



60 ECTS credits

12 months

Online

Master's Degree in Road Construction, Maintenance and Operation



UCAM
UNIVERSIDAD
CATÓLICA DE MURCIA



Structuralia

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STRUCTURALIA

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

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

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

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

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

BRIEF SUMMARY

Nowadays, roads are the main means of land transport, both for goods and people. As a matter of fact, the construction of new roads, and the maintenance of existing ones, have become a global demand, which has led to the increasing need for professionals with training and knowledge for the construction, maintenance, and operation of roads, considering that the service levels for mobility infrastructure is increasingly demanding.

WHO IS IT INTENDED FOR?

This master's degree is intended for civil engineers, architects and technicians who are currently qualified in the field of construction, or who are interested in starting a career in the sector. The program is also aimed at anyone who seeks to acquire, or update, their knowledge about road construction, maintenance and operations from a practical point of view.

JOB OPPORTUNITIES

- Construction Production Manager
- Construction Manager at construction firms
- Road Operation and Maintenance Manager
- Technical Office Manager

GOALS

This program has been designed to achieve the following goals:

- Gain a general understanding of road construction.
- Learn about the practical means and methodologies applied to earthworks during road construction.
- Learn the most important elements involved in structure construction from an operation-oriented point of view.
- Learn about bituminous mixes: Manufacturing and implementation.
- Quality control in road construction.
- Road maintenance methodologies.
- Gain a comprehensive understanding of road maintenance.
- Learn the use of organization tools for the maintenance of road elements.

PROGRAM

MODULE I: EXCAVATION, BLASTING AND EARTHWORKS

Unit 1. Earthworks

- Earthworks classification
- Geotechnical materials and earthworks
- Excavability
- Surveying
- Environmental impact and safety and health

Unit 2. Operations and heavy machinery

- Digging
- Loading and hauling
- Spreading, grading and compaction
- Earthworks machinery productivity
- Excavations below the water table

Unit 3. Blasting excavation

- Basic concepts on blasting
- Blast-holes drilling
- Explosives
- Blasting mechanics
- Blasting vibrations and their control

Unit 4. Blasting design

- Bench blasting: main variables
- Bench blasting design
- Tunelling blasting: general aspects
- Tunelling blasting design
- Practical aspects and common deficiencies in blasting

MODULE II: DRAINAGE IN LINEAR WORKS

Unit 1. Hydrology in linear construction

- General concepts. Definitions
- Maximum daily precipitation
- Physical characteristics and intensity of rainfall
- Runoff and methods for calculating flood flows
- Application of SIG to hydrology

Unit 2. Transverse drainage

- General concepts. Definitions
- Transverse drainage works
- Design criteria and calculation methodology
- Energy dissipators
- Erosion and sedimentation in the cross drainage system

Unit 3. Drainage of roadbed and margins

- General concepts. Definitions
- Drainage in clearings
- Slope drainage
- Pavement drainage, structures, tunnels and sustainable drainage
- Design and dimensioning criteria

Unidad 4. Hydraulics in bridges and viaducts

- General concepts. Definition
- 1D hydraulic modeling
- 2D hydraulic modeling
- Erosion and foundation protection
- Channelization and protection

MODULE III: CIVIL ENGINEERING STRUCTURAL CALCULATION

Unit1. Prestressed concrete

- Introduction
- Materials
- Prestressing force. Instantaneous losses
- Prestressing deferred losses
- Calculating prestressing force in hyperstatic structures

Unit 2. Underpass structures or buried works

- Underpass works (I). Types
- Underpass works (II). Acting loads
- Cylindrical shells. Concepts and behavior
- Predimensioning of cylindrical shells (I). Concept and calculation
- Predimensioning of cylindrical shells (II). Spandrels and edge beams

Unit 3. Concrete tanks

- Concrete tank calculation elements
- Concrete tank design elements. Principles applied to calculating rectangular reinforced concrete tanks
- Calculating a rectangular reinforced concrete tank wall. Example
- Principles applied to calculating cylindrical reinforced concrete tanks
- Principles applied to analyzing a reinforced concrete tank floor slab. Example of how a rectangular reinforced concrete tank floor slab is calculated

Unit 4. Metal tanks

- Introduction. Design codes
- Types of storage tanks. Materials, joints and welds
- Design and calculation. Bottom and shell
- Calculation of fixed roofs
- Calculation by manometric pressure

MODULE IV: ROAD SURFACES, PAVEMENTS, AND BITUMINOUS MIXES. BASIC CONCEPTS

Unit 1. Introduction to the subject of pavements and road surfaces

- Definition of road surface and pavement, and types of road surfaces
- Main layers and materials composing road surfaces
- Basic design of a road surface following Standard 6.1-IC
- Influence of the road surface on the environment
- Management systems

Unit 2. Materials that make up road surfaces

- Hydrocarbon binders: bitumens and emulsions
- ARID
- Granular layers
- Lime and cement-treated coatings
- Concrete

Unit 3. Bituminous mixes and surface treatments

- Bituminous mixes: classification and characterisation
- Design, testing and characterisation of bituminous mixes
- Manufacture and laying of hot mix bituminous mixes
- Cold asphalt mixes and surface treatments
- Functional and structural properties. Auscultations

Unit 4. New paving technologies

- Mixture with rubber
- Semi-hot and warm mixes
- Ultra-thin mixtures
- SMA mixes
- Photocatalytic road surfaces

MODULE V: QUALITY CONTROL IN PROJECT DESIGN AND IMPLEMENTATION

Unit 1: Risks, Planning process, and Introduction to Quality Planning in Construction Projects

- Introduction
- Risk and opportunities in construction projects
- Project design and development quality control
- Construction project quality planning

Unit 2: Detailed Quality Planning and its Application during Project Implementation

- Implementation resource organization
- Specification, methods, and template development
- Procurement control
- Supplier and outsourcing control
- Construction project monitoring and evaluation

Unit 3: Part I: Building and Urban Development Quality and Water Treatment

- Quality in urban development and urban construction projects
- Quality control in residential construction projects
- Quality control for non-residential social buildings
- Quality control for non-residential industrial buildings
- Quality control in the construction of water treatment facilities

Unit 4: Quality control in construction works

- Dam quality control
- Roads and airport quality control
- Railway quality control
- Quality control in port and offshore construction works
- Quality control in crossing construction works: Bridges, crossings, etc.
- Quality control in crossing construction works: Tunnels

MODULE VI: GENERAL CONSERVATION SCHEME

Unit 1. Introduction and objectives

- General concepts
- Road assistance
- Routine maintenance or unkeep activities
- Activites to improve functional and safety condition
- Road use and defence activities

Unit 2. Main conservation actions

- Mowing, pruning and weeding
- Maintenance of plantations
- Roadway and shoulder cleaning
- Road safety
- Cleaning and repair of drainage

Unit 3. Operational groups

- The management of conservation activities
- Road and operational procedures
- Routine maintenance operations (I)
- Routine maintenance operations (II)
- Machinery

Unit 4. Operational, energy, and environmental

- Efficiency of heavy maintenance vehicles
- Tunnel lighting
- Control and management system for tunnel installations
- Environmental management in integrated conservation
- Indicators and exploitation

MODULE VII: ROAD SAFETY. ROAD OPERATION

Unit 1. Accidents on road networks

- Competing factors. Accident rates
- Road safety programmes. Audits and inspections
- Analysis of accidents "in situ". Mobility restriction
- Traffic engineering (I)
- Traffic engineering (II)

Unit 2. Road operation

- Legislation. Public domain
- Advertising. Authorisations and other elements
- Access
- Infractions and penalties
- Arterial networks, crossings and urban sections

Unit 3. Fixed works signs

- Role and purpose
- Elements
- Traffic management. Manual of examples
- Installation and removal of construction site signs
- Special cases, conservation, errors and developments

Unit 4. Mobile construction site signalling

- Function and purpose
- Procedure
- Equipment and marking of vehicles
- Maintenance work with mobile signalling
- Manual of examples. Evolution of the technique

MODULE VIII: MAINTENANCE OF ROAD ELEMENTS (I)

Unit 1. Pavements (I)

- Classification of Pavements
- Pavement Monitoring
- Surface Repair of Pavements
- Deep Pavement Repair (I)
- Deep Pavement Repair (II)

Unit 2. Pavements (II)

- Pavement Management
- Maintenance Activities
- Studies of the Evolution of a Pavement
- Operational Efficiency in Pavement Maintenance
- Software for Road Management and Maintenance

Unit 3. Land and structures (I)

- Inspection of Structures
- Monitoring of Structures
- Maintenance Plan
- Typology of Damage to a Structure
- Repair Catalog

Unit 4. Land and structures (II)

- Slope Inspection
- Anchors and Guided Meshes on Slopes
- Landslide Barriers
- Protection Ditches
- Slope Control and Monitoring

MODULE IX: MAINTENANCE OF ROAD ELEMENTS (II)

Unit 1. Signalling

- Definition, design and characteristics of vertical signage
- Retroreflection and criteria for vertical signage implementation
- Vertical marking operations
- Definition, purpose and characteristics of horizontal signage
- Materials, selection criteria and application of horizontal signage

Unit 2. Beaconing and defenses

- Definition, classification and beaconing elements
- Installation and operations of beacons
- Enclosure fencing
- Vehicle restraint systems. Safety barriers and parapets
- Arrangement of barriers and parapets. Other vehicle restraint systems

Unit 3. Tunnel installations

- Diagnosis of the installations
- Tunnel diagnosis and intervention
- Tunnels – facilities
- Tunnels - structural elements
- Tunnels - state of the linings

Unit 4. Winter maintenance

- General aspects
- Organization of winter maintenance
- Fluxes and machinery
- Performance techniques
- Meteorology and management systems

MODULE X: MASTER'S FINAL PROJECT

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

AUTHOR PROFILE

DIRECTOR – Alberto de la Orden

Alberto de la Orden Agueda is a Civil Engineer (Roads, canals and ports) by the UPM (Universidad Complutense de Madrid), and holds an MBA (Master in Business Administration). De la Orden has been working in different construction firms such as Grupo FCC, Grupo ORTIZ and OCIDE for the past 20 years as an on-site engineer and leader of civil works projects related to roads, airports, residential areas, treatment plants, etc. Presently, Alberto works as business management consultant and freelance consultant in the construction sector.

Julio Garzón Roca

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

Juan Claudio Gonzalez

Juan Claudio Gonzalez is a Civil Engineer (Roads, canals and ports) with extensive experience in concrete and metal structural calculation. For over 20 years, Juan has been working in the public

sector, especially in foundation design and buildings for ministry from other countries, cable-car foundations, public administration buildings, provisioning warehouses, storm tanks, and foundations for specific airport-related elements. As for his experience in the private sector, Gonzalez has worked in projects such as industrial warehouses, multi-storey industrial platforms, large-diameter circular metal ducts, biological reactors, metal boilers, pressure tanks, transference towers, and heavy hoisting elements. Presently, Juan Claudio works as a structural calculator at the engineering and design department of a construction firm specialized in metal structures. One key aspect of his work is the strong discipline that must be exercised while defining, estimating, and 3D modeling to produce the necessary plans for the manufacture of structural elements in the most cost-efficient manner.

José Manuel Cachaza Castiñeira

José Manuel Cachaza is a Technical Civil Engineer from the UPM, and a Master BIM Manager in Civil Engineering, Infrastructure and GIS by the Zigurat Global Institute. Cachaza dedicated the first part of his professional career to working in the fields of water and environment at Euroestudios, where he trained and worked for 18 years in projects related to hydraulics and drainage of linear works. At present, Jose Manuel works as a Senior Drainage Engineer at Ayesa Ingeniería y Arquitectura, a Spanish multinational specialized in Engineering, Technology and Consulting (ETC).

Gonzalo García Crespo

Gonzalo García Crespo is a Civil Engineer (Roads, canals, and ports) since 2013, and specializes in Road surface and pavement engineering. Since 2014, Garcia has been working at the Spanish multinational Eptisa Engineering Services, in the Field Engineering Division. He has also participated in numerous national and international roads, airports, ports, industrial logistics, speed circuits, and cycling area projects.

The following are the main areas Garcia Crespo has worked in throughout his professional career:

- Road surface design, optimization and rehabilitation through international standards and regulations.
- Technical assistance to, and supervision of construction projects

- Due diligences y CAPEX plans for concessionnaires
- Design and follow-up of innovative mixes
- Design and interpretation of road surface auscultation campaigns
- Expert reporting
- Research, Development and Innovation (R+D+i).

Gonzalo is also the author of several publications in technical magazines, and conducted conferences in specialized congresses in the field of road surface and materials.

Sonia Moreno Angulo

Sonia Moreno is an agronomist from the UPM, with a PDD (Management Development Program) diploma and a master 's degree in engineering and environmental management from the EOI (School of Industrial Organization). She also holds a master 's degree in Trainers of Trainers by the UAB, and an expert diploma in Customer Experience by the AEC. Sonia dedicated the first part of her professional career to working in the field of quality and environment at DGrupo OHL, where she trained and worked for 18 years. more specifically in the areas of quality and environmental management, and project control. Presently, she is partner-manager at the firm Huella Responsable (Responsible footprint), as well as a consultant in CSR, environment, and quality.

Miguel Ortin

Civil Engineering (Roads, canals and ports) specialized in infrastructure management. Director of Highway operations at Aragón Sociedad Concesionaria S.A., Highway A2, Calatayud-Alfajarín road section. PMP® MBA #ferrovial. Collaborator in working group recycled road surface at ATC.

Miguel Ángel García Gómez

Miguel Ángel García Gómez is a Civil Engineer from the Polytechnic University of Valencia, with a master's degree in Infrastructure, Equipment and Service Management from the UPM-CICCP, along with a diploma in Innovative Management Program (PID) from the IESE Business School.

Garcia began his professional career by providing technical assistance in highway construction projects in Technical Assistance in the construction of various highway sections funded by the Ministry of Public Works, Abia de la Obispalía – Cuenca and Alcázar del Rey – Horcajada de la Torre, in Cuenca, and later, Toledo – Torrijos in the province of Toledo; all of these sections correspond to the A-40 motorway. He also worked in Project Management in a national real estate developer in various residential and industrial projects.

Since 2008, Miguel Ángel has been working as the Director of Road maintenance and operation for a concessionaire company in a shadow toll contract funded by the Ministry of Transport, Mobility and Urban Agenda.

José Ramón Granero

- Education: Public works technical engineering.

- Professional experience:

Road Maintenance Operations Manager (17 months).

Road Maintenance Manager (11 years y 8 months).

- Present:

Technical department at energy efficiency consulting firm.

Trainer of road maintenance operators.

METHODOLOGY

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

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

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

The Director will ask all students to complete a Master's project, in which they will apply everything they have learnt in the previous modules, to practical cases. Students will have 3 months to complete and submit the project, during which they will receive the support from the program's team.

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

EVALUATION

The assessment will be ongoing throughout the training program and will take into account not only the acquisition of knowledge, but also the development of skills and attitudes.

At the end of each monthly module, the student must answer a test-type exam on the online training platform, in addition to pose a variety of practical cases along the topics and optional unit test so as to achieve the maximum consolidation of technical concepts.

To obtain the degree it will be necessary to pass the assessable modules of the program.

DEGREE

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

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

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



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