Professional Master's Degree

Geotechnical and Foundation Engineering

tech global university

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Professional Master's Degree
Geotechnical and Foundation Engineering

- Modality: **online**
- Duration: **12 months**
- Certificate: **TECH Global University**
- Credits: **60 ECTS**
- Schedule: **at your own pace**
- Exams: **online**

Website: **www.techtitute.com/us/engineering/professional-master-degree/master-geotechnics-foundations**

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01

Introduction

This comprehensive program is designed to provide the student with in-depth knowledge of the contents and techniques of geotechnical engineering and their application to the various foundations and structures that can be found in different types of civil engineering projects. Focused directly on practical application, this program will address all the current issues in this area of intervention, providing the professional with a complete and efficient education.

A thorough and intensive study of the differential characteristics of soils and rocks, in relation to soil behavior, bearing capacity or strength"

The program is academically designed to provide in-depth knowledge, starting from advanced concepts already acquired in the world of Civil Engineering and from a practical application point of view, to the most important geotechnical aspects that can be found in different types of civil works.

The content ranges from the specific behavior of soils and rocks, with a constant differentiation of both types of terrain throughout all the topics, to their direct application in foundations and structures.

The program, divided into 10 modules, has a syllabus that mixes some of these modules that have more applied theory (such as those related to soil behavior models, the necessary requirements for a good identification of soils and rocks or the interaction of the soil with seismic disturbances), with others that have an emphasis on practical analysis. The knowledge acquired on the behavior of the soil and its stress-strain states in this first part is applied to the usual structures of Geotechnical Engineering: slopes, walls, screens, tunnels, etc.

Geotechnical engineering and its application in foundations and structures is present in many civil engineering projects and works. This path, which goes from compaction and seismic considerations in linear works to the execution of tunnels and galleries, is the one that is carried out with the case studies addressed in each of the topics. It is a priority to ensure that these case studies are current and relevant. This allows for an original and application-oriented analysis of the theoretical concepts developed throughout the course.

Therefore, the Professional Master's Degree in Geotechnical and Foundation Engineering integrates the most complete and innovative educational program in the current market in terms of knowledge and the latest available technologies, in addition to encompassing all sectors or parties involved in this field. In addition, the program consists of exercises based on real cases of situations currently managed or previously faced by the teaching team.

All this, through a 100% online program that allows the student to take the course wherever and whenever they want. All they will need is a device with internet access, and they will be able to access a universe of knowledge that will be the main basis for engineers to position themselves in a sector that is increasingly demanded by companies in various industries.

This **Professional Master's Degree in Geotechnical and Foundation Engineering** contains the most complete and up-to-date program on the market. Its most notable features are:

- Practical cases presented by experts in Civil Engineering and Geotechnics
- The graphic, schematic, and practical contents with which they are created, provide scientific and practical information on the disciplines that are essential for professional practice
- Practical exercises where the self-assessment process can be carried out to improve learning
- Special emphasis on innovative methodologies
- Theoretical lessons, questions to the expert, debate forums on controversial topics, and individual reflection assignments
- Content that is accessible from any fixed or portable device with an Internet connection

An intensive study of the contents and techniques of Geotechnical Engineering and their application to foundations and structures"

Acquire the working skills required to develop the initial site survey and valuations that are essential for the creation of adequate and safe structures"

A 100% online refresher program that will allow you to balance your studies with the rest of your daily activities

Make the most of the opportunity and take the step to get up to date on the latest developments in Geotechnical and Foundation Engineering

The program's teaching staff includes professionals from the sector who contribute their work experience to this program, as well as renowned specialists from leading societies and prestigious universities.

The multimedia content, developed with the latest educational technology, will provide the professional with situated and contextual learning, i.e., a simulated environment that will provide an immersive education, programmed to learn in real situations.

This program is designed around Problem-Based Learning, whereby the professional must try to solve the different professional practice situations that arise during the academic year. For this purpose, the professional will be assisted by an innovative interactive video system created by renowned and experienced engineering experts.

02

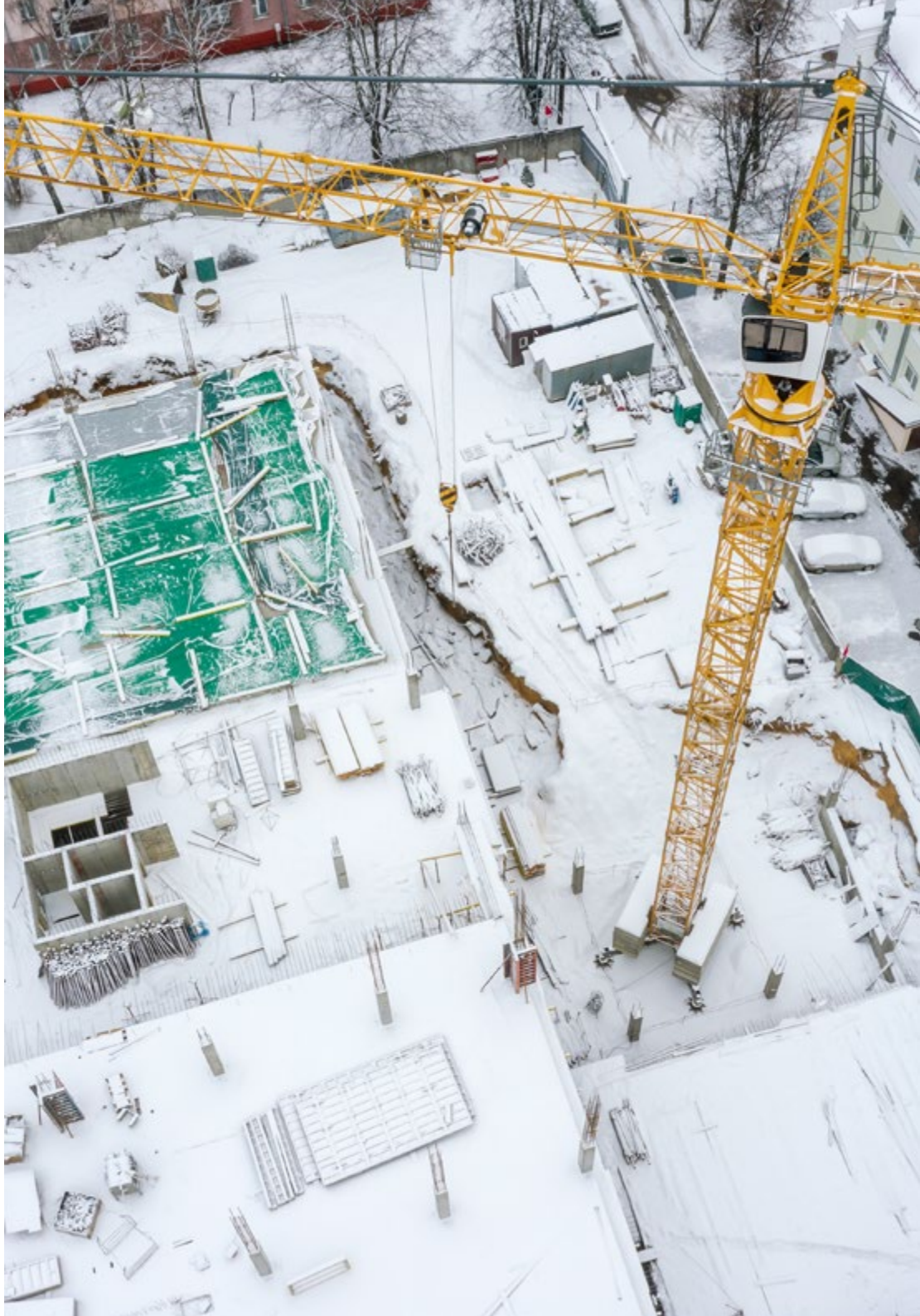
Objectives

Through this program, engineering professionals will acquire the necessary knowledge to analyze the characteristics of soils and rocks, assessing with solvency the suitability of each approach in civil works. With the security and efficiency of a program created to boost professionals in the management and approach of civil works in relation to the land as an imperative technical base, this learning will make you unstoppable on your way to mastering these issues.

Learn to recognize the different types of soils and to adapt the construction works to the behavior that these differences determine, according to the latest technological and scientific developments in the sector"

General Objectives

- Delve deeper into kinds of soil, not only in their typology but also in their behavior. Not only in the evident differentiation of stresses and deformations of soils and rocks, but also under particular but very common conditions, such as the presence of water or seismic disturbances
- Efficiently recognize the needs for soil characterization, being able to design campaigns with the optimal means for each type of structure, optimizing and giving added value to the study of materials
- Identify the behavior of slopes and semi-subterranean structures such as foundations or walls in their different typologies. This complete identification must be based on understanding and being able to anticipate the behavior of the terrain, the structure and its interface
- Know, in detail, the possible faults that each set can produce and, as a consequence, have an in-depth understanding of the repair operations or improvement of materials to mitigate damage
- Carry out a complete review of tunnel and gallery excavation methodologies, analyzing all drilling procedures, design constraints, support and lining



Specific Objectives

Module 1. Soil and Rock Behavior

- Establish the main differences between dynamic and static characterization and behavior of soils and rocks
- Present the most important geotechnical parameters in both cases and their most commonly used constitutive relationships
- Gain detailed knowledge of the different behaviors of terrain and the most commonly used elastic and plastic models for all types of terrain
- Make a presentation of the most common stress cases in practice and soil behavior at different degrees of saturation, swelling and compaction in soils. The fundamental principles of these constraints and their application throughout the development of terrain dynamics and statics are the application parts and objectives for this module
- From the practical point of view, the objectives will be marked by the need to discern all the parameters, stresses, types of stresses and soil and rock concepts. In the same way, we must know which of the constitutive models of the terrain should be used for each of the cases, depending on the characteristics of each of the actions to be approached

Module 2. Terrain Reconnaissance: Characterization and Auscultation

- Define the characteristics to be contained in a specific geotechnical study applied to each particular soil and application requirements
- Establish the concepts included in the most important international standards for sampling and field testing, making a comparison of each one of them
- Acquire in-depth knowledge of the data obtained in field surveys and their interpretation
- Recognize the need to complement field tests with other complementary tests, such as dynamic and static penetration tests
- Acquire the necessary knowledge regarding drilling fluids, both for field testing and for other types of drilling: Characteristics, applications, performance, etc.
- Deepen understanding of the practical utility of permeability tests, identifying their fields of application and their convenience
- Make special emphasis on the correct planning of a geotechnical survey campaign, establishing the timing and performance of each phase
- Extend in a practical way the knowledge of laboratory tests, not in terms of definition, which is a known fact, but in terms of being able to foresee the results to be obtained and to identify inappropriate results and malpractice in their execution
- Establish the usefulness of geophysical survey systems
- As far as auscultation is concerned, the main objective of the subject is the recognition of the elements to be auscultated and their actual application on site. In addition, new technologies for continuous auscultation are analyzed

Module 3. Behavior of Water in Terrain

- Identify of the presence of water in the behavior of soils and acquire correct knowledge of the different storage functions and characteristic curves
- Discuss the terms of effective and total pressures and determine the exact influence of effective and total pressures on the loadings of the land
- Identify the most common errors regarding the use of these terms of effective and total pressures, and show practical applications of these concepts that are of great importance
- Apply knowledge of the behavior of semi-saturated soils in data collection and sample analysis, with regard to laboratory tests: drained and undrained tests

- Determine the uses of soil compaction as a measure to reduce soil saturation. Correctly handle the compaction curve by analyzing the most common errors and their applications
- Analyze the most common saturation processes such as swelling, suction and liquefaction in soils, describing the characteristics of the processes and their consequences in soils
- Apply all these concepts to the modeling of stresses and their variation according to the degree of saturation of the soil
- Know in detail the applications of saturation in surface works and saturation removal processes in superficial linear works
- Correctly define zonal hydrogeology in a project, determining the concepts that should encompass its study and the long-term consequences it may have on structural elements
- Explain in depth the definition of preconsolidation processes as a way to provide soils with improved mechanical properties by reducing soil saturation
- Carry out flow modeling, the permeability concept and its actual application in interim and final construction states

Module 4. Seismicity Continuous Medium Mechanics and Constitutive Models. Application to Soils and Rocks

- Identify the effects induced in the ground by seismic action, as part of the non-linear behavior of the ground
- Deepen understanding of the particularities of the terrain, discretizing between soils and rocks, and understand the instantaneous behavior under seismic loads
- Analyze the most important regulations in the seismic field, especially in areas of the planet where earthquakes are frequent and of significant magnitude
- Analyze the changes that the seismic action produces in the identifying parameters of the terrain and observe how they evolve depending on the type of seismic action
- Delve into the different practical methodologies for the analysis of ground behavior under seismic conditions, both semi-empirical simulations as well as complex finite element modeling
- Quantify the impact of seismic disturbances on foundations, both in terms of their definition in the design and final sizing
- Apply all of these conditions to both shallow and deep foundations
- Perform a sensitivity analysis of the above-mentioned behaviors in containment structures and in the most common elements of subway excavations
- Apply the study of seismic wave disturbances in other elements that can propagate along the ground, such as the study of noise and vibration transmission in the ground

Module 5. Land Treatment and Improvement

- Acquire comprehensive knowledge of the different types of existing land treatments
- Analyze the range of existing typologies and their correspondence with the improvement of the different properties
- Know precisely the variables that are found in the processes of land improvement by injection: consumption, requirements, advantages and disadvantages
- Present, in an extensive way, gravel column treatments as relatively-little-used elements of land treatment, but with remarkable technical applications
- Gain in-depth knowledge of soil treatments by chemical treatment and freezing, as little-known treatments, but with very good spot applications
- Define the applications of preloading (preconsolidation), which was covered in a previous module, as an element of soil treatment to accelerate the evolution of soil behavior

- Complete the knowledge of one of the most used ground treatments in subway works, such as micropile umbrellas, defining applications different from the usual ones and the characteristics of the process
- Deal in depth with soil decontamination as a land improvement process, defining the typologies that can be used

Module 6. Slope Analysis and Stability

- Determine, for soils and rocks, the stability conditions and behavior of slopes, whether it is stable or unstable, and the stability margin
- Define the loads to which each part of the slope is subjected and the operations that can be carried out on them
- Investigate the potential mechanisms of slope failure and the analysis of practical cases of this type of failure
- Determine the sensitivity or susceptibility of slopes to different mechanisms or triggering factors, including external effects such as the presence of water, the effect of rainfall, earthquakes, etc
- Compare the effectiveness of different remediation or stabilization options and their effect on slope stability
- Learn more about the different options for improving and protecting slopes, from the point of view of structural stability and the conditions to which they may be subjected during their service life
- Design optimal slopes in terms of safety, reliability and economy
- Review the application of slopes in hydraulic works as a major part of the design and use of major slopes
- Detail the calculation methodologies associated with finite elements currently in use for the design of this type of elements

Module 7. Superficial Foundations

- Gain in-depth knowledge of the conditioning factors that influence the design and behavior of shallow foundations
- Analyze the trends in the different international design standards, contemplating their differences in terms of criteria, and the different safety coefficients used
- Recognize the different actions present in shallow foundations, both those that require and those that contribute to the stability of the element
- Establish a sensitivity analysis of the behavior of the foundations in the evolution of this type of loads
- Identify the different types of improvement of foundations already in use, classifying them according to the type of foundation, the soil on which it is located and the age at which it was built
- Break down, in a comparative way, the costs of the use of this type of foundations and their influence on the rest of the structure
- Identify the most common types of surface foundation failures and their most effective corrective measures

Module 8. Deep Foundations

- Acquire detailed knowledge of piles as deep foundation elements, analyzing all their characteristics, construction typologies, auscultation capacity, types of failure, etc
- Review other deep foundations of more specific use, for special structures, pointing out those types of projects in which they are used and in very particular practical cases
- Analyze the major enemies of this type of foundations, such as negative friction or loss of tip resistance, among others
- Have a high degree of knowledge of deep foundation repair methodologies and auscultation, both initial execution and repairs
- Measure, in a correct way and according to the particular characteristics of the work, the appropriate deep foundations
- Complete the study of deep foundations with the upper bracing elements and their grouping, with a clear development of the structural dimensioning of the pile caps

Module 9. Retaining Structures: Walls and Screens

- Define and acquire complete knowledge of the loads that the soil produces on the retaining structures
- Extend this knowledge with the analysis of the interaction of surface loads, lateral loads and seismic loads that may occur in the soil adjacent to this type of structure
- Go through the different types of retaining structures, from the most common continuous screens and piles to other elements of more specific use such as sheet piling or Soldier-piles
- Deal with the deformational behavior of the backside of these elements, both in the short and long term, with special interest in the calculation of surface seating in deep screens
- Learn more about the sizing and behavior of bracing structures, struts and anchors
- Analyze with current finite element calculation methods the most common safety coefficients in this type of structures as well as their correlation by applying statistical reliability concepts

Module 10. Tunnel and Mining Engineering

- Establish the different most common methodologies for tunnel excavation, both those excavated by conventional methods and those excavated by mechanical means
- Be clear about the classification of these methodologies according to the type of terrain, excavation diameters and end use of tunnels and galleries
- Apply the very different soil and rock behaviors defined in other modules of this master's degree to tunnel and gallery excavation
- Recognize the design constraints of the supports and revetments, and understand more deeply their relationship with rock mechanical classifications and soil typologies
- Adapt all these conditions to other types of deep excavation such as shafts, subway connections, interactions with other structures, etc
- Analyze the mining excavation with the particularities it has due to the depth of its actions
- Gain detailed knowledge of the interaction of deep excavations on the surface Performing an approach to seat calculation in different phases
- Establish a concrete relationship between seismic disturbances and the stress-strain behavior of tunnels and galleries, as well as identify how this type of disturbance modifies the supports and linings

A unique specialization program that will enable you to acquire superior knowledge for development in this field"

03

Skills

This Professional Master's Degree will enable the professional to detect and solve problems within broad contexts related to Geotechnical Engineering. All this, taking into account aspects such as the market, the structure of the current system and the development of business projects, incorporating the assurance of in-depth knowledge of the problems that the field can cause and the proper use and management of its possibilities. This is done with the certainty of being up to date with the most innovative proposals in this field.

You will develop competence in the global management of the practical conditions affecting civil engineering projects, with knowledge of the current international context"

General Skills

- Master the global environment of Geotechnical Engineering and foundations, from the international context and markets, to project development, operation and maintenance plans and sectors such as insurance and asset management
- Know how to apply acquired knowledge and problem-solving skills in current or unfamiliar environments within broader contexts related to Geotechnics
- Be able to integrate knowledge and get a deep vision of the different uses of Geotechnics, as well as the importance of its use in today's world
- Know how to communicate design, development and management concepts of the different systems of civil engineering
- Understand and internalize the scope of digital and industrial transformation applied to foundation systems for efficiency and competitiveness in today's market
- Be able to perform critical analysis, evaluation and synthesis of new and complex ideas related to the field of Civil Engineering
- Be able to promote, in professional contexts, technological, social or cultural progress within a knowledge-based society

Specific Skills

- Perform a safe approach to a construction site that has geotechnical components
- Master the concepts necessary to identify the actions to be taken, the tasks to be coordinated or the corrective decisions to be made, after a very exhaustive review of the casuistry that can be generated by Geotechnical Engineering
- Know in depth the practical and concrete data, so that the subject matter and the way of dealing with each of the topics creates a reference base
- The program is academically designed to provide in-depth knowledge, starting from advanced concepts already acquired in the world of Civil Engineering, and from a practical application point of view, of the most important geotechnical aspects that can be found in different types of civil engineering projects
- Understand the specific behavior of soils and rocks
- Know how to differentiate the types of terrain

Improving your geotechnical skills will give you a boost to your professional career, with greater intervention skills and better results"

04

Course Management

TECH follows strict criteria for all its educational programs. This guarantees students that, by studying here, they will find the best educational content taught by the best professionals in the sector. In this sense, this Professional Master's Degree in Geotechnical and Foundation Engineering is delivered by highly prestigious professionals in this field, who contribute their years of experience to this program, as well as the knowledge they've acquired from research in the field. All this to provide the engineer with a high-level program, which will enable them to practice with greater guarantees of success.

Learn with the best and acquire the knowledge and skills you need to intervene in this area of development with total success"

Management

Dr. Estébanez Aldona, Alfonso

- Civil Engineer, graduated from the Polytechnic University of Madrid
- PhD student at ETSI Caminos, Canales y Puertos UPM in the Department of Terrain Engineering
- Course on Health and Safety Coordinator in Construction Works registered by the CAM nº 3508
- Engineering and Technical Director at ALFESTAL
- International Consultant and Project Manager at D2
- Project Manager in the Department of Tunnels and Underground Works in Inarsa S.A
- Assistant Technician in the Geology and Geotechnical Department of Intecsa-Inarsa

Professors

Dr. Sandin Sainz-Ezquerra, Juan Carlos

- Specialist in the calculation of structures and foundations, fields in which he has developed his entire professional career over the last 25 years
- Civil Engineer at the ETSI of Roads, Canals and Ports at the Polytechnic University of Madrid (UPM)
- PhD student at ETSI Roads, Canals and Ports at UPM in the Department of Structures.
- Course on Integration of BIM Technology in Structural Design 2017
- Lecturer in the BIM Master's Degree developed at the Colegio de Caminos 2019
- Technical assistance for SOFISTIK AG for Spain and Latin America, finite element modeling software for terrain and structures

Ms. Lope Martín, Raquel

- Geological Engineer, Complutense University of Madrid UCM
- PROINTEC Technical Department.
- She has been involved in various projects requiring improvement treatments, both nationally and internationally: jet grouting, gravel columns, vertical drains, etc
- Course on Geotechnics Applied to Building Foundations
- Course on Technical Control for Property and Casualty Insurance Geotechnics, foundations and structures

Dr. Clemente Sacristan, Carlos

- Civil Engineer graduated from the Polytechnic University of Madrid
- Development of large-scale linear works for different administrations (ADIF, Ministry of Public Works, Provincial Council of Vitoria) being a reference project manager in the field of linear works
- Executive at BALGORZA S.A
- Occupational risk prevention course for construction company managers
- Advanced course in management of large turnkey projects (EPC)

05

Structure and Content

The syllabus has been built based on the intensive and high-impact teaching requirements of this Professional Master's Degree. Through a complete course, which incorporates all the fields of work in which geotechnical analysis intervenes, the student will develop their theoretical and practical knowledge, achieving a professional and personal growth that will allow them to intervene in this field of work with the confidence of an expert

A high-impact syllabus, focused on the complete acquisition of knowledge, incorporating both theoretical knowledge and practical skills"

Module 1. Soil and Rock Behavior

1.1. Fundamental Principles and Magnitudes
- 1.1.1. Ground as a Three-Phase System
- 1.1.2. Types of Stress States
- 1.1.3. Constitutive Quantities and Relationships

1.2. Semi-Saturated Soils
- 1.2.1. Soil Compaction
- 1.2.2. Water in Porous Environment
- 1.2.3. Stress in Soil
- 1.2.4. Behavior of Water in Soil and Rocks

1.3. Behavior Models in Soils
- 1.3.1. Constitutive Models
- 1.3.2. Non-Linear Elastic Models
- 1.3.3. Elastoplastic Models
- 1.3.4. Basic Formulation of Critical State Models

1.4. Soil Dynamics
- 1.4.1. Behavior after Vibrations
- 1.4.2. Soil-Structure Interaction
- 1.4.3. Soil Effect on Structures
- 1.4.4. Behavior in Soil Dynamics

1.5. Expansive Soils
- 1.5.1. Saturation Processes Swelling and Collapse
- 1.5.2. Collapsible Soils
- 1.5.3. Soil Behavior under Swelling

1.6. Rock Mechanics
- 1.6.1. Mechanical Properties of Rocks
- 1.6.2. Mechanical Properties of Discontinuities
- 1.6.3. Applications of Rock Mechanics

1.7. Characterization of the Rock Massif
- 1.7.1. Characterization of the Properties of Massifs
- 1.7.2. Deformity Properties of Massifs
- 1.7.3. Post-Breakage Characterization of the Massif

1.8. Rock Dynamics
- 1.8.1. Crust Dynamics
- 1.8.2. Rock Elasticity-Plasticity
- 1.8.3. Rock Elasticity Constants

1.9. Discontinuities and Instabilities
- 1.9.1. Geomechanics of Discontinuities
- 1.9.2. Water in Discontinuities
- 1.9.3. Discontinuity Families

1.10. Limit States and Loss of Equilibrium
- 1.10.1. Natural Stress in Terrain
- 1.10.2. Types of Breakages
- 1.10.3. Flat Break and Wedge Break

Module 2. Terrain Reconnaissance: Characterization and Auscultation

2.1. Geotechnical Study
- 2.1.1. Terrain Recognition
- 2.1.2. Content of the Geotechnical Study
- 2.1.3. On-site Testing and Trials

2.2. Standards for the Execution of Tests
- 2.2.1. Comparison of International Standards
- 2.2.2. Results and Interactions

2.3. Field Probes and Reconnaissance
- 2.3.1. Probes
- 2.3.2. Static and Dynamic Penetration Tests
- 2.3.3. Permeability Tests

2.4. Identification Tests
- 2.4.1. Status Tests
- 2.4.2. Resistance Tests
- 2.4.3. Expansivity and Aggressivity Tests

2.5. Considerations Prior to Proposing Geotechnical Surveys
- 2.5.1. Perforation Program
- 2.5.2. Geotechnical Performance and Scheduling
- 2.5.3. Geological Factors

2.6. Perforation Fluids
- 2.6.1. Variety of Perforation Fluids
- 2.6.2. Fluid Characteristics: Viscosity
- 2.6.3. Additives and Applications

2.7. Geological-Geotechnical Testing, Geomechanical Stations
- 2.7.1. Test Typology
- 2.7.2. Determination of Geomechanical Stations
- 2.7.3. Characterization at Great Depth

2.8. Pumping Wells and Pumping Tests
- 2.8.1. Typology and Means Required
- 2.8.2. Test Planning
- 2.8.3. Interpretation of the Results

2.9. Geophysical Investigation
- 2.9.1. Seismic Methods
- 2.9.2. Electric Methods
- 2.9.3. Interpretation and Results

2.10. Auscultation
- 2.10.1. Superficial and Firm Auscultation
- 2.10.2. Auscultation of Movements, Stresses and Dynamics
- 2.10.3. Application of New Technologies in Auscultation

Module 3. Behavior of Water in Terrain

3.1. Partially Saturated Soils
- 3.1.1. Storage Function and Characteristic Curve
- 3.1.2. Condition and Properties of Semi-Saturated Soils
- 3.1.3. Characterization of Partially Saturated Soils in Modeling

3.2. Effective and Total Pressure
- 3.2.1. Total, Neutral and Effective Pressure
- 3.2.2. Darcy's Law in Terrain
- 3.2.3. Permeability

3.3. Drainage Incidence in Tests
- 3.3.1. Drained and Undrained Shear Tests
- 3.3.2. Drained and Undrained Consolidation Tests
- 3.3.3. Post-Rupture Drainage

3.4. Soil Compaction
- 3.4.1. Principle Fundamentals in Compaction
- 3.4.2. Compaction Methods
- 3.4.3. Tests, Trials and Results

3.5. Saturation Processes
- 3.5.1. Swelling
- 3.5.2. Suction
- 3.5.3. Liquefaction

3.6. Stresses in Saturated Soils
- 3.6.1. Tension Spaces in Saturated Soils
- 3.6.2. Evolution and Transformation in Stresses
- 3.6.3. Associated Displacements

3.7. Application to Roads and Plains
- 3.7.1. Compaction Values
- 3.7.2. Bearing Capacity of the Soil
- 3.7.3. Specific Tests

3.8. Hydrogeology in Structures
- 3.8.1. Hydrogeology in Different Soil Types
- 3.8.2. Hydrogeology Model
- 3.8.3. Problems that Groundwater Can Cause

3.9. Compressibility and Preconsolidation
- 3.9.1. Compressibility in Soils
- 3.9.2. Preconsolidation Pressure Terms
- 3.9.3. Water Table Oscillations in Preconsolidation

3.10. Fluid Analysis
- 3.10.1. One-Dimensional Flow
- 3.10.2. Critical Hydraulic Gradient
- 3.10.3. Flow Modelling

Module 4. Seismicity Mechanics of the Continuous Medium and Constitutive Models Application to Soil and Rocks

4.1. Seismic Response of Soils
- 4.1.1. Seismic Effect in Soils
- 4.1.2. Non-Lineal Behavior in Soils
- 4.1.3. Induced Effects Due to Seismic Action

4.2. Seismic Study in Regulations
- 4.2.1. Interaction Between International Standards
- 4.2.2. Comparison of Parameters and Validations

4.3. Estimated Ground Motion under Seismic Conditions
- 4.3.1. Predominant Frequency in a Stratum
- 4.3.2. Jake's Thrust Theory
- 4.3.3. Nakamura Simulation

4.4. Earthquake Simulation and Modeling
- 4.4.1. Semiempirical Formulas
- 4.4.2. Simulations in Finite Element Modeling
- 4.4.3. Analysis of Results

4.5. Seismicity in Foundations and Structures
- 4.5.1. Modulus of Elasticity in Earthquakes
- 4.5.2. Variation in the Stress-Strain Relationship
- 4.5.3. Specific Rules for Piles

4.6. Seismicity in Excavations
- 4.6.1. Influence of Earthquakes on Earth Pressure
- 4.6.2. Typologies of Equilibrium Losses in Earthquakes
- 4.6.3. Measures for Control and Improvement of Excavation in Earthquakes

4.7. Site Studies and Seismic Hazard Calculations
- 4.7.1. General Criteria of Design
- 4.7.2. Seismic Danger in Structures
- 4.7.3. Special Seismic Construction Systems for Foundations and Structures

4.8. Liquefaction in Saturated Granular Soils
- 4.8.1. Liquefaction Phenomenon
- 4.8.2. Reliability of Calculations Against Liquefaction
- 4.8.3. Evolution of Parameters in Liquefactive Soils

4.9. Seismic Resilience in Soils and Rocks
- 4.9.1. Fragility Curves
- 4.9.2. Seismic Risk Calculations
- 4.9.3. Estimation of Soil Resistance

4.10. Transmission of Other Types of Waves in Terrain Sound Through Terrain
- 4.10.1. Vibrations Present in the Terrain
- 4.10.2. Transmission of Waves and Vibrations in Different Types of Terrain
- 4.10.3. Disturbance Transmission Modeling

Module 5. Land Treatment and Improvement

5.1. Objectives. Movements and Property Enhancement
- 5.1.1. Internal and Global Property Enhancement
- 5.1.2. Practical Objectives
- 5.1.3. Improvement of Dynamic Behaviors

5.2. Improvement by High-Pressure Mixing Injection
- 5.2.1. Typology of Soil Improvement by High-Pressure Grouting
- 5.2.2. Characteristics of Jet-Grouting
- 5.2.3. Injection Pressures

5.3. Gravel Columns
- 5.3.1. Overall Use of Gravel Columns
- 5.3.2. Quantification of Land Property Improvements
- 5.3.3. Indications and Contraindications of Use

5.4. Improvement by Impregnation and Chemical Injection
- 5.4.1. Characteristics of Injections and Impregnation
- 5.4.2. Characteristics of Chemical Injections
- 5.4.3. Method Limitations

5.5. Freezing
- 5.5.1. Technical and Technological Aspects
- 5.5.2. Different Materials and Properties
- 5.5.3. Application and Limitation Fields

5.6. Preloading, Consolidations and Compactions
- 5.6.1. Preloading
- 5.6.2. Drained Preloading
- 5.6.3. Control During Ejection

5.7. Improvement by Drainage and Pumping
- 5.7.1. Temporary Drainage and Pumping
- 5.7.2. Utilities and Quantitative Improvement of Properties
- 5.7.3. Behavior after Restitution

5.8. Micropile Umbrellas
- 5.8.1. Ejection and Limitations
- 5.8.2. Resistant Capacity
- 5.8.3. Micropile Screens and Grouting

5.9. Comparison of Long-Term Results
- 5.9.1. Comparative Analysis of Land Treatment Methodologies
- 5.9.2. Treatments According to Their Practical Application
- 5.9.3. Combination of Treatments

5.10. Soil Decontamination
- 5.10.1. Physicochemical Processes
- 5.10.2. Biological Processes
- 5.10.3. Thermal Processes

Module 6. Slope Analysis and Stability

6.1. Slope Stability and Calculations
- 6.1.1. Factors Affecting Slopes Stability
- 6.1.2. Slope Foundation Stability
- 6.1.3. Slope Body Stability

6.2. Factors that Influence Stability
- 6.2.1. Geotechnical Stability
- 6.2.2. Conventional Slope Loads
- 6.2.3. Accidental Slope Loads

6.3. Ground Slopes
- 6.3.1. Stability in Ground Slopes
- 6.3.2. Elements Influencing Stability
- 6.3.3. Calculation Methods

6.4. Rock Slopes
- 6.4.1. Stability in Rock Slopes
- 6.4.2. Elements Influencing Stability
- 6.4.3. Calculation Methods

6.5. Foundation and Slope Base
- 6.5.1. Important Land Requirements
- 6.5.2. Typology of Foundations
- 6.5.3. Base Land Considerations and Improvements

6.6. Breakages and Discontinuities
- 6.6.1. Typologies of Slope Instability
- 6.6.2. Characteristic Detection of Stability Losses
- 6.6.3. Short- and Long-Term Stability Improvement

6.7. Slope Protection
- 6.7.1. Parameters that Influence Stability Improvement
- 6.7.2. Short- and Long-Term Slope Protection
- 6.7.3. Temporal Validity of Each Type of Protection Element

6.8. Slopes in Dams with Loose Material
- 6.8.1. Particular Features of Slopes in Dams
- 6.8.2. Slope Behavior under Loose Materials Dam Loads
- 6.8.3. Auscultation and Monitoring of Slope Evolution

6.9. Dams in Maritime Works
- 6.9.1. Particular Features of Slopes in Maritime Works
- 6.9.2. Slope Behavior under Maritime Works
- 6.9.3. Auscultation and Monitoring of Slope Evolution

6.10. Simulation and Comparative Software
- 6.10.1. Simulations for Slopes in Rock and Soil
- 6.10.2. Bidimensional Calculations
- 6.10.3. Finite Element Modeling and Long-Term Calculations

Module 7. Superficial Foundations

7.1. Footings and Foundation Slabs
- 7.1.1. Most Common Types of Footings
- 7.1.2. Rigid and Flexible Footings
- 7.1.3. Large Shallow Foundations

7.2. Design Criteria and Regulations
- 7.2.1. Factors that Affect Footing Design
- 7.2.2. Elements Included in International Foundation Regulations
- 7.2.3. General Comparison Between Normative Criteria for Shallow Foundations

7.3. Forces on Foundations
- 7.3.1. Forces in Buildings
- 7.3.2. Forces in Retaining Structures
- 7.3.3. Terrain Forces

7.4. Foundation Stability
- 7.4.1. Bearing Capacity of the Soil
- 7.4.2. Sliding Stability of the Footing
- 7.4.3. Tipping Stability

7.5. Ground Friction and Adhesion Enhancement
- 7.5.1. Soil Characteristics Influencing Soil-Structure Friction
- 7.5.2. Soil-Structure Friction According to the Foundation Material
- 7.5.3. Soil-Citation Friction Improvement Methodologies

7.6. Foundation Repairs Underlay
- 7.6.1. Need for Foundation Repair
- 7.6.2. Types of Repairs
- 7.6.3. Underlay Foundations

7.7. Displacement in Foundation Elements
- 7.7.1. Displacement Limitation in Shallow Foundations
- 7.7.2. Consideration of Displacement in the Calculation of Shallow Foundations
- 7.7.3. Estimated Calculations in the Short Term and in the Long Term

7.8. Comparative Relative Costs
- 7.8.1. Estimated Value of Foundation Costs
- 7.8.2. Comparison According to Superficial Foundations
- 7.8.3. Estimation of Repair Costs

7.9. Alternative Methods Foundation Pits
- 7.9.1. Semi-Deep Superficial Foundations
- 7.9.2. Calculation and Use of Pit Foundations
- 7.9.3. Limitations and Uncertainties About the Methodology

7.10. Types of Faults in Superficial Foundations
- 7.10.1. Classic Breakages and Capacity Loss in Superficial Foundations
- 7.10.2. Ultimate Resistance in Superficial Foundations
- 7.10.3. Overall Capacities and Safety Coefficients

Module 8. Deep Foundations

8.1. Piles: Calculation and Dimensioning
- 8.1.1. Types of Piles and Their Application to Each Structure
- 8.1.2. Limitations of Piles Used as Foundations
- 8.1.3. Pile Calculation as Elements of Deep Foundations

8.2. Alternative Deep Foundations
- 8.2.1. Other Types of Deep Foundations
- 8.2.2. Particularities of Pile Alternatives
- 8.2.3. Specific Works that Require Alternative Foundations

8.3. Pile Groups and Pile Caps
- 8.3.1. Limitations of Piles Used as Individual Elements
- 8.3.2. Pile Caps of Pile Groups
- 8.3.3. Limitations of Pile Groups and Interactions Between Piles

8.4. Negative Friction
- 8.4.1. Fundamental Principles and Influence
- 8.4.2. Consequences of Negative Friction
- 8.4.3. Calculation and Mitigation of Negative Friction

8.5. Maximum Capacity and Structural Limitations
- 8.5.1. Individual Structural Topping of Piles
- 8.5.2. Maximum Capacity of Pile Groups
- 8.5.3. Interaction with Other Structures

8.6. Faults in Deep Foundations
- 8.6.1. Structural Instability in Deep Foundations
- 8.6.2. Bearing Capacity of the Terrain
- 8.6.3. Maximum Ground Capacity

8.7. Deep Foundation Repairs
- 8.7.1. Interventions on Ground
- 8.7.2. Interventions on Foundations
- 8.7.3. Unconventional Systems

8.8. Pile-Piles in Large Structures
- 8.8.1. Special Needs in Special Foundations
- 8.8.2. Mixed-Pile Piles: Types and Uses
- 8.8.3. Mixed Foundations in Special Structures

8.9. Sonic Continuity and Auscultation Checks
- 8.9.1. Pre-Execution Inspections
- 8.9.2. Checking the Condition of the Casting: Sonic Checks
- 8.9.3. Auscultation of Foundations During Service

8.10. Dimension Software for Foundations
- 8.10.1. Individual Pile Simulations
- 8.10.2. Modeling of Pile Caps and Structural Assemblies
- 8.10.3. Finite Element Methods in the Modeling of Deep Foundations

Module 9. Retaining Structures: Walls and Screens

9.1. Ground Thrusts
- 9.1.1. Ground Thrusts Present in Retention Structures
- 9.1.2. Impact of Surface Loads on Thrusts
- 9.1.3. Modeling of Seismic Loads in Retaining Structures

9.2. Pressure Modulus and Ballast Coefficients
- 9.2.1. Determination of Geological Properties Influencing within Retaining Structures
- 9.2.2. Spring Type Models of Simulation in Retention Structures
- 9.2.3. Pressure Modulus and Ballast Coefficient as Elements of Soil Resistance

9.3. Walls: Types and Foundations
- 9.3.1. Types of Walls and Behavior Differences
- 9.3.2. Particularities of Each Type with Regard to Calculation and Limitation
- 9.3.3. Factors that Affect Inside the Foundation of the Walls

9.4. Continuous Sheet Piles, Sheet Piling and Pile Screens
- 9.4.1. Basic Differences in the Application of Each of the Screen Types
- 9.4.2. Individual Characteristics in Each Type
- 9.4.3. Structural Limitations of Each Type

9.5. Design and Pile Calculations
- 9.5.1. Sheet Piles
- 9.5.2. Sheet Pile Use Limitations
- 9.5.3. Planning, Performance and Execution Details

9.6. Design and Continuous Sheet Calculations
- 9.6.1. Continuous Sheets
- 9.6.2. Limitation of the Use of Continuous Sheets
- 9.6.3. Planning, Performance and Execution Details

9.7. Anchoring and Bracing
- 9.7.1. Movement-Limiting Elements in Retaining Structures
- 9.7.2. Types of Anchoring and Limiting Elements
- 9.7.3. Control of Injections and Injection Materials

9.8. Ground Movements in Containment Structures
- 9.8.1. Stiffness of Each Type of Retaining Structure
- 9.8.2. Movement Limitations in the Ground
- 9.8.3. Empirical and Finite Element Computational Methods for Motions

9.9. Decrease of Hydrostatic Pressure
- 9.9.1. Hydrostatic Loads in Retaining Structures
- 9.9.2. Behavior of Retention Structures According to Long-Term Hydrostatic Pressure
- 9.9.3. Drainage and Waterproofing of Structures

9.10. Reliability in the Calculation of Retaining Structures
- 9.10.1. Statistical Calculation in Retaining Structures
- 9.10.2. Safety Coefficients for the Design Criterion
- 9.10.3. Types of Faults in Retaining Structures

Module 10. Tunnel and Mining Engineering

10.1. Excavation Methods
- 10.1.1. Application of Methodologies According to Geology
- 10.1.2. Excavation Methodologies According to Length
- 10.1.3. Construction Risks of Tunnel Excavation Methodologies

10.2. Tunnels in Rock-Tunnels in Soil
- 10.2.1. Basic Differences in Tunnel Excavation According to Terrain
- 10.2.2. Problems in the Excavation of Tunnels in Soil
- 10.2.3. Problems Encountered in the Excavation of Rock Tunnels

10.3. Tunnels with Conventional Methods
- 10.3.1. Conventional Excavation Methodologies
- 10.3.2. Excavation Ability of Terrain
- 10.3.3. Yields According to Methodology and Geotechnical Characteristics

10.4. Tunnels with Mechanical Methods (TBM)
- 10.4.1. Types of TBM
- 10.4.2. Tunnel Supports in Tunnels Excavated with TBM
- 10.4.3. Yields According to Methodology and Geomechanical Characteristics

10.5. Microtunnels
- 10.5.1. Range of Use of Microtunnels
- 10.5.2. Methodologies According to the Objectives and Geology
- 10.5.3. Coatings and Limitations of Microtunnels

10.6. Support and Coatings
- 10.6.1. General Support Calculation Methodology
- 10.6.2. Sizing of Final Coatings
- 10.6.3. Long-Term Behavior of Coatings

10.7. Wells, Galleries and Connections
- 10.7.1. Well and Gallery Sizing
- 10.7.2. Connections and Provisional Breakages of Tunnels
- 10.7.3. Auxiliary Elements in the Excavation of Shafts, Galleries and Connections

10.8. Mining Engineering
- 10.8.1. Particular Characteristics of Mining Engineering
- 10.8.2. Particular Types of Excavation
- 10.8.3. Particular Planning for Mining Excavations

10.9. Ground Movements Seating
- 10.9.1. Movement Stages in Tunnel Excavations
- 10.9.2. Semiempirical Methods for the Determination of Tunnel Seating
- 10.9.3. Finite Element Calculation Methodologies

10.10. Seismic and Hydrostatic Loads in Tunnels
- 10.10.1. Influence of Hydraulic Loads in Support Coatings
- 10.10.2. Long-Term Hydrostatic Loads in Tunnels
- 10.10.3. Seismic Modeling and its Impact on Tunnel Design

A unique learning opportunity that will catapult your career to the next level. Don't let it slip away"

06

Methodology

This academic program offers students a different way of learning. Our methodology uses a cyclical learning approach: **Relearning.**

This teaching system is used, for example, in the most prestigious medical schools in the world, and major publications such as the **New England Journal of Medicine** have considered it to be one of the most effective.

Discover Relearning, a system that abandons conventional linear learning, to take you through cyclical teaching systems: a way of learning that has proven to be extremely effective, especially in subjects that require memorization"

Case Study to contextualize all content

Our program offers a revolutionary approach to developing skills and knowledge. Our goal is to strengthen skills in a changing, competitive, and highly demanding environment.

At TECH, you will experience a learning methodology that is shaking the foundations of traditional universities around the world"

You will have access to a learning system based on repetition, with natural and progressive teaching throughout the entire syllabus

The student will learn to solve complex situations in real business environments through collaborative activities and real cases

A learning method that is different and innovative

This TECH program is an intensive educational program, created from scratch, which presents the most demanding challenges and decisions in this field, both nationally and internationally. This methodology promotes personal and professional growth, representing a significant step towards success. The case method, a technique that lays the foundation for this content, ensures that the most current economic, social and professional reality is taken into account.

> *Our program prepares you to face new challenges in uncertain environments and achieve success in your career"*

The case method is the most widely used learning system in the best faculties in the world. The case method was developed in 1912 so that law students would not only learn the law based on theoretical content. It consisted of presenting students with real-life, complex situations for them to make informed decisions and value judgments on how to resolve them. In 1924, Harvard adopted it as a standard teaching method.

What should a professional do in a given situation? This is the question that you are presented with in the case method, an action-oriented learning method. Throughout the program, the studies will be presented with multiple real cases. They will have to combine all their knowledge and research, and argue and defend their ideas and decisions.

Relearning Methodology

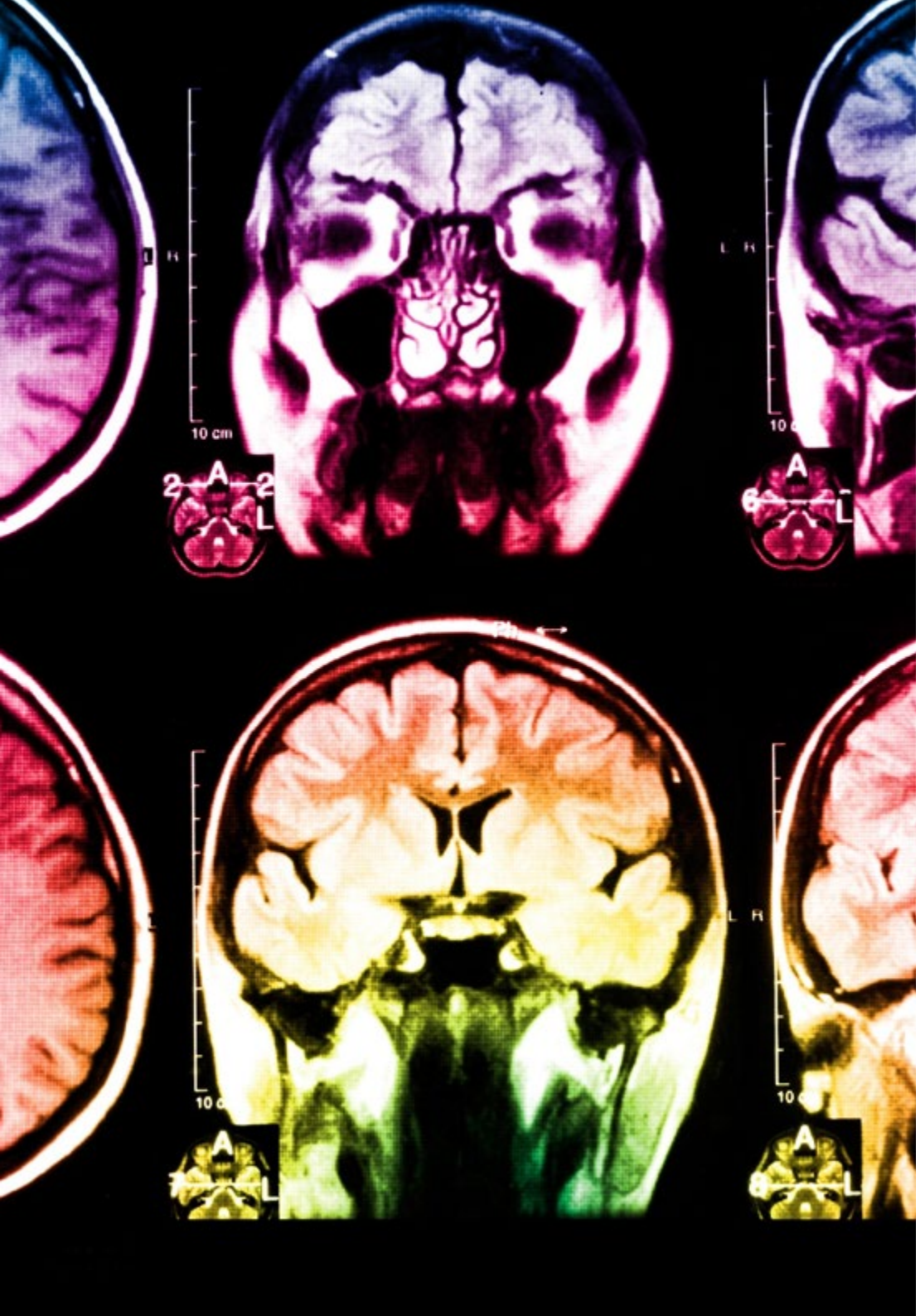
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines 8 different teaching elements in each lesson.

We enhance the Case Study with the best 100% online teaching method: Relearning.

In 2019, we obtained the best learning results of all online universities in the world

At TECH, you will learn using a cutting-edge methodology designed to educate the executives of the future. This method, at the forefront of international teaching, is called Relearning.

Our university is the only one in the world authorized to employ this successful method. In 2019, we managed to improve our students' overall satisfaction levels (teaching quality, quality of materials, course structure, objectives...) based on the best online university indicators.



In our program, learning is not a linear process, but rather a spiral (learn, unlearn, forget, and relearn). Therefore, we combine each of these elements concentrically. This methodology has trained more than 650,000 university graduates with unprecedented success in fields as diverse as biochemistry, genetics, surgery, international law, management skills, sports science, philosophy, law, engineering, journalism, history, and financial markets and instruments. All this in a highly demanding environment, where the students have a strong socio-economic profile and an average age of 43.5 years.

Relearning will allow you to learn with less effort and better performance, involving you more in your learning, developing a critical mindset, defending arguments, and contrasting opinions: a direct equation for success.

From the latest scientific evidence in the field of neuroscience, not only do we know how to organize information, ideas, images and memories, but we know that the place and context where we have learned something is fundamental for us to be able to remember it and store it in the hippocampus, to retain it in our long-term memory.

In this way, and in what is called neurocognitive context-dependent elearning, the different elements in our program are connected to the context where the individual carries out their professional activity.

This program offers the best educational material, prepared with professionals in mind:

Study Material

All teaching material is produced by the specialists who teach the course, specifically for the course, so that the teaching content is highly specific and precise.

These contents are then applied to the audiovisual format, to create the TECH online working method. All this, with the latest techniques that offer high quality pieces in each and every one of the materials that are made available to the student.

Classes

There is scientific evidence suggesting that observing third-party experts can be useful.

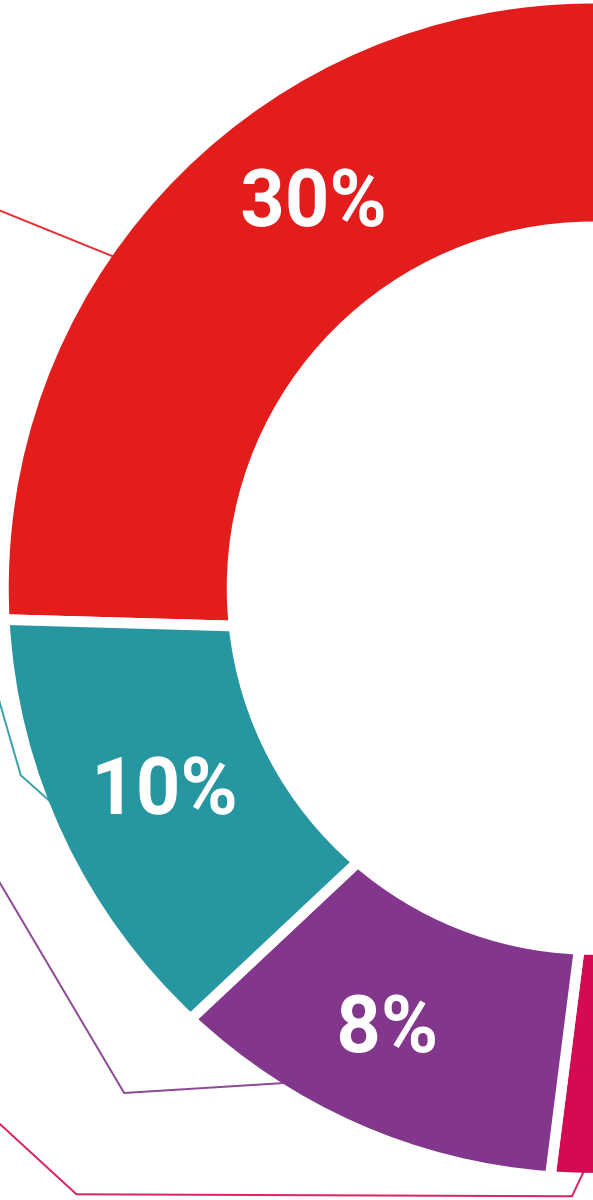
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

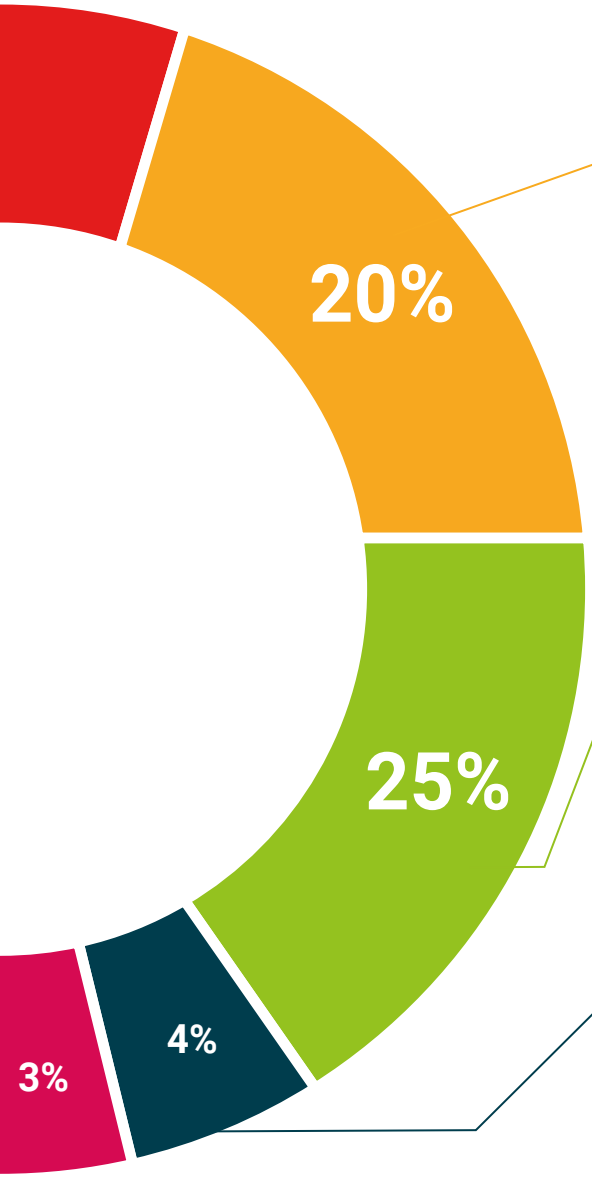
Practising Skills and Abilities

They will carry out activities to develop specific skills and abilities in each subject area. Exercises and activities to acquire and develop the skills and abilities that a specialist needs to develop in the context of the globalization that we are experiencing.

Additional Reading

Recent articles, consensus documents and international guidelines, among others. In TECH's virtual library, students will have access to everything they need to complete their course.





Case Studies

Students will complete a selection of the best case studies chosen specifically for this program. Cases that are presented, analyzed, and supervised by the best specialists in the world.

Interactive Summaries

The TECH team presents the contents attractively and dynamically in multimedia lessons that include audio, videos, images, diagrams, and concept maps in order to reinforce knowledge.

This exclusive educational system for presenting multimedia content was awarded by Microsoft as a "European Success Story".

Testing & Retesting

We periodically evaluate and re-evaluate students' knowledge throughout the program, through assessment and self-assessment activities and exercises, so that they can see how they are achieving their goals.

07

Certificate

The Professional Master's Degree in Geotechnical and Foundation Engineering guarantees you, in addition to the most rigorous and up-to-date education, access to a Professional Master's Degree issued by TECH Global University.

Successfully complete this program and receive your university qualification without travel or laborious paperwork”

This program will allow you to obtain your **Professional Master's Degree diploma in Geotechnical and Foundation Engineering** endorsed by **TECH Global University**, the world's largest online university.

TECH Global University is an official European University publicly recognized by the Government of Andorra (***official bulletin***). Andorra is part of the European Higher Education Area (EHEA) since 2003. The EHEA is an initiative promoted by the European Union that aims to organize the international training framework and harmonize the higher education systems of the member countries of this space. The project promotes common values, the implementation of collaborative tools and strengthening its quality assurance mechanisms to enhance collaboration and mobility among students, researchers and academics.

This **TECH Global University** title is a European program of continuing education and professional updating that guarantees the acquisition of competencies in its area of knowledge, providing a high curricular value to the student who completes the program.

Title: **Professional Master's Degree in Geotechnical and Foundation Engineering**

Modality: **online**

Duration: **12 months**

Accreditation: **60 ECTS**


tech global university

Mr./Ms. _____ with identification document _____
has successfully passed and obtained the title of:

Professional Master's Degree in Geotechnical and Foundation Engineering

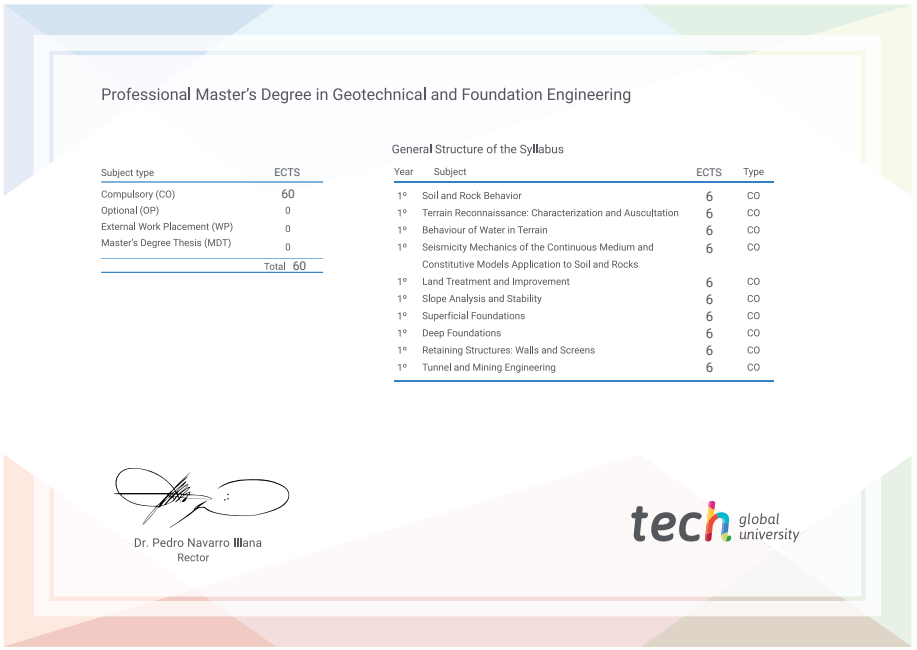
This is a program of 1,500 hours of duration equivalent to 60 ECTS, with a start date of dd/mm/yyyy and an end date of dd/mm/yyyy.

TECH Global University is a university officially recognized by the Government of Andorra on the 31st of January of 2024, which belongs to the European Higher Education Area (EHEA).

In Andorra la Vella, on the 28th of February of 2024

Dr. Pedro Navarro Illana
Rector

This qualification must always be accompanied by the university degree issued by the competent authority to practice professionally in each country. Unique TECH Code: AFWORD23S techtitute.com/certificates


Professional Master's Degree in Geotechnical and Foundation Engineering

Subject type	ECTS
Compulsory (CO)	60
Optional (OP)	0
External Work Placement (WP)	0
Master's Degree Thesis (MDT)	0
Total	60

General Structure of the Syllabus

Year	Subject	ECTS	Type
1º	Soil and Rock Behavior	6	CO
1º	Terrain Reconnaissance: Characterization and Auscultation	6	CO
1º	Behaviour of Water in Terrain	6	CO
1º	Seismicity Mechanics of the Continuous Medium and Constitutive Models Application to Soil and Rocks	6	CO
1º	Land Treatment and Improvement	6	CO
1º	Slope Analysis and Stability	6	CO
1º	Superficial Foundations	6	CO
1º	Deep Foundations	6	CO
1º	Retaining Structures: Walls and Screens	6	CO
1º	Tunnel and Mining Engineering	6	CO

Dr. Pedro Navarro Illana
Rector

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*Apostille Convention. In the event that the student wishes to have their paper diploma issued with an apostille, TECH Global University will make the necessary arrangements to obtain it, at an additional cost.

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Professional Master's Degree
Geotechnical and Foundation Engineering

- Modality: **online**
- Duration: **12 months**
- Certificate: **TECH Global University**
- Credits: **60 ECTS**
- Schedule: **at your own pace**
- Exams: **online**

Professional Master's Degree
Geotechnical and Foundation Engineering

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