, during which they will receive the support from the program's team.

Finally, you will receive the status reports from our team through regular follow-ups throughout the program.

DEGREE

Students who have visualized all the lessons, successfully passed the self-assessments and exams, and submitted the master's final project, will receive Structuralia's certificate and the title of Master of Professional Development by the Universidad Católica San Antonio de Murcia (UCAM), in digital format.

Likewise, the student can request a certificate of completion of his/her master's degree, or a certificate of completion from Structuralia.

The student may also request a the Hague Apostille on his/her certificate of completion from the university an additional fee.

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