Advanced Master's Degree
Geotechnical and Road Construction

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Advanced Master's Degree
Geotechnical and Road Construction

- Modality: **online**
- Duration: **2 years**
- Certificate: **TECH Global University**
- Credits: **120 ECTS**
- Schedule: **at your own pace**
- Exams: **online**

Website: **www.techtitute.com/us/engineering/advanced-master-degree/advanced-master-degree-geotechnical-road-construction**

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01

Introduction

Without roads, the world world would not be the way it is. People would not be able to travel to visit their families. We would not be able to go to the movies or shopping malls. We could not go to work. We would not have the great freedom of movement he enjoys. Although this is often overlooked, it is nonetheless true: the social, economic and cultural fabric of countries is sustained by public roads. They are an indispensable service that requires trained professionals for proper construction and maintenance. Its realization is a complex task that depends on many factors and without a complete and specific education of the professionals who carry them out, it could fail. For that reason, this program offers all the knowledge for engineers who wish to specialize to do so with guarantees, ensuring a great future in the field of road construction, an area that demands quality personnel to build the roads of the present and the future.

New roads are being planned every day. That's why companies and public administrations need engineers like you to build them"

Every day, millions of people around the world use different types of roads to get around. They do so with their own vehicles or by public transportation. And each of these people has a different reason: some go to pick up their children from school, others want to go shopping. There are also those who go to a leisure activity such as the cinema or theater, or go to work. All these people depend on perfectly constructed roads to be safe and durable.

However, there are also other cases: an ambulance takes a patient to the hospital, a police car drives to a place where its presence is required, or a transport vehicle is on its route to drop off various errands, parcels and letters. Thus, roads are not just a way to get from one place to another: they are a public service on which the health and safety of the population depends.

For this reason, there is a need for highly specialized professionals who can respond to the demand of companies and public institutions that require competent personnel. Without such personnel, the roads on which most people travel would be defective and unsafe, and societies and countries would function with difficulty.

This Advanced Master's Degree in Geotechnics and Road Construction responds to this demand, offering the best knowledge for engineers and professionals to become true experts in the construction of this type of roads. To this end, it combines specific knowledge in road construction and geotechnics, so that graduates have the most complete education, integrating both branches to obtain the best possible results.

This **Advanced Master's Degree in Geotechnics and Road Construction** contains the most complete and up-to-date educational program on the market. Its most notable features are:

- The development of case studies presented by experts in civil, building and geotechnical engineering.
- 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
- Its special emphasis on innovative methodologies in geotechnical and road construction
- Theoretical lessons, questions to the expert, debate forums on controversial topics, and individual reflection work.
- Content that is accessible from any fixed or portable device with an Internet connection

Think of all the people who travel by road every day. You could help make their commute fast, safe and enjoyable"

This knowledge will make you the greatest road construction expert around"

If you want to give your career a boost, combine the specialties of geotechnics and road construction with this Advanced Master's Degree.

Geotechnics applied to road construction will lead you to master all types of projects and make every company want to count on you.

Its teaching staff includes professionals belonging to the civil engineering field, who contribute their work experience to this program, as well as renowned specialists from reference 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 learning experience designed to prepare for real-life situations.

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

02

Objectives

The main objective of this Advanced Master's Degree in Geotechnics and Road Construction is to offer its students the best contents in planning and construction of all types of road projects. Thanks to the integral nature of this degree, professionals who complete it will be able to cover several disciplines, thus being able to apply knowledge from all these fields to solve problems and bring planned projects to a successful conclusion.

You will get to build the great roads of your country"

General Objectives

- Deepen in the soils both in their typology and in their behavior. And, 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 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
- Master the different life phases of a highway, and the associated contracts and administrative procedures, both at national and international level
- Develop detailed knowledge of how a company is managed and the most important management systems.
- Analyze the different phases in the construction of a highway and the different types of bituminous mixes.
- Detailed knowledge of the factors that affect the safety and comfort of the road, the parameters that measure it and the possible actions for its correction.
- Gain an in-depth understanding of the different tunnel construction methods, the most frequent pathologies, and how to establish a maintenance plan.
- Analyze the singularities of each type of structure, and how to optimize its inspection and maintenance.
- Learn about the different electromechanical and traffic installations in tunnels, their function and operation and the importance of preventive and corrective maintenance.
- Analyze the assets that comprise a road, what factors should be taken into account in inspections, and what are the actions associated with each one of them
- Accurately understand the life cycle of the road and associated assets.
- In-depth breakdown of factors affecting occupational risk prevention.
- Know the fundamental aspects of the operation of a road in detail: applicable regulations, processing of files or authorizations.
- Understand how a predictive traffic model is performed and its applications.
- Mastering the fundamental factors affecting road safety
- Understanding precisely how winter maintenance is organized and managed
- Analyze the operation of a tunnel control center and how different incidents are managed.
- Know in detail the structure of the operation manual and the actors involved in tunnel operation.
- Break down the conditions for defining the minimum conditions under which a tunnel can be operated, and how to establish the associated methodology for fault resolution.
- In-depth understanding of BIM methodology and how to apply it to each phase: design, construction and maintenance and operation.
- Make a comprehensive analysis of the most current trends in terms of society, environment and technology: connected vehicle, autonomous vehicle, Smart Roads.
- Have a firm grasp on the possibilities that some technologies are offering. In this way, combined with the student's experience, it can be the perfect alliance when designing the actual application or improving existing processes.

Specific Objectives

- 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 terrain dynamics and statics are the parts that are applicable and objective for this module.
- Discern the set of parameters, stresses, stress types and concepts for soils and rocks. In the same way, which are for each of the cases, the constituent models of the terrain to be used depending on the characteristics of each of the actions to be approached
- 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 Features, applications, performance, etc.
- Deepen in 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
- Recognize the elements to be monitored and their real application on site and analyze the new technologies for continuous monitoring.
- 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. Determining the concepts that should encompass its study and the long-term consequences it may have on 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
- Identify the effects induced in the ground by seismic action, as part of the non-linear behavior of the ground
- Deepen in the particularities of the terrain, discretizing between soils and rocks, and of the instantaneous behavior under seismic loads
- Analyze the most important regulations in the field of seismic, 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 to 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 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 to other elements that can propagate along the ground, such as the study of noise and vibration transmission in the ground
- Acquire a thorough 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 elements of land treatment of relatively little use, but with remarkable technical applications
- In-depth presentation 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 detail with soil decontamination as a land improvement process, defining the typologies that can be used
- 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
- 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
- Acquire a 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 with 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
- Mesaure and size 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
- Define and acquire a 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 structures
- 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 Soldierpiles
- 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 applying statistical reliability concepts
- 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 Advanced 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 mining excavation, with the particularities it has due to the depth of its actions
- 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 to identify how this type of disturbance modifies the supports and linings
- Analyze the different management systems used for the management of the different assets: pavements, structures, electrical and traffic installations and other elements of the road and the most relevant indicators.
- Develop a deeper understanding of the contractual structure related to roads.
- Develop business management concepts
- Discover the guidelines that will enable entrepreneurship in the sector
- Establish how to achieve more sustainable policies by minimizing the resources used and taking advantage of new technologies.
- Acquire in-depth knowledge in the design and layout of roads, understanding the importance of the different phases and stages for the realization of the same.
- Acquire the necessary knowledge regarding the different operations related to earth moving. Developing the different existing types, with a practical approach, which allows to know their costs, performance, etc., depending on the different terrains and typology of the works to be executed.
- Know, in detail, from a current and practical point of view, the constituent elements of bituminous pavements.
- Develop, in a comprehensive manner, the different types of existing pavements, with special emphasis on which situations to use each one of them. All this from an objective point of view based on experience, without forgetting to strengthen the knowledge from the point of view of the design of each of the different types of pavement.
- Able to accurately understand the day-to-day operation of a bituminous mix manufacturing facility. From the dosing and quality marking of the different mixtures, to the study of manufacturing costs and their maintenance
- Deepen in the day-to-day work of laying bituminous mixes, identifying the essential aspects and the most common difficulties in transport, paving and compacting operations.
- Analyze the different tunnel construction systems and identify the most common pathologies depending on the construction system used.
- Master the inspection methods, deepen in data collection through destructive and non-destructive techniques, and know how to perform condition assessment.
- Make a comprehensive analysis of the different types of tunnel structural maintenance: ordinary, extraordinary, renovations, rehabilitations and reinforcements and how each is managed
- Understand the parameters that accurately measure the safety, comfort, capacity and durability of a pavement.
- In-depth knowledge of pavement monitoring and inspection systems.
- Discuss in detail the actions that can be taken to correct the different pavement parameters. parameters of pavements
- Analyze how the life cycle of structures is managed through structure management systems.

  of structures
- Understand, in detail, the different types of structural inspection, which players are involved, what methods are used and how the severity index is assessed
- Establish the different types of structural maintenance and how they are managed
- Gain an in-depth understanding of some of the unique maintenance operations.
- Analyze the differences between opencast and tunnel lighting systems.
- In-depth breakdown of the operation and function of the various installations involved in tunnel operation: power supply, ventilation, pumping stations, PCI systems.
- Perform effective maintenance of the facilities based on a combination of corrective and preventive maintenance, with emphasis on predictive maintenance.
- Establish the various systems for detecting incidents in tunnels

- Know precisely which systems are involved in incident signaling, as well as the systems used to communicate with the user in the event of an incident.
- Know in detail how the communication between the Control Center and the field equipment is structured and the elements involved.
- Perform effective maintenance of traffic facilities based on a combination of corrective and preventive maintenance, with emphasis on predictive maintenance.
- Gain in-depth knowledge of the existing signaling, beaconing and containment elements on the road, the existing typologies and how their inspection and maintenance is carried out.
- Break down the different enclosure elements and their components, and how they are inspected and maintained.
- Analyze the elements involved in road drainage, and how their inspection and maintenance is carried out.
- Discuss in detail the different slope protection systems and how to check their condition and maintenance.
- Establish the regulations applicable to roads and identify the different road protection zones.
- Master traffic restrictions and how to manage special transport or sporting events
- Cover in detail how the different administrative files are processed.
- Understand precisely how predictive modeling is performed and how traffic data is exploited
- Understand what factors influence traffic accidents and how road safety audits contribute to maximizing the safety of systems and elements.
- Analyze some of the most relevant ISO management systems in road maintenance.
- Delve into the structure of the winter maintenance plan, the necessary means and the differences between preventive and corrective treatments.
- Analyze how a tunnel control center works and how traffic and facility management is carried out. Understand the importance of action plans
- Know in detail the basic document in the operation of a tunnel: the operation manual and the actors involved.
- Understand the need to establish the minimum conditions under which an infrastructure can be operated and how to plan actions in a degraded situation.
- Gain insight into the BIM concept and distinguish it from simply deciding which commercial software to use.
- Delve into the different levels of BIM implementation.
- Be prepared to address BIM implementation in both projects and pre-existing infrastructure.
- Analyze the technologies that complement the BIM philosophy.
- Understand precisely how social equity measures enhance competitiveness
- Prepare for the change in direction that the roadside professional faces in the immediate future.
- Further study of the changes that new technologies will force on the infrastructure or the vehicle
- Discover how to lead environmentally responsible policies through detailed knowledge of new trends.

03

Skills

Upon completion of this degree, students will be able to perform a wide range of tasks and projects focused on civil road engineering. Thanks to the combination of the two major disciplines that make up this Grand Master, geotechnics and road construction, the professionals who take it will be able to cover a vast area of knowledge and will master all kinds of skills aimed at the proper construction of this type of roads.

Learn all about road construction with this Advanced Master's Degree"

General Skills

- Master the global environment of geotechnical engineering and foundations, from the international context, 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
- Integrate knowledge and gain an in-depth understanding of the different uses of geotechnical engineering, 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
- Perform critical analysis, evaluation and synthesis of new and complex ideas related to the field of civil engineering.
- Promote, in professional contexts, technological, social or cultural progress within a knowledge-based society.
- Master the global environment of highway construction, maintenance and operation, from the international context, markets, to project development, operation and maintenance plans and sectors such as insurance and asset management.
- Apply acquired knowledge and problem-solving skills in current or unfamiliar environments within broader contexts related to road construction
- Integrate knowledge and get an in-depth view of the different procedures used in road construction.
- Know how to communicate design, development and management concepts of different engineering systems.
- Understand and internalize the scope of digital and industrial transformation applied to road construction systems for efficiency and competitiveness in today's market.
- Perform critical analysis, evaluation and synthesis of new and complex ideas related to the field of engineering.
- 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 a deep 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 works.
- Understand the specific behavior of soils and rocks
- Know how to differentiate the types of terrain
- knowledge the different management systems used for the management of the different assets: pavements, structures, electrical and traffic installations and other elements of the road and the most relevant indicators.
- Manage the contractual structure related to roads.
- Master the design and layout of roads, understanding the importance of the different phases and stages for their realization.

- Have the necessary knowledge of the different operations related to earthmoving. Developing the different existing types, with a practical approach, which allows to know their costs, performance, etc., depending on the different terrains and typology of the works to be executed.
- Handle, from a current and practical point of view, the constituent elements of bituminous pavements.
- Analyze the different tunnel construction systems and identify the most common pathologies depending on the construction system used.
- Master the inspection methods, deepen in data collection through destructive and non-destructive techniques, and know how to perform condition assessment.
- Understand how the life cycle of structures is managed through structure management systems.
- Understand, in detail, the different types of structural inspection, which players are involved, what methods are used and how the severity index is assessed
- Understand the differences between opencast and tunnel lighting systems.
- Know how to set up the various systems for detecting incidents in tunnels
- Know precisely which systems are involved in incident signaling.
- Learn the existing signaling, beaconing and containment elements on the road, the existing typologies and how their inspection and maintenance is carried out.
- Know how to work with the different enclosure elements and their components, and how their inspection and maintenance is carried out
- Know the regulations applicable to roads and identify the different road protection zones.

- Adapting work to traffic restrictions and how special transport or sporting events are managed
- Master the BIM concept and distinguish it from the mere decision of which commercial software to use.
- Understand precisely how social equity measures enhance competitiveness

You want to make your mark on society and you know that roads are an essential part of it: enroll and get closer to your goal"

04

Course Management

This Advanced Master's Degree in Geotechnics and Road Construction is taught by the best specialists in these matters, who have extensive experience in all types of projects and public works related to roads and the land on which they are built. In this way, students who complete this degree will be able to directly apply all the contents taught by these experts in their work, since they are knowledge that has been put into practice in numerous works and roads.

The best experts are waiting to teach you all the keys to road construction"

Management

Dr. Estébanez Aldona, Alfonso

- 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
- Engineering and Technical Director at ALFESTAL
- International Consultant and Project Manager at D2
- Civil Engineer from the Polytechnic University of Madrid
- Doctoral student at E.T.S.I. 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

Mr. Barbero Miguel, Héctor

- Head of Safety, Operations and Maintenance at Empresa Mantenimiento y Explotación M30, S.A. (API Conservación, Dragados-IRIDIUM and Ferrovial Servicios)
- Somport Bi-national Tunnel Operations Manager
- Technical Engineer in Public Works from the University of Salamanca.
- Head of COEX in one of the Areas of the Provincial Council of Bizkaia
- COEX technician in Salamanca for the maintenance of the roads of the Junta de Castilla y León.
- Civil Engineer, Alfonso X el Sabio University.
- Professional Certificate in Spanish in Digital Transformation by MIT. Partner of EJE&CON

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
- Lecturer in the BIM Master's program developed at the Colegio de Caminos.
- Technical assistance for SOFISTIK AG for Spain and Latin America, finite element modeling software for terrain and structures
- Civil Engineer graduated the ETSI of, Canals and Ports from the Polytechnic University of Madrid)
- Pursuing a Doctorate from E.T.S.I. Roads, Canals and Ports U.P.M. in the Structures Department
- Course on integration of BIM technology in structural design

Dr. Clemente Sacristán, Carlos

- 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
- Civil Engineer graduated from the Polytechnic University of Madrid
- Occupational risk prevention course for construction company managers
- Advanced course in management of large turnkey projects (EPC)

Ms. Lope Martín, Raquel

- PROINTEC Technical Department
- Geological Engineer Complutense University of Madrid UCM
- 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

Ms. Suárez Moreno, Sonia

- Production Manager at Empresa Mantenimiento y Explotación M30, S.A. (API Conservación, Dragados-IRIDIUM and Ferrovial Servicios)
- Public Works Engineer, Universidad Politécnica de Madrid.
- Civil Engineer from the European University of Madrid.
- Senior Technician in Occupational Risk Prevention. Occupational Safety and Ergonomics and Applied Psychosociology
- EJE&CON's "Talent without Gender" award for the company's talent development and communication policies.
- Member of the Conservation Committee of the Technical Road Association (ATC)

Ms. Hernández Rodríguez, Lara

- Specialist in international railway tenders. In the International Contracting Department of OHL Construction, Barcelona
- Degree in Civil Engineering from the Polytechnic University of Madrid.
- Production Manager at Nuevos Accesos Ampliación Sur. Phase 1A. Port of Barcelona
- Production Manager. Work on the abutments of the Barranco de Pallaresos viaduct on the Madrid-French border high-speed railway line.
- Expert in Port and Coastal Engineering from the University of Las Palmas de Gran Canaria.

Mr. Fernández Díaz, Álvaro

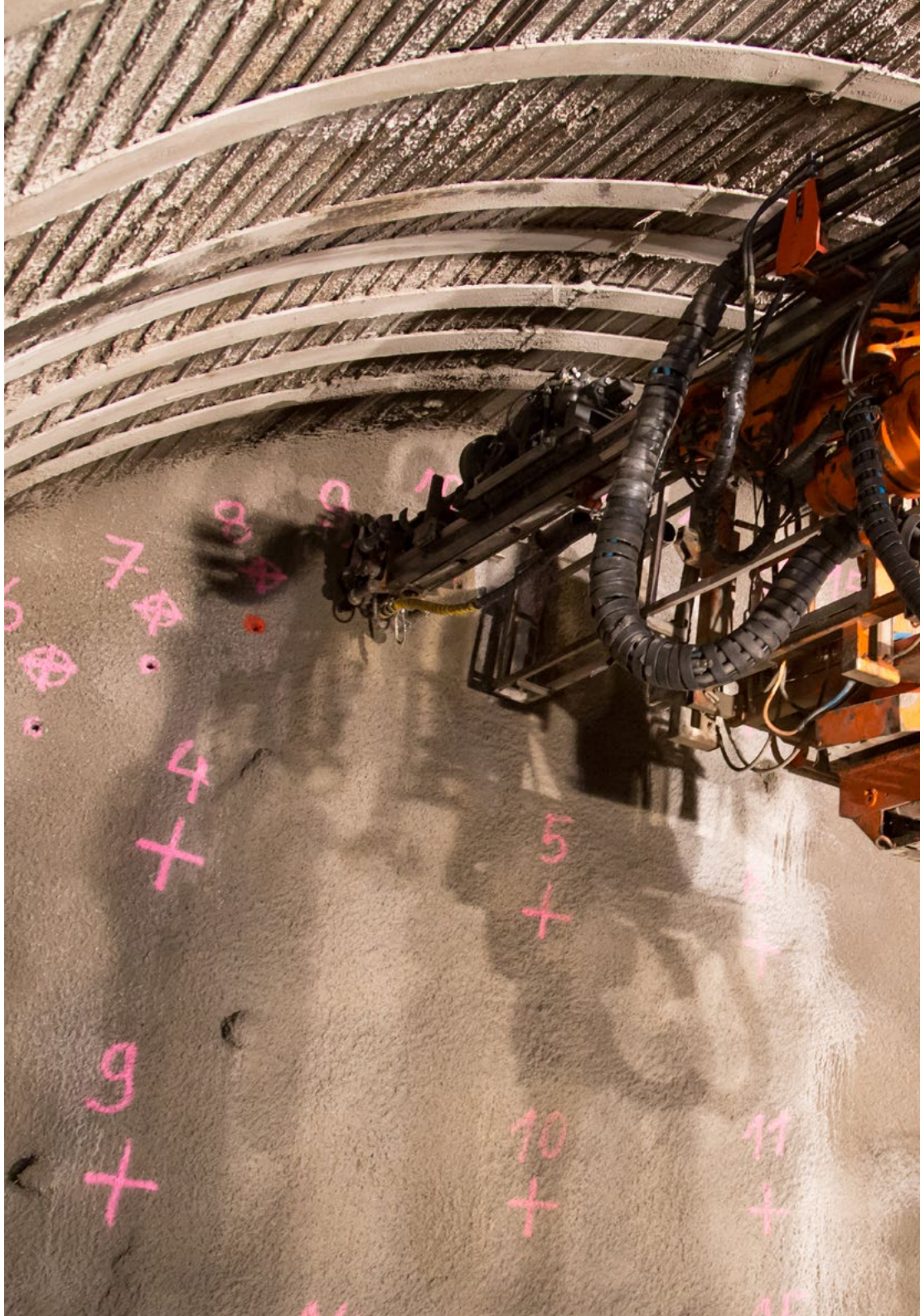
- Area delegate at trabajos Bituminosos SLU
- Civil Engineering at the E.T.S.I. de Caminos, C. y P. of the Polytechnic University of Madrid.
- Course on occupational risk prevention for managers of construction companies. Taught by the Construction Labor Foundation.
- Motivation, teamwork and leadership course. Delivered by Fluxá Training and Development

Mr. Navascués Rojo, Maximiliano

- Works Group Leader at the multinational company DRAGADOS
- Civil Engineer by the Polytechnic University of Madrid and Master in Tunnels and Underground Works by the Spanish Association of Tunnels and Underground Works.
- Master's Degree in E-business and E-Commerce from the Comillas Pontificia University ICAI-ÍCADE
- Executive - MBA from Business School
- PMP (*Project Management* Professional) certificate by the *Project Management* Institute.

Dr. García García, Antonio

- *Staff Engineer Network Intelligence & Automation* en COMMSCOPE/ARRIS



- Member of the EMEA Network Intelligence & Automation Solution group within the Professional Services business unit.
- He has developed his professional career in different companies in the communications sector at European level such as ONO, Netgear, Telenet, Telindus or Vodafone.
- Computer Systems Technical Engineer Pontifical University of Salamanca

Mr. Ferrán Íñigo, Eduardo

- Opening and management of business centers in Madrid, under a franchise system.
- Degree in Business Administration from the University of Salamanca.
- Creation from scratch of a company that installs electric vehicle recharging points. Pioneer brand in the market with more than 4 years of life and wide implantation in Madrid and national presence.
- Master's Degree in *Business Administration* from ICADE (Madrid)

05

Structure and Content

This degree is divided into 20 modules, through which students will be able to learn everything about road construction and geotechnics, which will give them a panoramic and transversal vision of these two disciplines, being able to apply them together in their professions. Thus, as they study all the topics that make up this Advanced Master's Degree, students will become great experts in the discipline and will be able to build a large number of types of public roads with the highest quality and efficiency.

The best program and the best content for the most demanding engineers"

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 tress 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. 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. Basis of Testing Standards
- 2.2.2. Comparison of International Standards
- 2.2.3. 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. Behaviour of water in the 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. Tensional 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 Behaviour in Soils
- 4.1.3. Induced Effects Due to Seismic Action

4.2. Seismic Study in Regulations
- 4.2.1. Properties of Seismic Regulations
- 4.2.2. Interaction Between International Standards
- 4.2.3. 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 the Field Sound Through Ground
- 4.10.1. Vibrations Present in the Ground
- 4.10.2. Transmission of Waves and Vibrations in Different Types of Soil
- 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 Behaviours

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. Physical-Chemical 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. Soil Bearing 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. Dikes 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. Actions Carried Out on Foundations
- 7.3.1. Actions in Buildings
- 7.3.2. Actions in Retaining Structures
- 7.3.3. Terrain Actions

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 of 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. Shallow Semi-Deep Shallow 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 Behaviour Differences
- 9.3.2. Particularities of Each Types 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 Expensive 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 Geological
- 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 Grounds
- 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 in Grounds
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 Geological
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 Behaviour 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

Module 11. Contract and Business Management

11.1. Phases in the Life of the Road
- 11.1.1. Planning
- 11.1.2. Project
- 11.1.3. Construction
- 11.1.4. Conservation
- 11.1.5. Operation
- 11.1.6. Financing

11.2. Types of Contract
- 11.2.1. Road Works
- 11.2.2. Services
- 11.2.3. Grants

11.3. The Contract
- 11.3.1. Bidding
- 11.3.2. Allocation
- 11.3.3. Contractual Structure
- 11.3.4. Completion Deadlines
- 11.3.5. Changes to the Contract
- 11.3.6. Social Clauses
- 11.3.7. Progress Clause

11.4. Management Systems
- 11.4.1. Integrated Management System
- 11.4.2. Other Systems Regulated in ISO Standards
- 11.4.3. Bridge Management System
- 11.4.4. Pavement Management System
- 11.4.5. CMMS
- 11.4.6. Management Indicators

11.5. Relevant Aspects at the Construction Site
- 11.5.1. Health and Safety
- 11.5.2. Outsourcing
- 11.5.3. Environment
- 11.5.4. Quality Control

11.6. Business and Entrepreneurship
- 11.6.1. Strategy and Strategic Analysis
- 11.6.2. Corporate Models
- 11.6.3. HR
- 11.6.4. Business Models and Marketing

11.7. Business Management
- 11.7.1. Analysis Tools and Models
- 11.7.2. Certifications and Compliance
- 11.7.3. Competitive Advantages
- 11.7.4. Optimization and Digitization

11.8. Financial Management
- 11.8.1. Risk Analysis
- 11.8.2. Public Budget
- 11.8.3. Private Works, Negotiation and Bidding
- 11.8.4. Cost Analytics

11.9. Internationalization of the Sector
- 11.9.1. Main Markets
- 11.9.2. Contracting Models
- 11.9.3. How to Be Competitive Abroad

11.10. Technology at the Service of Sustainability
- 11.10.1. Access to Databases
- 11.10.2. The Use of Artificial Intelligence Techniques
- 11.10.3. Drones on the Road

Module 12. Layout, Grading and Pavement Execution

12.1. Road Planning and Design
- 12.1.1. Development and Evolution of Materials
- 12.1.2. Preliminary Study and Preliminary Design
- 12.1.3. The Project

12.2. The Layout
- 12.2.1. Plan Layout
- 12.2.2. Elevation Plotting
- 12.2.3. Cross Section

12.2.4. Drainages
12.3. Earth Moving, Excavation and Blasting
12.3.1. Earthwork
12.3.2. Excavations
12.3.3. Ripping and Blasting
12.3.4. Singular Actions
12.4. Pavement Sizing
12.4.1. Esplanade
12.4.2. Road Surface Sections
12.4.3. Analytical Calculation
12.5. Constituent Elements of Bituminous Pavements
12.5.1. Aggregates
12.5.2. Bitumens and Binders
12.5.3. Filler
12.5.4. Additives
12.6. Hot Mix Asphalt
12.6.1. Conventional Bituminous Mixes
12.6.2. Discontinuous Bituminous Mixtures
12.6.3. Bituminous Mixes type SMA
12.7. Management of an Asphalt Plant
12.7.1. Plant Organization
12.7.2. Dosing of Mixtures: Working Formulas
12.7.3. Quality Control: CE Marking
12.7.4. Site maintenance
12.8. Cold Asphalt Mixtures
12.8.1. Bituminous Slurries
12.8.2. Gravel Irrigation
12.8.3. Cold Agglomerate
12.8.4. Complementary Techniques: Crack Sealing, etc.
12.9. Rigid Sidewalks
12.9.1. Design
12.9.2. On-site Installation
12.9.3. Maintenance of Rigid Pavements
12.10. On-site Installation
12.10.1. Transportation and Paving
12.10.2. Compaction
12.10.3. Good Practices

Module 13. Tunnels and road works

13.1. Recycling and In-Situ Stabilization of Pavements with Cement and/or Lime
13.1.1. Stabilized in Situ with lime
13.1.2. Stabilized in Situ with Cement
13.1.3. In-situ Recycling of Concrete Pavements
13.2. Recycling of Bituminous Mixtures
13.2.1. Recycling Machinery
13.2.2. In-situ Cold Recycling with Bituminous Emulsion Coatings
13.2.3. Recycling at Plant (RAP)
13.3. Pavement Monitoring
13.3.1. Deterioration Assessment
13.3.2. Surface Regularity
13.3.3. Pavement Adhesion
13.3.4. Deflections
13.4. Maintenance Operations on Pavements
13.4.1. Repair of Damage
13.4.2. Surface Rejuvenation and Renewal of the Wearing Course
13.4.3. CRT Correction
13.4.4. IRI Correction
13.4.5. Pavement Rehabilitation
13.5. Singular Actions
13.5.1. Asphalt Operation in Urban Areas
13.5.2. Actions on High-Capacity Roads

13.5.3. Use of Geogrids and/or Geocomposites
13.6. Tunnels. Regulations
13.6.1. Construction
13.6.2. Operation
13.6.3. International
13.7. Tunnel Typology
13.7.1. Open Air
13.7.2. In Mine
13.7.3. With Tunnel Boring Machine
13.8. General Characteristics of the Tunnel
13.8.1. Excavation and Support
13.8.2. Waterproofing and Coating
13.8.3. Tunnel Drainage
13.8.4. International Singularities
13.9. Tunnel Inventory and Inspection
13.9.1. Inventory
13.9.2. Laser Scanners
13.9.3. Thermography
13.9.4. Georadar
13.9.5. Passive Seismic
13.9.6. Refraction Seismic
13.9.7. Pits
13.9.8. Drilling and Coring
13.9.9. Coating Coring
13.9.10. Condition Assessment
13.10. Tunnel Maintenance
13.10.1. Ordinary Maintenance
13.10.2. Extraordinary Maintenance
13.10.3. Renovation Operations
13.10.4. Rehabilitation
13.10.5. Reinforcements

Module 14. Structures and masonry

14.1. Evolution of Structures
14.1.1. Roman Engineering
14.1.2. Evolution of Materials
14.1.3. Evolution of Structural Design
14.2. Passage Works
14.2.1. Pontoon
14.2.2. Bridge
14.2.3. Singular Works for the Preservation of Wildlife
14.3. Other Structures
14.3.1. Walls and Retaining Elements
14.3.2. Footbridges
14.3.3. Porticos and Banners
14.4. Small Masonry and Drainage Works
14.4.1. Spouts
14.4.2. Culverts
14.4.3. Sewers
14.4.4. Drainage Elements in Structures
14.5. Bridge Management System
14.5.1. Inventory
14.5.2. Systematization of Structure Management
14.5.3. Severity Rates
14.5.4. Planning of Actions
14.6. Inspection of Structures
14.6.1. Routine Inspections
14.6.2. General Major Inspections
14.6.3. Detailed Major Inspections
14.6.4. Special Inspections

14.7. Structural Maintenance
- 14.7.1. Ordinary Maintenance
- 14.7.2. Renovation Operations
- 14.7.3. Rehabilitation
- 14.7.4. Reinforcements

14.8. Singular Maintenance Actions
- 14.8.1. Expansion Joints
- 14.8.2. Support
- 14.8.3. Concrete Walls
- 14.8.4. Adequacy of Containment Systems

14.9. Singular Structures
- 14.9.1. By Design
- 14.9.2. For its Light
- 14.9.3. For its Materials

14.10. The Value of Structures
- 14.10.1. Asset Management
- 14.10.2. Collapse. Unavailability Costs
- 14.10.3. Equity Value

Module 15. Electromechanical Installations

15.1. Roadside Facilities
- 15.1.1. Fundamental Concepts
- 15.1.2. Open Air
- 15.1.3. In Tunnel
- 15.1.4. Predictive Maintenance

15.2. Open-air Lighting
- 15.2.1. Installation.
- 15.2.2. Preventative Maintenance
- 15.2.3. Corrective Maintenance

15.3. Tunnel Lighting
- 15.3.1. Installation.
- 15.3.2. Preventative Maintenance
- 15.3.3. Corrective Maintenance

15.4. Power Supply
- 15.4.1. Installation.
- 15.4.2. Preventative Maintenance
- 15.4.3. Corrective Maintenance

15.5. Generator Sets and UPS
- 15.5.1. Installation.
- 15.5.2. Preventative Maintenance
- 15.5.3. Corrective Maintenance

15.6. Ventilation
- 15.6.1. Installation.
- 15.6.2. Preventative Maintenance
- 15.6.3. Corrective Maintenance

15.7. Pumping Stations
- 15.7.1. Installation.
- 15.7.2. Preventative Maintenance
- 15.7.3. Corrective Maintenance

15.8. PCI Systems
- 15.8.1. Installation.
- 15.8.2. Preventative Maintenance
- 15.8.3. Corrective Maintenance

15.9. Particulate and Gas Filtering Stations
- 15.9.1. Installation.
- 15.9.2. Preventative Maintenance
- 15.9.3. Corrective Maintenance

Module 16. Traffic installations

16.1. The Fourth Technician
- 16.1.1. Description
- 16.1.2. Documentation
- 16.1.3. Maintenance

16.2. CCT Equipment
- 16.2.1. Control Software
- 16.2.2. Application Integration
- 16.2.3. Decision Support System

16.3. ERU/PLC
- 16.3.1. Installation.
- 16.3.2. Preventative Maintenance
- 16.3.3. Corrective Maintenance

16.4. CCTV/DAI
- 16.4.1. Installation.
- 16.4.2. Preventative Maintenance
- 16.4.3. Corrective Maintenance

16.5. SOS and Radio Communication Poles
- 16.5.1. Installation.
- 16.5.2. Preventative Maintenance
- 16.5.3. Corrective Maintenance

16.6. Variable Signaling
- 16.6.1. Installation.
- 16.6.2. Preventative Maintenance
- 16.6.3. Corrective Maintenance

16.7. Access Equipment
- 16.7.1. Installation.
- 16.7.2. Preventative Maintenance
- 16.7.3. Corrective Maintenance

16.8. Detection of Atmospheric Conditions
- 16.8.1. Installation.
- 16.8.2. Preventative Maintenance
- 16.8.3. Corrective Maintenance

16.9. Traffic Stations
- 16.9.1. Installation.
- 16.9.2. Preventative Maintenance
- 16.9.3. Corrective Maintenance

16.10. Other Facilities
- 16.10.1. Public Address
- 16.10.2. Thermal Cameras
- 16.10.3. Fire Detection

Module 17. Other highway elements

17.1. Vertical Signage
- 17.1.1. Types of Vertical Signage
- 17.1.2. Inspections
- 17.1.3. Performance

17.2. Horizontal Signage
- 17.2.1. Types of Road Markings
- 17.2.2. Auscultation
- 17.2.3. Performance

17.3. Beacons, Traffic Islets and Curbs
- 17.3.1. Types of Beacons
- 17.3.2. Inspections
- 17.3.3. Performance

17.4. Containment Systems
- 17.4.1. Types of Containment Systems
- 17.4.2. Inspections
- 17.4.3. Performance

17.5. Enclosures
- 17.5.1. Components
- 17.5.2. Inventory and Inspection
- 17.5.3. Maintenance

17.6. Drainages
- 17.6.1. Drainage Elements
- 17.6.2. Inventory and Inspection
- 17.6.3. Maintenance

17.7. Slopes and Vegetation
- 17.7.1. Slope Protection Systems
- 17.7.2. Inventory and Inspection
- 17.7.3. Maintenance

17.8. Level Crossings
- 17.8.1. Road - FFCC
- 17.8.2. Highway - Airport
- 17.8.3. Road - Bike Lane

17.9. RRLL Prevention
- 17.9.1. Industry Idiosyncrasy
- 17.9.2. Good Practices
- 17.9.3. The Importance of Training
- 17.9.4. Technology at the Service of Sustainability

17.10. The Lifecycle
- 17.10.1. Construction and Start-Up
- 17.10.2. Maintenance and Operation
- 17.10.3. End of Useful Life

Module 18. Operation

18.1. Use and Defence
- 18.1.1. Applicable Regulations
- 18.1.2. Road Defence
- 18.1.3. Road Use

18.2. Processing of Administrative Files
- 18.2.1. Authorizations for Construction Work, Special Transportation or Sports Events
- 18.2.2. Damage Claim File
- 18.2.3. Sanctioning File

18.3. Traffic Studies
- 18.3.1. Traffic Forecasts for the Project
- 18.3.2. The Traffic Model Based on The Information
- 18.3.3. Exploitation of Traffic Data

18.4. Road Safety
- 18.4.1. Skills
- 18.4.2. Road Safety Agents
- 18.4.3. The Importance of Training and Information
- 18.4.4. Road Safety Audit
- 18.4.5. International Experiences

18.5. International Experiences
- 18.5.1. Asset Management
- 18.5.2. Road Safety Management Systems
- 18.5.3. Energy Efficiency
- 18.5.4. Other Management Systems

18.6. Winter Road Maintenance
- 18.6.1. Winter Road Plan
- 18.6.2. Machinery
- 18.6.3. Fluxes

18.7. The Control Center
- 18.7.1. Traffic Management
- 18.7.2. Facility Management
- 18.7.3. Incident Response

18.8. The Operating Manual
- 18.8.1. Operational Actors: Administrative Authority, Tunnel Manager, Safety Officer, Operator
- 18.8.2. Review and Approval
- 18.8.3. On the Structure of the Operating Manual

18.9. Minimum Operating Conditions
- 18.9.1. Atmospheric
- 18.9.2. CCTV
- 18.9.3. Ventilation
- 18.9.4. PCI
- 18.9.5. Lighting
- 18.9.6. Hydrants
- 18.9.7. Networks
- 18.9.8. Other Facilities

18.10. The Tunnel Operator
- 18.10.1. Control Center Operator
- 18.10.2. Maintenance Operator
- 18.10.3. Incident Response Operator

Module 19. BIM in highways

19.1. Origins of Information
- 19.1.1. Project Documentation
- 19.1.2. Network Inventory
- 19.1.3. CMMS
- 19.1.4. ITS

19.2. BIM at the conceptual level
- 19.2.1. Applicable Regulations
- 19.2.2. Description of BIM Methodology
- 19.2.3. BIM Advantages

19.3. Implementation of the BIM Methodology in an In-Service Infrastructure.
- 19.3.1. Coding Assets
- 19.3.2. Documentation Coding
- 19.3.3. Attribute Dictionary
- 19.3.4. IFC

19.4. The BIM Model in Maintenance and Operation
- 19.4.1. Integration of the Different Platforms
- 19.4.2. The Importance of Document Management
- 19.4.3. Knowledge of the State of the Infrastructure

19.5. BIM Experiences in other Infrastructures
- 19.5.1. BIM in Railroads
- 19.5.2. BIM in Building
- 19.5.3. BIM in Industry

19.6. Software BIM
- 19.6.1. Planning
- 19.6.2. Open BIM
- 19.6.3. Modeling

19.7. BIM Management
- 19.7.1. ISO 119.50
- 19.7.2. BIM manager
- 19.7.3. The Role of the BIM

19.8. Digital Twin
- 19.8.1. Description
- 19.8.2. Operation
- 19.8.3. Advantages

19.9. Other Skills to be Developed by the Roadside Professional
- 19.9.1. Databases
- 19.9.2. *Python* Programming
- 19.9.3. Big Data

19.10. New Technologies
- 19.10.1. 3D Printing
- 19.10.2. Virtual Reality, Augmented Reality
- 19.10.3. Point Cloud

Module 20. The Road of the Future

20.1. Social Equity
- 20.1.1. Equality Policies
- 20.1.2. Transparency
- 20.1.3. Remote work Possibilities

20.2. Environment
- 20.2.1. Circular Economy
- 20.2.2. Energy Autonomy of the Road
- 20.2.3. Energy Use of the Subsoil
- 20.2.4. New Projects under Development

20.3. Present Continuous
- 20.3.1. RSC
- 20.3.2. Administration Liability
- 20.3.3. The Road in Pandemic

20.4. From Passive to Active Information
- 20.4.1. The Hyperconnected User
- 20.4.2. Cross Information with Other Modes of Transportation
- 20.4.3. RRSS

20.5. Operation
- 20.5.1. Variable Speed Management
- 20.5.2. Pay-Per-Use
- 20.5.3. Dynamic Electric Recharging

20.6. 5G Networks
- 20.6.1. Network Description
- 20.6.2. Network Deployment
- 20.6.3. Utilities

20.7. The Connected Vehicle
- 20.7.1. Road - Vehicle
- 20.7.2. Vehicle - Road
- 20.7.3. Vehicle - Vehicle

20.8. Autonomous Vehicle
- 20.8.1. Fundamental Principles
- 20.8.2. How Does It Affect the Road?
- 20.8.3. Services Required

20.9. *Smart Roads*
- 20.9.1. Solar Roads
- 20.9.2. Roads that Decarbonize
- 20.9.3. Road and Solar Energy
- 20.9.4. Asphalt of the Future

20.10. Applications at your Fingertips
- 20.10.1. Artificial Intelligence: Image Recognition
- 20.10.2. Drones on the Road: From Surveillance to Inspection
- 20.10.3. Robotics in the Service of Occupational Safety

Your career will progress rapidly when you finish this Advanced Master's Degree"

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"

At TECH, we use the Case Method

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

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

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

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 intensive Engineering program at TECH Global University prepares you to face all the challenges in this field, 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 Global 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 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

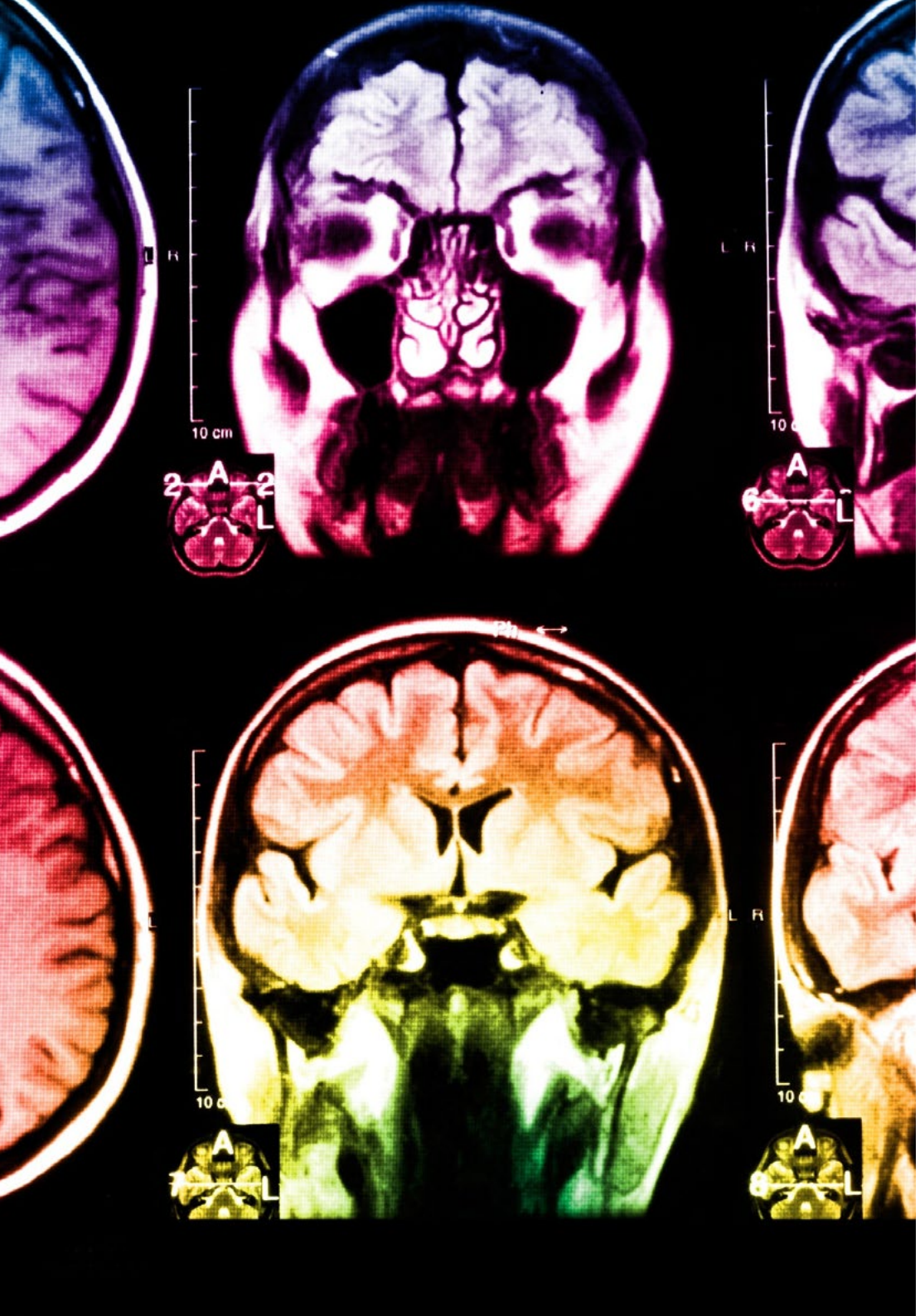
TECH is the first university in the world to combine Harvard University *case studies*with a 100% online learning system based on repetition, which combines 8 different didactic elements in each lesson.

We enhance Harvard *case studies* 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 prepare 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 re-learn). Therefore, we combine each of these elements concentrically. This methodology has prepared 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 education, 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 e-learning, 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 adapted in 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.

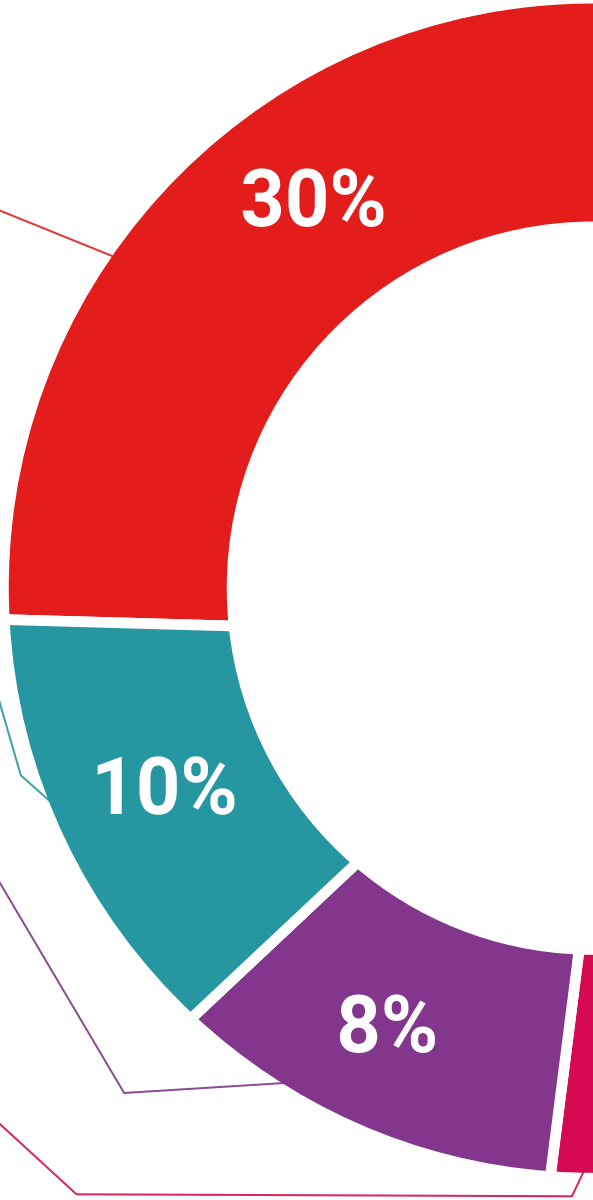
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

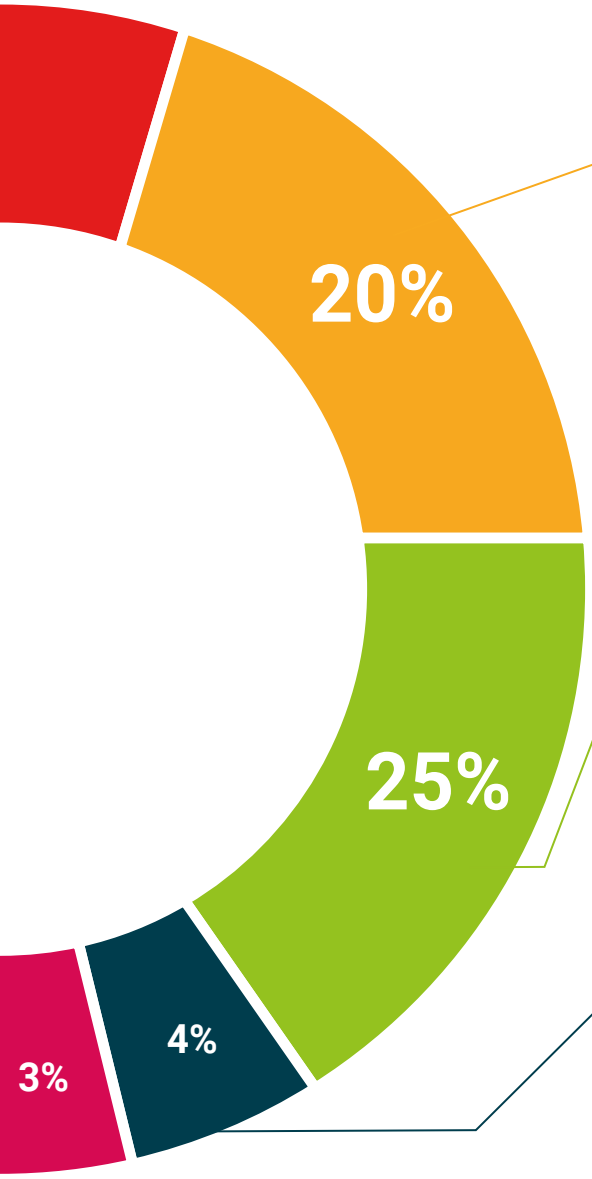
Practising Skills and Abilities

They will carry out activities to develop specific competencies and skills in each thematic field. 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

They 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 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 assess and re-assess 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 Advanced Master's Degree in Geotechnics and Road Construction guarantees students, in addition to the most rigorous and up-to-date education, access to an Advanced Master's Degree issued by TECH Global University.

By successfully completing this program, you will receive your TECH qualification without the need for complicated paperwork"

This program will allow you to obtain your **Advanced Master's Degree diploma in Geotechnics and Road Construction** 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: **Advanced Master's Degree in Geotechnics and Road Construction**

Modality: **online**

Duration: **2 years**

Accreditation: **120 ECTS**

tech global university

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

Advanced Master's Degree in Geotechnics and Road Construction

This is a program of 3,000 hours of duration equivalent to 120 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

Advanced Master's Degree in Geotechnics and Road Construction

General Structure of the Syllabus

Year	Subject	ECTS	Type	Year	Subject	ECTS	Type
1º	Soil and Rock Behavior	6	CO	2º	Tunnel and Mining Engineering	6	CO
1º	Terrain reconnaissance: characterization	6	CO	2º	Contract and Business Management	6	CO
	and auscultation		CO	2º	Layout, Grading and Pavement Execution	6	CO
1º	Behaviour of water in the terrain	6	CO	2º	Tunnels and Road Works	6	CO
1º	Seismicity Mechanics of the Continuous Medium and	6	CO	2º	Structures and Masonry	6	CO
	Constitutive Models Application to Soil and Rocks			2º	Electromechanical Installations	6	CO
1º	Land Treatment and Improvement	6	CO	2º	Traffic Facilities	6	CO
1º	Slope Analysis and Stability	6	CO	2º	Other Roadway Elements	6	CO
1º	Superficial Foundations	6	CO	2º	Exploitation	6	CO
1º	Deep foundations	6	CO	2º	BIM in roads	6	CO
1º	Retaining structures: walls and screens	6	CO	2º	The Road of the Future	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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Advanced Master's Degree
Geotechnical and Road Construction

- Modality: **online**
- Duration: **2 years**
- Certificate: **TECH Global University**
- Credits: **120 ECTS**
- Schedule: **at your own pace**
- Exams: **online**

Advanced Master's Degree

Geotechnical and Road Construction

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