

# Postgraduate Diploma

## Geotechnical Behavior of Slopes and their Applications





## Postgraduate Diploma Geotechnical Behavior of Slopes and their Applications

Course Modality: **Online**

Duration: **6 months.**

Certificate: **TECH - Technological University**

**18 ECTS Credits**

Teaching Hours: **450 hours.**

Website: [www.techtitute.com/us/engineering/postgraduate-diploma/postgraduate-diploma-geotechnical-behavior-slopes-applications](http://www.techtitute.com/us/engineering/postgraduate-diploma/postgraduate-diploma-geotechnical-behavior-slopes-applications)

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# 01

# Introduction

The main objective of the Postgraduate Diploma in Geotechnical Behavior of Slopes and their Applications is to have a clear idea of the major differences between geology and all that it entails in rocks and soils. Thus, this training program will address the contents and techniques of geotechnical engineering and its application in foundations and structures, which are present in countless projects and civil engineering works. These contents will allow the professional to carry out an original and application-oriented analysis of the theoretical concepts developed throughout the Postgraduate Diploma.





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*Geotechnical projects are on the rise, and acquiring the competencies to operate successfully in this sector is a highly disruptive skill in an ever-growing industry”*

The Postgraduate Diploma in Geotechnical Behavior of Slopes and their Applications is academically designed to provide in-depth knowledge, based on 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 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 Postgraduate Diploma, has a syllabus that mixes some of them with more applied theoretical load (such as those related to the models of ground behavior, the necessary requirements for a good identification of soils and rocks or the interaction of the ground with seismic disturbances), with others with eminent component of practical analysis, where the knowledge acquired on the behavior of the ground and its stress-strain states of this first part, are applied to the usual structures of Geotechnical Engineering: slopes, walls, walls, screens, tunnels.....

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 Postgraduate Diploma subjects. It is a priority 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 Postgraduate Diploma in Geotechnical Behaviour of Slopes and their Applications integrates the most complete and innovative educational program in the current market in terms of knowledge and latest available technologies, as well as encompassing all the sectors or parties involved in this field. In addition, the Postgraduate Diploma consists of exercises based on real cases of situations currently managed or previously faced by the teaching team.

All this, along a 100% online training that provides the student with the ease of being able to take it wherever and whenever they want. All you need is a device with internet access, and you will be able to access a universe of knowledge that will be the main asset of the engineer when positioning themselves in a sector that is increasingly in demand by companies in various sectors.

The **Postgraduate Diploma in Geotechnical Behaviour of Slopes and their Applications** contains the scientific most complete and up-to-date educational program on the market. The most important features of the program include:

- ◆ Practical cases presented by experts in Civil Engineering and Geotechnics.
- ◆ The graphic, schematic, and eminently 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.



*Apply the latest advances in soil and rock foundations and become a successful engineer"*

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*You will be provided with innovative teaching materials and resources that will facilitate the learning process and the retention of the contents learned for a longer period of time”*

*A 100% online training that will allow you to combine your studies with the rest of your daily activities*

The program's teaching staff includes professionals from the sector who contribute their work experience to this training 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 immersive training programmed to train 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

TECH has designed this comprehensive Postgraduate Diploma with the aim of training engineering professionals to be able to design, implement and work on Civil Works, knowing everything related to this industry and technical and professional aspects at the national and international level that directly affect it. To this end, specific aspects of the profession that stand out for their enormous importance in today's business landscape will be addressed, and for which large corporations are increasingly demanding competent engineers with a solid specialized training





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*With this program, TECH has only one goal: to help you grow in your profession and become a prestigious engineer”*



## General Objectives

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- ◆ Delve deeper into kinds of grounds, 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 ground 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 a deep understanding of the repair operations or improvement of materials to mitigate damage.
- ◆ Receive a complete tour of tunnel and gallery excavation methodologies, analyzing all drilling procedures, design constraints, support and lining.



*A training designed based on practical cases that will teach you how to act in real situations in the daily practice of your profession"*



## Specific Objectives

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### 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.
- ◆ Detailed knowledge of the different behaviours 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 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 ground 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, which are for each of the cases, the constitutive models of the terrain to be used depending on the characteristics of each of the actions to be approached.

## Module 2: Behaviour of Water in the Ground

- ◆ Identification of the presence of water in the behavior of soils and acquiring a 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 Correct handling of 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 the zonal hydrogeology in a project or work. Determine the concepts that should encompass its study and the consequences it may have in the long term on the structural elements.
- ◆ Go in detail into the definition of preconsolidation processes as a way to provide soils with improved mechanical properties by reducing soil saturation.
- ◆ Flow modeling, permeability concept and its actual application in interim and final construction states.

## Module 3: 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.

# 03

# Course Management

TECH applies a criterion based on high quality in all its training. This guarantees students that by studying here they will find the best didactic content taught by the best professionals in the sector. In this sense, this Postgraduate Diploma in Geotechnical Behaviour of Slopes and their Applications has professionals of high prestige within this area, who pour into the training the experience of their years of work, as well as the knowledge acquired from research in the field. All to provide the engineer with a high-level program, which will enable them to practice in national and international environments with greater guarantees of success.





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

## Management



### Mr. Aldona, Alfonso, Estébanez

- ◆ Civil Engineer graduated from the Polytechnic University of Madrid.
- ◆ Studying the E.T.S.I. Ph.D Roads, Canals and Ports U.P.M. in the Department of Terrain Engineering.
- ◆ Course of 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

### Mr. Sandin Sainz-Ezquerro, 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 graduated the ETSI of, Canals and Ports from the Polytechnic University of Madrid (U.P.M.).
- ◆ Studying the E.T.S.I. Ph.D Roads, Canals and Ports U.P.M. in the Structures Department.
- ◆ Course on integration of BIM technology in structural design 2017.
- ◆ Lecturer in the BIM Master 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.

### Mr. 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).

### Ms. Lope Martín, Raquel

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

# 04

# Structure and Content

The syllabus of the Postgraduate Diploma is structured as a comprehensive tour through each and every one of the concepts required to understand and work in this field. Thus, through a novel didactic approach, based on the practical application of the contents, the engineer will learn and understand the functioning of geotechnics and foundations, knowing how to design and implement projects in this sense, providing high safety indexes and services to the companies. This, in addition to adding value to your professional profile, will make you a much better prepared professional to work in a variety of environments.





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*A complete curriculum focused on the acquisition of knowledge and its conversion into real skills, created to propel you towards excellence”*

## Module 1: Soil and Rock Behavior

- 1.1. Principle Fundamentals 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. Behaviour of water in Soil and Rocks
- 1.3. Behaviour 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. Behaviour 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: Behaviour of water in the ground**

- 2.1. Partially Saturated Soils
  - 2.1.1. Storage Function and Characteristic Curve
  - 2.1.2. Condition and Properties of Semi-saturated Soils
  - 2.1.3. Characterization of Partially Saturated Soils in Modeling
- 2.2. Effective and Total Pressure
  - 2.2.1. Total, Neutral and Effective Pressure
  - 2.2.2. Darcy's Law in Terrain
  - 2.2.3. Permeability
- 2.3. Drainage Incidence in Tests
  - 2.3.1. Drained and Undrained Shear Tests
  - 2.3.2. Drained and Undrained Consolidation Tests
  - 2.3.3. Post-rupture Drainage
- 2.4. Soil Compaction
  - 2.4.1. Principle Fundamentals in Compaction
  - 2.4.2. Compaction Methods
  - 2.4.3. Tests, Trials and Results
- 2.5. Saturation Processes
  - 2.5.1. Swelling
  - 2.5.2. Suction
  - 2.5.3. Liquefaction
- 2.6. Stresses in Saturated Soils
  - 2.6.1. Tensional Spaces in Saturated Soils
  - 2.6.2. Evolution and Transformation in Stresses
  - 2.6.3. Associated Displacements
- 2.7. Application to Roads and Plains
  - 2.7.1. Compaction Values
  - 2.7.2. Bearing Capacity of the Soil

- 2.7.3. Specific Tests
- 2.8. Hydrogeology in Structures
  - 2.8.1. Hydrogeology in Different Soil Types
  - 2.8.2. Hydrogeology Model
  - 2.8.3. Problems that Groundwater Can Cause
- 2.9. Compressibility and Preconsolidation
  - 2.9.1. Compressibility in Soils
  - 2.9.2. Preconsolidation Pressure Terms
  - 2.9.3. Water Table Oscillations in Preconsolidation
- 2.10. Fluid Analysis
  - 2.10.1. One-dimensional Flow
  - 2.10.2. Critical Hydraulic Gradient
  - 2.10.3. Flow Modelling

**Module 3: Slope Analysis and Stability**

- 3.1. Slope Stability and Calculations
  - 3.1.1. Factors Affecting Slopes Stability
  - 3.1.2. Slope Foundation Stability
  - 3.1.3. Slope Body Stability
- 3.2. Factors That Influence Stability
  - 3.2.1. Geotechnical Stability
  - 3.2.2. Conventional Slope Loads
  - 3.2.3. Accidental Slope Loads
- 3.3. Ground Slopes
  - 3.3.1. Stability in Ground Slopes
  - 3.3.2. Elements Influencing Stability
  - 3.3.3. Calculation Methods
- 3.4. Rock Slopes
  - 3.4.1. Stability in Rock Slopes
  - 3.4.2. Elements Influencing Stability
  - 3.4.3. Calculation Methods

- 3.5. Foundation and Slope Base
  - 3.5.1. Important Land Requirements
  - 3.5.2. Typology of Foundations
  - 3.5.3. Base Land Considerations and Improvements
- 3.6. Breakages and Discontinuities
  - 3.6.1. Typologies of Slope Instability
  - 3.6.2. Characteristic Detection of Stability Losses
  - 3.6.3. Short and Long-Term Stability Improvement
- 3.7. Slope Protection
  - 3.7.1. Parameters That Influence Stability Improvement
  - 3.7.2. Short and Long-Term Slope Protection
  - 3.7.3. Temporal Validity of Each Type of Protection Element
- 3.8. Slopes in Dams with Loose Material
  - 3.8.1. Particular Features of Slopes in Dams
  - 3.8.2. Slope Behavior Under Loose Materials Dam Loads
  - 3.8.3. Auscultation and Monitoring of Slope Evolution
- 3.9. Dikes in Maritime Works
  - 3.9.1. Particular Features of Slopes in Maritime Works
  - 3.9.2. Slope Behavior Under Maritime Works
  - 3.9.3. Auscultation and Monitoring of Slope Evolution
- 3.10. Simulation and Comparative Software
  - 3.10.1. Simulations for Slopes in Rock and Soil
  - 3.10.2. Bidimensional Calculations
  - 3.10.3. Finite Element Modeling and Long-Term Calculations





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

05

# Methodology

This training provides you with a different way of learning. Our methodology uses a cyclical learning approach: **Re-learning**.

This teaching system is used 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.





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*Discover Re-learning, 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"*

## At TECH we use the Case Method

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

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*With TECH you can experience a way of learning that is shaking the foundations of traditional universities around the world”*



*We are the first online university to combine Harvard Business School case studies with a 100% online learning system based on repetition*





### A learning method that is different and innovative.

This Engineering program at TECH- Technological University is an intensive program that prepares you to face all the challenges in this area, both nationally and internationally. We are committed to promoting your personal and professional growth, the best way to strive for success, that is why at TECH Technological University you will use Harvard case studies, with which we have a strategic agreement that allows us to offer you material from the best university in the world.



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

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

The case method has been the most widely used learning system among the world's leading business schools for as long as they have existed. 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.

In a given situation, what would you do? This is the question that you are presented with in the case method, an action-oriented learning method. Throughout the course, you will be presented with multiple real cases. You will have to combine all your knowledge, and research, argue, and defend your ideas and decisions.

## Re-Learning Methodology

Our University is the first in the world to combine Harvard University case studies with a 100% online learning system based on repetition, which combines different teaching elements in each lesson.

We enhance Harvard case studies with the best 100% online teaching method: Re-learning.

*In 2019 we obtained the best learning results of all Spanish-language online universities in the world*

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

Our University is the only one in Spanish-speaking countries licensed to incorporate 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 Spanish online university indicators.



In our program, learning is not a linear process, but rather a spiral (we learn, unlearn, forget, and re-learn). Therefore, we combine each of these elements concentrically.

With this methodology we have 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, markets, and financial 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.

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

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

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



In this program you will have access to the best educational material, prepared with you 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.

This content is then adapted in an audiovisual format that will create our way of working online, with the latest techniques that allow us to offer you high quality in all of the material that we provide you with.



### 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 our future difficult decisions.



### Practising Skills and Abilities

You 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 we live in.



### Additional Reading

Recent articles, consensus documents, international guides. in our virtual library you will have access to everything you need to complete your training.





**Case Studies**

You will complete a selection of the best case studies in the field used at Harvard. Cases that are presented, analyzed, and supervised by the best senior management specialists in Latin America.



**Interactive Summaries**

We present the contents attractively and dynamically in multimedia lessons that include audio, videos, images, diagrams, and concept maps in order to reinforce knowledge.

This unique multimedia content presentation training system was awarded by Microsoft as a "European Success Story".



**Testing & Re-testing**

We periodically evaluate and re-evaluate your knowledge throughout the program. We do this on 3 of the 4 levels of Miller's Pyramid.



06

# Certificate

Through a different and stimulating learning experience, you will be able to acquire the necessary skills to take a big step in your training. An opportunity to progress, with the support and monitoring of a modern and specialized university, which will propel you to another professional level.



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*Include in your training a Postgraduate Diploma in Geotechnical Behavior of Slopes and their Applications: a highly qualified added value for any professional in the field of education"*

The Postgraduate Diploma in Geotechnical Behaviour of Slopes and their Applications contains the scientific most complete and up-to-date educational program on the market.

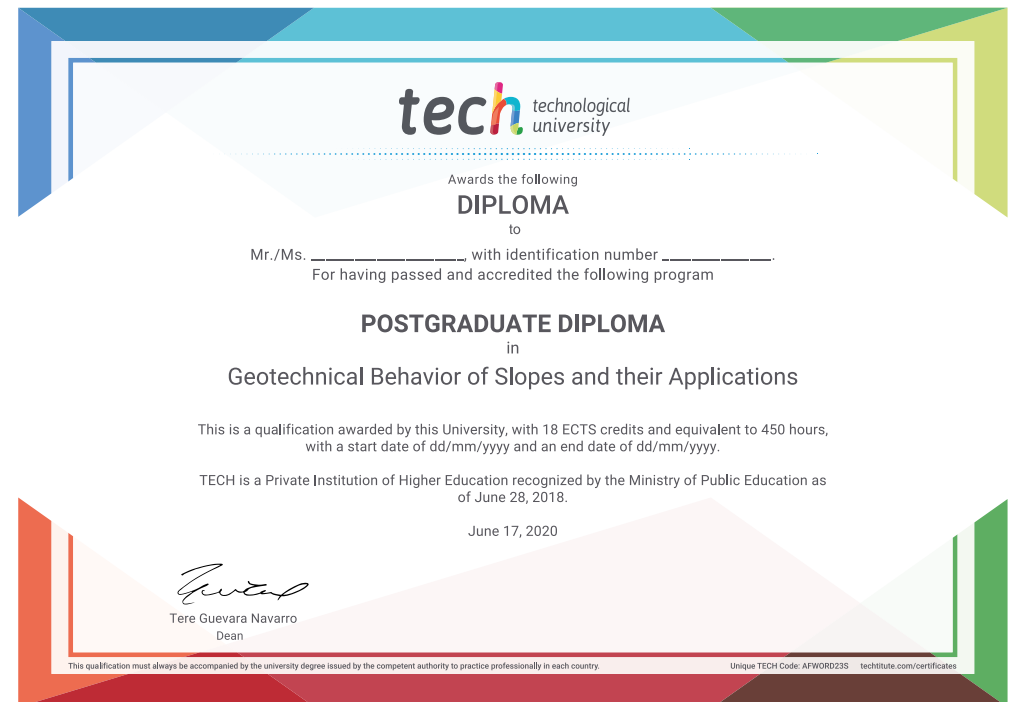
Once the student has passed the evaluation, they will receive by post, with acknowledgement of receipt, their corresponding **Postgraduate Diploma** issued by **TECH- Technological University**.

The certificate issued by **TECH - Technological University** will specify the qualification obtained through the Postgraduate Diploma, and meets the requirements commonly demanded by labor exchanges, competitive examinations, and professional from career evaluation committees.

Title: **Postgraduate Diploma in Geotechnical Behavior of Slopes and their Applications**

ECTS: **18**

Official Number of Hours: **450**



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



future

health confidence people

education information tutors

guarantee accreditation teaching

institutions technology learning

community commitment

personalized service innovation

knowledge present quality

online training

development language

classroom

**tech** technological  
university

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