Institut Supérieur Aquitain
ÉCOLE D'INGÉNIEURS

ISA BTP
FORMATION INGÉNIEUR

GENERAL SYLLABUS

ISABTP – 2026–2027

UNIVERSITÉ DE PAU ET DES PAYS DE L'ADOUR

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Competence Framework

Competencies and Levels

Four competence clusters have been identified for the ISABTP Engineering degree:

COMPETENCY 1: ANALYSING A CONSTRUCTION PROJECT WITHIN ITS CONTEXT

COMPETENCY 2: SPECIFYING TECHNICAL SOLUTIONS FOR SUSTAINABLE AND MORE DURABLE CONSTRUCTION

COMPETENCY 3: DESIGNING STRUCTURES AND SYSTEMS COMPETENCY

4: MANAGING A CONSTRUCTION ORGANISATION

Each of these skill sets is divided into **three levels**:

LEVEL 1: The engineering student analyses simple projects under the supervision of experienced engineers.

Years covered: ISA 1 and ISA 2

LEVEL 2: The assistant engineer independently analyses routine projects whilst receiving occasional supervision from experienced engineers.

Year covered: ISA 3

LEVEL 3: The junior engineer analyses complex projects **related to their field of study** and works independently.

Years covered: ISA 4 and ISA 5

COMPETENCY C1: ANALYSING A CONSTRUCTION PROJECT WITHIN ITS CONTEXT

ESSENTIAL COMPONENTS:

- Drawing on fundamental scientific knowledge and tools
- By interacting effectively with the various project stakeholders, including in a foreign language
- By integrating the context and challenges of the project, in a relevant and comprehensive manner, within a sustainable development approach
- By assessing the project's impacts in relation to its human, economic, social and environmental dimensions
- By adopting the mindset of a responsible citizen

TYPES OF SITUATIONS:

- As a manager within an organisation and a civil society actor
- As a practising engineer working for a project owner, project manager, engineering consultancy or company… in France and internationally
- As a point of reference who can draw on expertise and is familiar with professional standards
- As a consulting engineer who assists with decision-making

COMPETENCY C2: SPECIFYING TECHNICAL SOLUTIONS FOR SUSTAINABLE AND MORE DURABLE CONSTRUCTION

ESSENTIAL COMPONENTS:

- Ensuring their optimisation based on a multi-criteria analysis that sets out their advantages and disadvantages
- By assessing risks and their behaviour throughout the construction's life cycle
- By balancing economic and environmental constraints
- By interacting with stakeholders in the construction sector through effective communication that utilises digital collaborative tools, whilst respecting each party's roles and responsibilities
- By producing detailed and well-documented drawings and written documents, in accordance with the specifications, the regulatory framework and Quality, Safety and Environment standards

TYPES OF SITUATIONS:

- As a practising engineer working for a project owner, project manager, engineering consultancy or construction firm...
- As an engineer working in an international context
- As a project manager or technical sales representative
- As a consultancy engineer

COMPETENCY C3: DESIGNING STRUCTURES AND SYSTEMS

ESSENTIAL COMPONENTS:

- By adopting a rigorous scientific approach that ensures reliability, safety and sustainability
- By designing an optimal structure or system, based on judicious choices of materials and equipment that minimise costs and environmental impact
- By drafting precise notes on assumptions, calculations and expert assessments, in accordance with professional practice and the regulatory framework
- By making judicious use of the results from digital tools and professional software
- By incorporating recommendations following the assessment of an existing structure or system, in order to optimise their design in line with users' needs

TYPES OF SITUATIONS:

- As an engineer at a PROJet or EXE engineering consultancy
- As a technical inspector or expert
- As a cost engineer
- In the context of new construction or the refurbishment of existing structures

COMPETENCY C4: MANAGING A CONSTRUCTION ORGANISATION

ESSENTIAL COMPONENTS:

- By selecting the appropriate human and material resources for the construction project
- By ensuring compliance with standards and regulations, particularly regarding health and safety
- By coordinating interaction and communication between project stakeholders, whilst respecting each party's duties and responsibilities
- By producing implementation documents consistent with the project's objectives and constraints
- By carrying out project planning and monitoring (both technical and financial) in line with the initial commitments, whilst remaining flexible enough to adapt to changes

TYPES OF SITUATIONS:

- As a site supervisor or works manager
- As a project manager or manager
- As a CSPS, OPC or BIM Manager
- As a department head or company director

First year

•Aquitaine Higher Institute

SCHOOL D NGEN EURS

ISAConstruction

FORMAT or lWGČulEUR

Semester 1

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
R 1-1	Communication 1: Written and oral expression 1	9.79 %
R 1–3	English 1	8.2%
R 1–4	Spanish 1	8.2%
R 1–5	Mathematics 1: Analysis	13.67%
R 1–6	Mathematics 1: Algebra	18.45%
R 1-7	Probability	7.52%
R 1–9	Module 1: Connections – Actions – PFS – Geometric characteristics – Isostatic beams	13.67%
R 1-11	Surveying 1: General Principles – Levelling and Setting-out	9.57%
R 1-14	Drawing 1: Sketches – Plans – Sections (by hand)	6.83%
R 1-15	Introduction to environmental issues	4.1%
SAÉ for competence C1		**%**
SAÉ 1-1	Laboratory testing of materials: aggregates, cements, concrete	57.14%
SAÉ 1-2	Design challenge: materials, comfort, environmental impacts, models	42.86%

Competence C2 – Specifying technical solutions for sustainable and more durable construction

Resources for Competency C2		%
R 1-1	Communication 1: Written and oral expression 1	17.41 %
R 1-8	Thermodynamics 1: Conduction – Convection – Radiation	24.29%
R 1-12	Technology 1: General principles of structural works	24.29%
R 1-13	Technology 2: General Road and Utilities – Roads – Earthworks	14.57%
R 1-14	Figure 1: Sketches – Plans – Sections (hand-drawn)	12.15 %
R 1-15	Introduction to environmental issues	7.29%
SAÉ for competence C2		**%**
SAÉ 1-1	Laboratory testing of materials: aggregates, cements, concrete	57.14%
SAÉ 1-2	Design challenge: materials, comfort, environmental impacts, models	42.86

Competence C3 – Dimensioning structures and systems

Resources for Competency C3		%
R 1–5	Mathematics 1: Analysis	20.41%
R 1–6	Mathematics 1: Algebra	27.55%
R 1-7	Probability	11.22%
R 1–8	Thermodynamics 1: Conduction – Convection – Radiation	20.41%
R 1–9	RdM 1: Connections – Actions – PFS – Geometric characteristics – Isostatic beams	20.41%
SAÉ for competence C3		**%**
SAÉ 1-2	Design challenge: materials, comfort, environmental impacts, models	100%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
R 1–3	English 1	17.14%
R 1–4	Spanish 1	17.14%
R 1–11	Surveying 1: General Principles – Levelling and Setting Out	20%
R 1-12	Technology 1: General principles of structural works	28.57%
R 1-13	Technology 2: General Road and Utilities – Roads – Earthworks	17.14%
SAÉ for competence C4		**%**
SAÉ 1-1	Laboratory testing of materials: aggregates, cements, concrete	57.14%
SAÉ 1-2	Design challenge: materials, comfort, environmental impacts, models	42.86%

R 1-1 - Communication 1: Written and oral expression 1

Timetable	
Semester	1
Period	Sept. – Dec.
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
Lecture	3 hours
Tutorial	8 hours
Tutorial	10.30
Total	9.30

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Written and oral expression

Prerequisites

Writing skills equivalent to those of a sixth-form student, combined with a critical thinking ability that needs to be developed and consolidated. This module continues in Semester 2.

Objectives

- To understand contemporary means of expression in the age of the information and communication society
- To apply critical thinking skills through a sound general knowledge base
- To master techniques of written expression (cover letters, CVs, text analysis, summaries) and oral expression (presenting an internship report, meeting minutes, oral presentations in general)
- To master formal language (written and spoken)

Programme

- General knowledge: Topics relating to general knowledge and society explored through the critical analysis of advertising, newspapers, books, films and exhibitions, etc.
- A critical approach to communication:
  - Definition of communication theory (noise, redundancy, etc.)
  - Critique of language
  - Social psychology
  - Analysis of imagery based on a play, a film or advertisements
- Written expression:
  - Learning to summarise and synthesise documents on in-depth topics, thereby developing general knowledge

  - Drafting and formatting an internship report
  - Internship application letter, cover letter, CV
  - Note-taking
- Oral expression:
  - Preparing for the oral defence of the work placement report
  - Press reviews
  - Oral presentations on a chosen social issue (noise, the city, etc.)
  - Debates and discussions based on the social issues covered

Bibliography

- *French for BTS*, published by Nathan
- *The Theory of Communication*, Jacobson

Communication

Prerequisites

The written skills of a sixth-form student, combined with a critical thinking ability that needs to be developed and consolidated. This module continues in Semester 2.

Objectives

- To master oral expression techniques (volume, rate and intonation of the voice, pauses and speech rhythm; use of body language, gestures and facial expressions, visual aids) whilst developing a constructive critical mindset
- To improve communication through a better understanding of oneself, one's key personality traits and the underlying mechanisms
- To improve communication through a better understanding of communication processes, communication tools that foster high-quality relationships and more effective information exchange, and, finally, the main communication styles (assertive, aggressive, manipulative and passive)

Programme

- Oral expression:
  - Oral presentations subject to constructive criticism from students to highlight the verbal, paraverbal and non-verbal characteristics of a good speaker,
  - Practical improvement exercises
  - Learning stress management techniques
  - Communication tools used in a range of exercises
  - Test on different communication behaviours

R 1-2 – IT tools 1: Office software – AI

Timetable
Semester.....1
Term .....Sept. – Dec.
Face-to-face teaching

Duration
Lecture.....3 hours
Tutorial.....9 am
Total.....12 hours

Assessment
Assessed as SAÉ

Prerequisites

Manage your networked IT account, access and use your E.N.T. (Digital Workspace on the university portal) for work placement applications, email, online courses, etc.

Objectives

- Use office software to write reports and presentations using a word processor
- Use a spreadsheet to perform automatic calculations and create graphical representations of results
- Create presentation slides for an oral presentation
- Optimise an image for insertion into a digital document.

Course programme

The face-to-face course comprises three parts covering:

- Using a word processor: formatting text (using styles), inserting objects, managing (editing and integrating) digital images
- Using a spreadsheet: using functions and formulas, creating charts, etc.
- Using presentation software: creating a presentation document, managing animations, managing (editing and integrating) digital videos

in order to introduce the key features of this type of software and outline the skills to be acquired. These skills will therefore be developed primarily through independent study using the exercises available on `elearn.univ-pau.fr`, and through work carried out for the reports and presentations on the 'Aggregates' practical course and an introduction to concrete.

Bibliography

- `elearn.univ-pau.fr`: ISA1 office software course
- websites: `www.libreoffice.org`,
- online software help
- `pix.fr`: Pix is the public online service for assessing, developing and certifying digital skills.

R 1-3 - English 1

Timetable	
Term	1
Period	Sept. – Dec.
Face-to-face teaching	

Duration	
Tutorial	18 hours
Total	**18 hours**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 – Managing a construction organisation

Prerequisites

None

Syllabus

Tutorials:

- **TOEIC Preparation**
- Listening: Practice on Parts 1–4 with business and technology contexts
- Reading: Parts 5–7, focusing on connectors and vocabulary in context
- Mini practice tests under timed conditions
- Final full-length TOEIC mock test

Key learning outcomes

By the end of this course, you will be able to:

- Achieve a TOEIC score of at least **500**.
- Demonstrate mastery of the grammar points tested in the TOEIC:
- Understand and respond to listening passages relating to money, business and technology.
- Read and analyse business and professional texts under time constraints.

Bibliography

- The Complete TOEIC® – 3rd edition
- The Official TOEIC® Bible

Keywords: TOEIC, grammar, business English

R 1-4 - Spanish 1

Timetable	
Term	1
Period	Sept. – Dec.
Face-to-face teaching	

Duration	
Tutorial	18 hours
Total	**18 hours**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Managing a construction organisation

Prerequisites

None: beginners are welcome.

Objectives

For beginners:
To be able to introduce oneself, conjugate verbs in the present tense, count, spell, ask for and give basic information, master vocabulary relating to the home and the classroom, and describe basic actions (daily routines).

For others:
To acquire the skills required to achieve level A1 in international certification exams (such as DELE):
This level certifies that the student is able to cope using basic vocabulary in communication situations relating to immediate needs and everyday topics.

- Talk about their professional environment in very general terms
- Form simple sentences
- Describe and compare objects
- Cope in most situations encountered whilst travelling
- Deliver a simple and coherent speech on familiar topics and within their areas of interest.
- Describe an event, an experience or a dream.

Course programme

- Learning the vocabulary needed to discuss familiar everyday topics
- Learning the grammatical rules needed to express oneself clearly on the whole

R 1-5 – Mathematics 1: Analysis

Timetable
Semester.....1
Term .....Sept. – Dec.
Face-to-face teaching

Assessment
Continuous assessment throughout the course

Duration
CM .....12 hours
Tutorials.....12 hours
Tutorial.....6
Total.....**30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

Knowledge acquired in the final year of science or technical streams

Objectives

Real-valued functions are an indispensable tool for modelling and studying any physical phenomenon. In particular, they enable us to model the behaviour of numerical quantities as a function of certain parameters. In this chapter, we focus specifically on functions depending on a single real variable.

By the end of this module, you will be able to:

- Define the basic properties of real-valued functions, including continuity, differentiability and limits at a point and at infinity
- Compare functions
- Perform limit expansions at 0 and away from 0

Syllabus

- Introduction
- Definitions
- Initial properties
- Limits
- Continuity
- Differentiability
- Local comparison of functions
- Limited expansions

Key learning points

Basic properties of real functions, derivatives of common functions and composite functions, study of limits at a point or at infinity, comparison of functions and common limited expansions.

Bibliography

- Online e-learning course
- Mr ABOUZAID's personal page: http://mabouzai.perso.univ-pau.fr/
- All books on mathematics for engineers

Keywords: function, derivative, variations, limit

R 1-6 - Mathematics 1: Algebra

Timetable	
Term	1
Period	Sept. – Dec.
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	7.30 pm
Tutorial	9.00 pm
Total	**40h30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

Knowledge and skills acquired in the general or technological science A-level

Objectives

- To master the tools of elementary algebraic calculation and mathematical notation
- Calculations with complex numbers and their application to geometry
- Mastery of elementary trigonometry – solving trigonometric equations
- Working with the scalar product and its applications to 2D geometry

Syllabus

- Basic tools
- Complex Numbers
- Geometry and Trigonometry

Bibliography

- Online e-learning course
- Mr ABOUZAID's personal page: http://mabouzai.perso.univ-pau.fr/
- All books on mathematics for engineers

Keywords: geometry, complex plane, trigonometry, scalar product

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R 1-7 – Probability

Timetable	
Term	1
Period	Sept. – Dec.
Face-to-face teaching	

Duration	
CM	7.5 hours
Tutorial	9 hours
Total	**4.30 pm**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

Specialist mathematics courses from the final year of general or technical upper secondary education.

Objectives

To use and interpret various probability tools.

Syllabus

- General concepts relating to probability spaces
- Study of common probability distributions (discrete and continuous)

Key learning outcomes

- Modelling a random phenomenon using common probability distributions
- Calculating probabilities

Bibliography

Ouvrard, *Probability 1*

Keywords: distribution function, probability distribution, density

R 1-7 – Probability

R 1-8 – Thermodynamics 1: Conduction – Convection – Radiation

Timetable	
Semester	1
Term	Sept. – Dec.
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	15h
Tutorial	15 hours
Total	**30 hours**

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C3 - Designing structures and systems

Prerequisites

None

Objectives

- To understand the general principles of heat transfer
- Recognise the modes of heat transfer within a building
- Identify the source and assess the predominant heat flows involved in a given process involving heat transfer
- Subsequently, to examine technologies for insulation and heat conservation, as well as for heat generation or extraction

Syllabus

- Heat: definition, modes of transfer, transfer regimes
- General principles and definitions relating to conduction and simplified convection
- Density and heat flux
- Properties of heat flux
- Heat equation
- Thermal resistance and heat conduction
- Basic models: Single-layer and n-layer walls in series/parallel, single-layer and n-layer coaxial hollow cylinders, single-layer and n-layer coaxial hollow spheres
- Solving simple problems (electrical equivalence)
- General principles and definitions relating to radiation
- Black/grey bodies: properties and laws

- Energy exchange by radiation between surfaces (simple cases)

Note: wherever possible, all case studies (examples, exercises, etc.) will be drawn from the construction industry (building insulation, glazing, etc.)

Bibliography

- Heat Transfer: Lectures and Basic Data, Taine J., Petit J.-P., Dunod, 1995
- Heat Transfer, Bouvenot A., Masson, 1980
- Heat Transfer, Holman J.P., 7th edition, McGraw-Hill, 1990
- Heat Transfer: A Case-Study Approach, Triboix A., Bouvenot J.B., Eyrolles, 2015
- Heat Transfer, Ouin J., Casteilla, 1998

Keywords: conduction, convection, radiation, heat flux, thermal resistance

R 1-9 - RdM 1: Connections – Loads – PFS – Geometric characteristics – Isostatic beams

Timetable	
Semester	1
Period	Sept. – Dec.
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	9 hours
Tutorial	12 hours
Tutorial	9.00

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

Vector calculus, Trigonometry

Objectives

- To calculate the moment of inertia of a beam section and its centre of gravity
- Solve the equilibrium of an isostatic beam
- Model a solid-to-solid friction force

Syllabus

- Geometric characteristics of beam cross-sections
- Forces, moments, torsional moments
- Fundamental principle of statics
- Distributed loads
- Connection forces
- Coulomb friction

Key learning points

- Moment of inertia of a typical beam cross-section
- Solving for the equilibrium of a static beam subjected to vertical forces

Bibliography

- *Mechanics for Engineers, Volume 1: Statics (3rd edition)*, F. P. Beer, R. E. Johnston

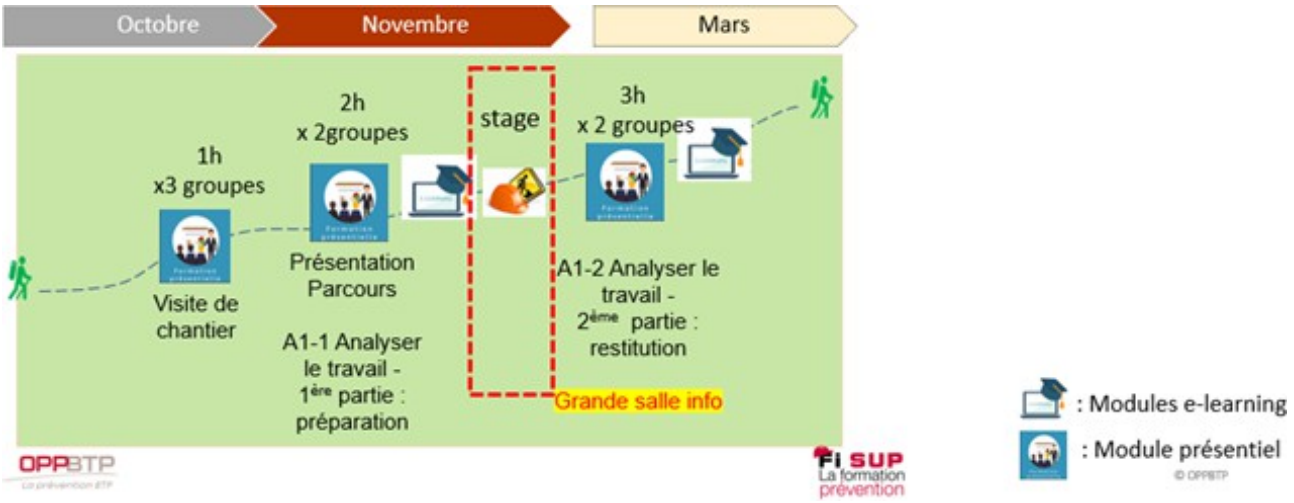
Keywords: Beam cross-section, static equilibrium

R 1-10 – Health and Safety 1: Introduction

Timetable
Semester.....1
Term .....Sept. – Dec.
Face-to-face teaching

Duration
Tutorial.....3 hours
Tutorial.....1 hour
Total.....4 hours

Assessment
Assessed as SAÉ



Prerequisites

None

Objectives

- To analyse the work in order to gain a better understanding of the prevention measures to be put in place
- To familiarise oneself with the terminology of prevention
- Outline your future role in workplace prevention
- Assess developments in health and safety in the construction industry

Programme

Session 1 (1 hour/practical session) Site visit

The site visit itinerary follows the HALTES Method/the 5Ms. The order of the visit covers the following points:

- Health and Safety: Inspection of site accommodation

- Access: Management of access routes, parking areas and traffic routes on site (pedestrians, vehicles, machinery)
- Delivery: The storage area, organisation of supplies and mechanical handling
- Tasks: Observation of tasks currently being carried out. For each workstation, care will be taken to observe the risks and preventive measures relating to the 5Ms: Environment, Equipment, Materials, Workforce, Operating Procedures
- Utilities: Management of utilities (water, electricity, fibre, fuel, etc.)
- First aid: Organisation of first aid

Session 2 (2 hours) Analysing the work: Feedback

Understanding the OPPBTP and the tools at their disposal.
Understanding the concept of the Mechanism of Damage Occurrence
Introduction to the principles of risk assessment.
Presentation on Serious and Imminent Danger: Duty to report and right to withdraw from work. Presentation of an observation exercise to be carried out during their work placement.

Teaching methods: Presentation, group discussions, videos and OPPBTP BEEKAST graphic tools, interactive activities

Session 3 (3 hours) Understanding the differences between the main players in health and safety

Knowing how to analyse a work situation, knowing how to identify a strength in prevention; knowing how to observe a construction site

Assessment

The assessment for this module includes the online assessment completed prior to the work placement.

Note: The task of observing a key aspect of health and safety during the work placement period and presenting the findings orally afterwards forms part of the assessment for the Work Placement module. The relevance of the students' choice and their presentation is assessed by the OPPBTP trainer and the group of students.

Key learning outcomes

- Analysing a work situation and identifying risks
- Identify those involved in health and safety and their roles
- Observe and assess health and safety measures on a construction site

Keywords: Prevention, safety, construction site, occupational risks, OPPBTP

R 1-11 - Surveying 1: General Principles – Levelling and Setting Out

Timetable
Semester.....1
Term .....Sept. – Dec.
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....12 hours
Tutorial.....9 hours
Total.....**21h**
Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

None

Objectives

- Read and interpret plans and topographical maps
- Carry out a direct levelling survey and analyse the results
- Carry out a simple site layout

Syllabus

- General information:
  - Surveying in the construction process
  - The various surveying instruments
  - Scales, plans and maps
  - The evolution of legal systems in France (NTF; RGF93)
- Mathematical refresher:
  - Solving arbitrary triangles: the various cases
  - Coordinate systems: polar; rectangular
  - Transformation: rectangular to polar
- Direct levelling:
  - NGF-IGN69 network
  - Principle of direct levelling
  - Radiation levelling
  - Traverse levelling
  - Checks

- Survey set-outs:
  - The various methods
  - Radiation setting
  - Controls
- Practical aspects:
  - Alignment and distance measurements
  - Using the optical square
  - Direct levelling
  - Angle measurement
  - Site marking

Key learning points

- Reading and interpreting a topographical plan
- Carrying out a direct levelling survey and processing the results
- Carrying out a simple site layout

Bibliography

- *Modern Surveying and Topometry – Volume 1: Measurement and Representation Techniques and Volume 2: Calculations*, Milles, Lagofun, published by Eyrolles

Keywords: Surveying, levelling, setting-out, geodesy, topographic surveys

R 1-12 – Technology 1: General Principles of Structural Work

Timetable	
Semester	1
Term	Sept. – Dec.
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	15h
Tutorial	15 hours
Total	**30 hours**

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C4 – Managing a construction organisation

Prerequisites

None

Objectives

- To learn about traditional structural construction methods
- To familiarise yourself with the technical terminology associated with the various processes
- To learn how to read a plan and identify all the necessary information

Syllabus

- Description of the different parts of a building
- Description of the main structural construction techniques used today in France
- Introduction to reading plans: different types of plans encountered, main symbols found on plans, conventional representation of materials, types of lines used, etc.
- Identifying structural elements on plans
- Reading levels (in plan and elevation)
- Presentation of schedules for different types of floor structures (beam-and-joist, precast slab and in-situ slab, etc.), and for the reinforcement of structural elements

Key learning outcomes

- Be able to recognise and describe standard structural elements of a building's structural work using the appropriate technical vocabulary
- Be able to explain in detail the construction techniques used to create standard structural elements of a building's structural shell, using the appropriate technical vocabulary
- Be able to read a technical drawing, i.e. understand the structure of a building, its dimensions and its positioning on the site

Bibliography

- *Technical Drawing – Reading Plans, Buildings and Reinforced Concrete*, Foucher, 1996
- *Reading Building Plans*, H. Richaud and B. Vuillerme, Nathan Technique, 1989
- *The House from A to Z*, G. Calvat, published by Alternatives, 2003
- *Handbook of Building – Design, Construction, Standardisation*, D. Didier, M. Le Brazidec, P. Nataf, J. Thiesset, published by Nathan, 2005
- *Building Construction, Volume 1: Structural Work and Volume 2: Finishing Work*, G. Karsenty, published by Eyrolles, 1997 and 2001

Keywords: Building, structural work, construction techniques, technical drawings

R 1-13 - Technology 2: General Principles of Roads and Utilities – Roads – Earthworks

Timetable
Semester.....1
Term .....Sept. – Dec.
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial.....9 hours
Total.....**18h**

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

R 1-14 - Drawing 1

Objectives

The main objective of this course is to acquire basic knowledge and an understanding of the orders of magnitude in the fields of earthworks, roads and drainage, based on a case study that will enable students to make the connection between road alignment and these three sectors of activity.

Syllabus

- Lectures:
  - **Overview of the construction industry**: FFB, FNTP, key figures, areas of activity in public works, key stakeholders, major construction groups in France and the various trades
  - **Road earthworks**: general overview, technical terminology (PST/AR/PF/TC), classification of soils and rocks using the Guide to Earthworks, Embankments and Sub-bases, the handling of excavated material and embankments, lime and cement treatment of in-situ soils and quality controls, organisation of an earthworks site
  - **Roads**: history, key figures, technical terminology relating to pavement layers and their functions, road alignment in plan view/longitudinal profile/cross-section, hydrocarbon and hydraulic binders, the composition of asphalt concrete, the construction of pavement structures and quality control
  - **Sewerage and drinking water networks**: combined or separate systems, stormwater (EP) and wastewater (EU) networks, drinking water supply (AEP) networks, technical terminology relating to trenches, the composition of inspection chambers, the different types of pipes, conduits, fittings and accessories for drinking water supply, the main risks during installation, the different types of shoring, the different types of installation and quality controls

- Practical Exercises:

  Route alignment with straight sections and circular arcs (plan view/longitudinal profile/cross-sections showing cut and fill to be completed, calculation of total volumes to be completed, representation of a stormwater treatment basin with inspection chambers and pipework).

Key learning outcomes

- Technical vocabulary relating to earthworks, roads and drainage;
- Concepts of road design in plan view, longitudinal profile and cross-sections;
- Knowledge of on-site implementation and quality control.

Bibliography

- *Guide to Earthworks, Embankments and Sub-bases* (May 2023 edition: Institute of Roads, Streets and Infrastructure for Mobility)
- *Catalogue of Standard Structures for New Pavements* (1998 edition: Technical Studies Department for Roads and Motorways (SETRA) and Central Laboratory for Bridges and Roads (LCPC))
- *Booklet 70-1: Supply, installation and rehabilitation of free-flow water pipes* (May 2021 edition).

Keywords: earthworks, roads, drainage

R 1-14 - Drawing 1: Sketches – Plans – Sections (by hand)

Calendar
Half-year 1
Period.....Sept. – Dec.
Face-to-face teaching

Assessment
Continuous assessment

Duration
Lecture.....3 hours
Tutorial.....3 hours
Tutorial.....9 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

None

Objectives

- Read a standard plan during the design phase (e.g. building permit application)
- Master standard graphical representations
- Produce a partial plan of a structure

Syllabus

Lectures:

- Understanding the different types of drawings: representations, projections, links between plans and project phases (design, construction, as-built), standard plans (Planning Permission, detailed construction drawings)
- Graphic languages and representations: types and line weights, hatching and shading
- Dimensions and annotations on plans
- Other elements: scale, title block, legend, symbols

Tutorials:

- Reading and interpreting plans from a planning application dossier: site plan, massing, levels, elevations, sections, details
- Relating drawings to the project

description or technical specifications

Practical work:

- Drawing a partial cross-section or longitudinal section (A3 format using drawing instruments)
- Drawing a detail (A3 or A4 format using drawing instruments)

During this module, engineering students learn technical construction vocabulary, building methods and construction materials.

Key learning outcomes

- Reading a standard design-stage drawing (such as a PC drawing)
- Mastering standard graphical representations
- Draw up a partial plan of a structure

Bibliography

- NF P 02-001: 'Architectural, building and civil engineering drawings: *conventional symbols, general principles, principles of* representation'
- NF P 02-005: 'Architectural, building and civil engineering drawings: dimensioning'
- Document 'Technical Drawing' – www.cdpsciencetechno.org
- Book 'Précis de Bâtiment' – Afnor / Nathan

Keywords: Plans, sketches, diagrams, conventions, language

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R 1-15 – Introduction to environmental issues

Timetable	
Semester	1
Period	Sept. – Dec.
Face-to-face teaching	

Duration	
CM	4h30
Tutorial	4h30
Total hours	**9**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

None

Objectives

- To understand environmental issues in the construction sector
- Master the life cycle analysis of a typical wall component

Syllabus

- Global environmental issues
- Environmental issues as they apply to the construction sector
- Life cycle assessment
- Introduction to environmental regulations 2020

Key learning points

- Knowing how to use life cycle assessment data
- Be able to carry out an environmental analysis of a wall
- Be able to link a product's environmental characteristics to current environmental issues

Bibliography

- *IPCC AR6 Synthesis Report*, IPCC, 2023
- *Consequential life cycle analysis applied to building complexes, PhD thesis*, Charlotte Roux, 2016
- *RE2020 Guide*, CEREMA, 2024

Keywords: Life cycle assessment, environmental quality, regulations 43

R 1-16 - Materials 1: Introduction to the properties of materials

Timetable	
Semester	1
Period	Sept. – Dec.
Face-to-face teaching	

Assessment
Assessed as SAÉ

Duration	
CM	4h30
Tutorial	4h30
Tutorial	3 hours
Total	**12 hours**

Prerequisites

None

Objectives

- To understand the main families of materials.
- To be able to link macroscopic characteristics to microstructure.

Syllabus

- Classification of materials: families, composition, uses. Illustrated with examples of materials used in various sectors of the construction industry.
- From microstructure to macroscopic properties: an introduction to crystallography. Overview of the main properties of materials (mechanical, thermal, acoustic, magnetic, etc.).

R 1-17 - Site visits and conferences 1

Timetable	
Semester	1
Period	Sept. – Dec.
Face-to-face teaching	

Duration	
CM	7.5 hours
Tutorials	3 hours
Total	**10.30**

Assessment
Assessed as SAÉ

Prerequisites

None

Objectives

The site visits and lectures organised during the first three years at ISA BTP serve several educational purposes:

- to explore the diversity of the construction industry:
  - structures and systems: buildings, engineering structures, infrastructure, road and rail networks, roads and utilities, civil engineering works, maritime structures, facilities, installations… ,
  - key players: client, project manager, engineering consultancy, contractors, subcontractors, health and safety coordinator, geotechnical engineer, technical inspector, laboratory technician. . . ,
  - roles: labourers, technical and managerial staff, executives, project managers, site managers, site supervisors, engineers, business owners, self-employed contractors, suppliers, technical sales representatives. . . ,
  - materials: 'conventional', innovative,
  - construction methods and working procedures,
- developing one's understanding of the construction industry: projects and sites ranging from routine to exceptional, local and national projects, technical terminology,
- linking this to the curriculum: Resources and SAÉ,
- developing curiosity and an open mind,
- encouraging interest in SAÉ work placements and facilitating the choice of the ISA4 and 5 pathways

Key learning outcomes

- develop listening and observation skills
- write a report on a site visit or take notes during lectures
- apply these discoveries and insights in the SAÉ

Keywords: Discovery, technologies, diversity, organisations, responsibilities

SAÉ 1-1 – Laboratory testing of materials: aggregates, cements, concrete

Timetable
Semester.....1
Term .....Sept. – Dec.
Face-to-face teaching

Assessment
Defences and Portfolio

Duration	1 week
Supervised hours	22 hours
Self-study	6 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

Basic knowledge of building materials

Objectives

Based on standards (or guidelines), students will be required to carry out tests to characterise the properties of materials. These tests are commonly carried out either in the laboratory or on site.

Syllabus

- Test preparation: reading and understanding standards
- Carrying out standardised tests on materials
- Interpretation and analysis of results
- Drafting of reports and minutes

Learning objectives

As a laboratory technician, you will need to:

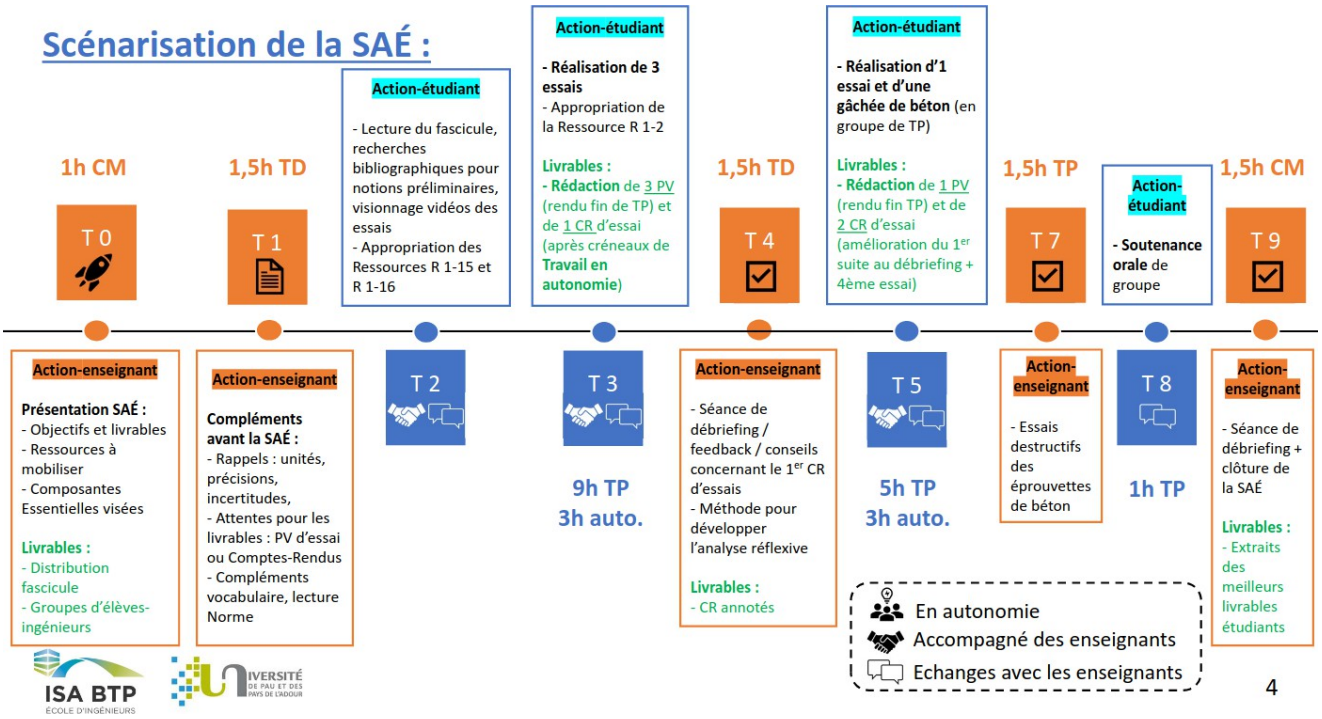
- understand the **purpose of the experiments**
- use **specific materials and equipment**
- understand and apply **experimental protocols,** which are generally based on AFNOR standards (NF EN ...)
- master the **basic concepts**

As a laboratory technician, you will need to draw up a **Test Report** summarising the various results of the procedures carried out at the end of each test, as well as **Procedure Reports**, in which you will:

- briefly explain the stages of the test (do not simply rewrite the protocols),

- present the results obtained: values, graphs, units, etc.,
- provide a critical analysis: order of magnitude of the results, any malfunctions or errors, possible improvements, etc.,
- indicate the impact of the results on a future concrete mix design.

Syllabus



- Introduction
  - Background / Some figures on concrete in France and worldwide /
  - Presentation of the SAÉ test scenario
- Background information prior to testing: Concepts of accuracy, errors and uncertainties; interpretation of standards
- Laboratory tests
  - Over the course of four rotating sessions, tests were carried out on aggregates, cements and mortars
    - Session 1 – Mortar: influence of sand, the water-to-cement ratio, a superplasticiser or an air-entraining agent – Preparation of 4x4x16 test specimens
      Mechanical tests on the cast test specimens are to be carried out independently approximately 7 days after casting
    - Session 2 – Tests on cement paste (setting start and end times; consistency of the cement paste) – Densities of cement
    - Session 3 – Particle size analysis, sieving, mixing
    - Session 4 – Granular arrangements: A: study of porosity and B: study of expansion

  - Concrete mix design and mixing
  - Mechanical tests on concrete specimens
- Debriefing and guidance on deliverables; methodology for developing reflective analysis
- Oral defence
- Final debriefing and conclusion of the SAÉ

Key learning points

- Carrying out standardised tests on materials in accordance with protocols
- Analysing and interpreting test results
- Draft a technical test report
- Analysing the relationships between the formulation parameters of mortar or concrete and the behaviour of mortar or concrete

Examples of deliverables or outputs

- Drafting a test report setting out the test procedure
- Test report
- Preparation of test specimens or material samples

Laboratory procedure manual Test standards

Keywords: Testing, materials, standards, characterisation

SAÉ 1-2 – Design challenge: materials, comfort, environmental impacts, models

Timetable
Semester.....1
Period.....Sept. – Dec.
Face-to-face teaching

Assessment
Defences and Portfolio

Duration	1 week
Supervised hours	22 hours
Self-study	6 hours
Targeted skill(s)	
C1 – Analysing a construction project within its context	
C2 - Specify technical solutions for sustainable and more durable construction	
C3 - Design structures and systems	
C4 - Manage a construction organisation	

Prerequisites

- Resource R 1-8 – Thermodynamics 1: Conduction – Convection – Radiation
- Resource R 1-16 – Materials 1: Introduction to the properties of materials

Objectives

To propose an energy-efficient building system (wall) with low environmental impact for winter comfort

Syllabus

- General overview
- Calculation of the thermal performance of the base wall and consideration of the proposed modifications to the wall (definition of the context, thermal, environmental and economic analysis, site organisation, etc.)
- Construction of the wall prototype (Laboratory)
- Conducting tests on the wall
- LCA study of the wall
- Improvement, testing and simulation
- Oral presentation by group

Key learnings

- Designing an energy-efficient wall in theory
- Build a scale-model wall and carry out measurements (experimental part)
- Present and defend one's choices orally

Keywords: Design, construction, measurements, energy analysis, life cycle assessment

Semester 2

Competency C1 – Analysing a construction project within its environment

Resources for Competency C1		%
R 2-1	Communication 2: Written and oral expression 2	9.05%
R 2-3	English 2	10.27%
R 2-4	Spanish 2	10.27%
R 2–5	Mathematics 2: Analysis	13.2%
R 2–6	Mathematics 2: Algebra	13.94%
R 2-7	Statistics 1	8.07%
R 2-12	Organisation 2: Task scheduling	6.6%
R 2-13	Technology 3: Building Finishing Works	8.8%
R 2-14	Technology 4: Engineering Structures – Civil Engineering	6.6%
R 2-15	Technology 5: Building Services Engineering	6.6%
R 2-17	Materials 3: Finishing materials 1	6.6%
SAÉ for competence C1		**%**
SAÉ 2-1	Structural design/stability challenge: bridge, tower, structure, models	9.4%
SAÉ 2-2	End-of-Year Project: new building or refurbishment (all trades)	18.8%
SAÉ 2-3	Construction placement	71.79%

Competence C2 – Specifying technical solutions for sustainable and more durable construction

Resources for Competency C2		%
R 2-1	Module 2: Written and Oral Communication 2	10.42%
R 2-8	Electricity: Basic Principles	16.9
R 2-11	Organisation 1: Quantity Surveying and Costing	10.99%
R 2-13	Technology 3: Building finishes	10.14
R 2-14	Technology 4: Engineering Structures – Civil Engineering	7.61%
R 2-15	Technology 5: Building Services Engineering	7.61%
R 2-16	Materials 2: Structural Materials 1 – Concrete – Metals	19.44%
R 2-17	Materials 3: Finishing materials 1	7.61%
R 2-18	Materials 4: Building with materials	9.3%
SAÉ for competence C2		**%**
SAÉ 2-1	Structural design/stability challenge: bridge, tower, structure, models	33.33%
SAÉ 2-2	End-of-Year Project: new building or refurbishment (all trades)	66.67%

Competency C3 – Dimensioning structures and systems

Resources for Competency C3		%
R 2-2	IT Tools 2: Introduction to Databases	9.62%
R 2-5	Mathematics 2: Analysis	17.31%
R 2-6	Mathematics 2: Algebra	18.27%
R 2-7	Statistics 1	10.58%
R 2-8	Electricity: Basic Principles	19.23 %
R 2-9	RdM 2: PFS – Loads – Normal stresses – Beams, trusses, isostatic frames	25%
SAÉ for competence level C3		**%**
SAÉ 2-1	Structural design/stability challenge: bridge, tower, structure, models	33.33%
SAÉ 2-2	End-of-Year Project: new building or refurbishment (all trades)	66.67

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
R 2-2	IT tools 2: Introduction to databases	8.33%
R 2-3	English 2	11.67%
R 2-4	Spanish 2	11.67%
R 2–9	RdM 2: PFS – Loads – Normal stresses – Beams, trusses, isostatic frames	21.67 %
R 2-11	Organisation 1: Quantity surveying and cost estimation	10.83%
R 2-12	Organisation 2: Task scheduling	7.5
R 2-16	Materials 2: Structural Materials 1 – Concrete – Metals	19.17%
R 2-18	Materials 4: Building with materials	9.17%
SAÉ for competence C4		**%**
SAÉ 2-1	Structural design/stability challenge: bridge, tower, structure, models	9.4%
SAÉ 2-2	End-of-Year Project: new-build or refurbishment (all trades)	18.8%
SAÉ 2-3	Construction placement	71.79%

R 2-1 - Communication 2: Written and Oral Expression 2

Timetable
Semester.....2
Period.....Feb – June
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM hours	3
Practical hours	8
Tutorial	7.30
Total	6.30

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Written and oral expression

This module follows on from the one in Semester 1. The content described here covers the entire programme for the year.

Prerequisites

Written and oral communication S1

Objectives

- To understand the means of expression in today's world, the age of the information and communication society
- To apply critical thinking skills through a sound general knowledge
- To master techniques of written expression (cover letters, CVs, text analysis, summaries) and oral expression (presenting an internship report, meeting minutes, oral presentations in general)
- To master formal language (written and spoken)

Programme

- General knowledge: Topics relating to general knowledge and society explored through the critical analysis of advertising, newspapers, books, films and exhibitions, etc.
- A critical approach to communication:
  - Definition of communication theory (noise, redundancy, etc.)
  - Critique of language
  - Social psychology
  - Analysis of imagery based on a play, a film or advertisements
- Written expression:

  - Learning to summarise and synthesise documents on in-depth topics to develop general knowledge
  - Drafting and formatting an internship report
  - Internship application letter, cover letter, CV
  - Note-taking
- Oral expression:
  - Preparing for the oral defence of the work placement report
  - Press reviews
  - Oral presentations on a chosen social issue (noise, the city, etc.)
  - Debates and discussions based on the social issues addressed

Bibliography

- *French for BTS*, published by Nathan
- *The Theory of Communication*, Jacobson

Communication

This module follows on from the one covered in Semester 1. The content described here covers the entire programme for the year.

Prerequisites

Communication S1

Objectives

- To master oral expression techniques (volume, rate of speech and intonation; pauses and speech rhythm; use of body language, gestures and facial expressions; visual aids) whilst developing a constructive critical approach
- To improve communication through a better understanding of oneself, one's key personality traits and the underlying mechanisms
- To improve communication through a better understanding of communication processes, communication tools that foster high-quality relationships and more effective information exchange, and, finally, the main communication styles (assertive, aggressive, manipulative and passive)

Programme

- Oral expression:
  - Oral presentations subject to constructive criticism from students to highlight the verbal, paraverbal and non-verbal characteristics of a good speaker,
  - Practical improvement exercises
  - Learning stress management techniques
  - Communication tools used in a range of exercises
  - Test on different communication behaviours

R 2-2 – IT tools2 : Introduction to databases

Timetable	
Semester	2
Period	Feb – June
Face-to-face in person	

Duration	
CM	4h30
Tutorial	10.5 hours
Total	**15h**

Assessment
Continuous assessment

Targeted skill(s)
C3 – Designing structures and systems
C4 - Managing a construction organisation

Prerequisites

None

Objectives

- To understand the Logical Data Model of a database and its relational schema
- Import a database
- Add and remove data
- Write queries to select from a single table
- Write queries to select from multiple tables
- Writing compound queries
- Create a database and create the various tables

Syllabus

- General definitions
- The Logical Data Model
- Practical Exercise: Fundamentals of using a DBMS (phpMyAdmin)

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R 2 –3 – English 2

Timetable
Semester.....2
Period.....Feb – June
Face-to-face in person

Duration
Tutorial .....21 hours
Total.....21 hours

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Managing a construction organisation

Prerequisites

English ISA1-S1

Syllabus

Tutorials:

- **TOEIC Preparation**
- Listening: Practice with Parts 1–4 in business and technology contexts
- Reading: Parts 5–7, focusing on connectors and vocabulary in context
- Mini practice tests under timed conditions
- Final full-length TOEIC mock test

Key learning outcomes

By the end of this course, you will be able to:

- Achieve a TOEIC score of at least **500**.
- Demonstrate mastery of the grammar points tested in the TOEIC:
- Understand and respond to listening passages relating to money, business and technology.
- Read and analyse business and professional texts under time constraints.

Bibliography

- The Complete TOEIC® – 3rd edition
- The Official TOEIC® Bible

Keywords: TOEIC, grammar, business English

R 2-4 – Spanish 2

Timetable	
Term	2
Period	Feb – June
Face-to-face in person	

Duration	
Tutorial	21 hours
Total	**21 hours**

Assessment
Comprehensive continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

Spanish S1

Objective

For beginners:
To acquire the skills required to achieve level A1 in international certification exams (such as DELE):
This level certifies that the student is able to get by using basic vocabulary in communication situations relating to immediate needs and everyday topics.

For others:
To acquire the skills needed to achieve level A2 in international certification exams (such as DELE):
Level A2 certifies that the student is able to cope and communicate on everyday topics: they must be able to describe their educational background, express a need, etc.

Targeted skills

- Talk about their professional environment in very general terms
- Form simple sentences
- Describe and compare objects
- Produce simple, coherent speech on familiar topics (home, restaurants, family, the town, etc.) and in areas of personal interest (expressing feelings, sensations, preferences, etc.).
- To recount an event, an experience or a dream.

Course programme

- Learning basic technical vocabulary related to construction
- Learning the vocabulary needed to discuss familiar everyday topics
- Learning the grammatical rules needed to express oneself clearly overall

R 2-5 - Mathematics 2: Analysis

Timetable	
Term	2
Period	Feb – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	10.30 am
Tutorial	10.30
Tutorial	6 hours
Total	**27**

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Sequences

Prerequisites

Key mathematical concepts from ISABTP1-S1, in particular those covered in R1-05.

Objectives

Numerical sequences are one of the main tools of numerical approximation.
By the end of this module, you will be able to:

- Define the basic properties of numerical sequences and identify the different types of sequences
- Examine the convergence of a sequence

Syllabus

- Introduction
- Definitions
- Basic properties of real sequences
- Convergence criteria
- Recurrent sequences

Key learning points

Convergence of a numerical sequence.

Bibliography

Online e-learning course

Primitives and integrals

Prerequisites

Key learning outcomes from the ISABTP1-S1 mathematics module, in particular those from R1-05.

Objectives

By the end of this module, you will be able to:

- Understand and master the basics of single-variable integral calculus

Syllabus

- Introduction
- Definitions
- Common antiderivatives
- Operations on antiderivatives
- Integral over a segment
- Chasles' relation and other properties
- Application to area calculation
- Integration techniques

Key Concepts

Common primitives, integration by parts, changes of variables

Bibliography

Online e-learning course

R 2-6 - Mathematics 2: Algebra

Timetable
Semester.....2
Period.....Feb – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM.....1.30 pm
Tutorial 12.00
Tutorial.....3

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

- Specialist Mathematics courses for Year 13 students in general or technical streams.
- R 1-5 – Mathematics: Analysis
- R 1-6 – Mathematics: Algebra

Targeted skills

- To understand and master the basics of polynomial calculus in one variable
- Understand and master the basics of matrix calculus
- Be able to analyse the properties of a linear system based on its coefficients
- Be able to solve small-dimension linear systems by hand

Syllabus

- Polynomials of degree 3 or higher in $\mathbb{R}[X]$ and $\mathbb{C}[X]$
- Rational fractions in $\mathbb{R}[X]$ and $\mathbb{C}[X]$, factorisation into simple terms
- Linear systems and matrix algebra

Key learning outcomes

- Calculating the roots of a second-degree polynomial
- Understand the relationship between roots and factorisation
- Knowing how to carry out the factorisation of a rational fraction
- Understand the basic tools of matrix algebra
- Know how to solve a low-dimensional linear system

Bibliography

- Mr ABOUZAID's personal website: http://mabouzai.perso.univ-pau.fr/
- All books on mathematics for engineers

Keywords: polynomials, rational fractions, factorisation, integral calculus, antiderivatives

R 2-7 – Statistics 1

Timetable
Semester.....2
Term.....Feb – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....6 hours
Practical sessions.....6 hours
Tutorial 4h30
Total 16.5

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

Probabilities for Semester 1

Objectives

To use and interpret the various tools of descriptive statistics

Syllabus

- Tools for univariate statistics
- Bivariate statistical tools

Key learning outcomes

- Comparing data sets
- Plotting data sets
- Establishing a linear relationship between two quantitative statistical variables

Bibliography

Statistics and Probability T2, Verlant St Pierre

Keywords: mean, standard deviation, quantile, histogram, empirical distribution function, linear regression

R 2-8 – Electricity: Basic Principles

Timetable
Semester.....2
Period.....Feb – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM.....1.30 pm
Tutorial.....1.30 pm
Tutorial.....3 hours

Targeted competence(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C3 - Designing structures and systems

Prerequisites

- Physics: direct current (Ohm's law, derivative currents, laws of resistance combination, loops and nodes).
- Mathematics: complex numbers, derivatives and integrals.

Objectives

- Apply Ohm's law to alternating currents based on the concept of impedance
- Calculate the active and reactive power balances in a circuit

Syllabus

- Alternating current circuits – average and effective currents
- Ohm's Law – complex representation
- RLC circuits: resonance and anti-resonance: effects and properties: a deductive approach through practical work
- Active and reactive power

Bibliography

- *The Essentials of Electrokinetics*, J-N. Beury, Ellipses, 1998, 223 pp.
- *Electricity: Exercises and Answered Problems*, J-P. Dubarry-Barbe, A. Frey, Ellipses, 1998, 192 pp.
- *A Handbook of Physics: Electrocinetic Theory*, J-L. Queyrel, J. Mesplede, Bréal, 1996, 384 pp.
- *Exercises and Problems in General Electricity*, G. Granjon, 2nd edition, Dunod, 2004

R 2-9 - RdM 2: PFS - Loads - Normal stresses - Beams, trusses, isostatic frames

Timetable
Semester.....2
Term.....Feb – June
Face-to-face in person

Assessment
Continuous assessment throughout the course

Duration
CM.....10.30 am
Tutorial.....4.30 pm
Tutorial 12.0 0

Targeted skill(s)
C3 – Designing structures and systems
C4 - Managing a construction organisation

Prerequisites

- RDM Mechanics: Rdm1
- Mathematics: Linear Algebra, Analysis

Objectives

- To determine the loads, deformation state and stress state of isostatic beams
- Understand and calculate the buckling risk of straight beams

Syllabus

- Concepts of stress and strain, normal stresses, shear stresses.
- Modelling and design of isostatic beams subjected to simple or compound bending
- Buckling of straight beams

Bibliography

- Handout distributed to students: "Strength of Materials Course", D. Grégoire, ISA BTP

- This course has been compiled drawing primarily on:
  - Christian La Borderie's *'Mechanics Course and Exercises'* from ISABTP, http://web.univ-pau.fr/~clb/rdm/index.html
  - Jean-Pierre Pelle's *Mechanics Course* at the ENS de Cachan,
  - Pierre-Alain Boucard's *'Course on Structural Design'* at the IUT de Cachan, http://meca.iutcachan.free.fr/files/RdM_screen.pdf
  - from *the *Guide to Structural Analysis** by D. Spenlé and R. Gourhant, published by Hachette.

R 2-10 – Health and Safety 2: Running the work placement

Timetable
Semester.....2
Term.....Feb – June
Face-to-face in person

Duration
Tutorial.....3 hours
Total.....3 hours

Assessment
Assessed in SAÉ

Prerequisites

- R1-10 – Health and Safety 1: Introduction
- SAÉ 2-3 – Practical Training

Objectives

- To analyse the field observations made during the work placement
- To analyse the safety practices observed in the workplace

Syllabus

- Feedback on work placements
- Analysis of observed work situations

Key lessons learnt

- Identifying and analysing occupational risks on a construction site
- Assessing the effectiveness of existing preventive measures

Keywords: Health and safety, work placement, feedback

R 2-11 - Organisation 1: Quantity surveying and cost estimation

Timetable
Semester.....2
Period.....Feb. – June
Face-to-face in person

Assessment
Continuous assessment throughout the course

Duration
CM.....7.5 hours
Tutorials.....6 hours
Tutorial 6.00

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

Basic knowledge of structural and finishing works technology Sufficient following the 6-week work placement S1

Objectives

- To understand the phases of the construction process in accordance with the Public Procurement Code (CCP)
- List the contractual documents relating to the price of a works contract. (Tender Documents)
- Draw up a bill of quantities for a simple construction project. (DQE)

Syllabus

- Core scope of the project management role for a works contract in accordance with the Public Procurement Code
- Components of the tender documentation (DCE)
  - Reference documents for setting a price
  - The contractor's obligations regarding the price, following signature of the contract
- Basic techniques for preliminary quantity surveys with a view to drawing up a bill of quantities:
  - Traditional method using a spreadsheet and/or a hand-drawn quantity take-off
  - Extracting quantities from a digital model
- Calculation of the selling price of a structure and/or a basic structural element
  - Concepts of direct labour costs, site costs, overheads, sales margin, selling price
  - Method using price breakdowns and/or price libraries
  - Analysis of labour costs

Key learning points

- Building contract, reference documents for a works contract
- Preliminary quantity survey, measurement of significant quantities within a lot.
- Cost analysis, preparation of a contractor's quotation

Bibliography

- *Le Métré*, Gousset, Capdeville, published by EYROLLES
- *BimVision*, free digital model *viewer*
- Spreadsheet software
- Price database provided (quantity surveying)

R 2-12 - Organisation 2: Task scheduling

Timetable	
Half-year	2
Period	Feb – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	4h30
Tutorial hours	6
Tutorial hours	3
Total	1.5

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 – Managing a construction organisation

Prerequisites

- Technology resources: Technology 1 (R1-12) and Technology 2 (R1-13)
- Basic concepts of organising common construction sites

Syllabus

Lectures:

- the roles of planning
- Types of schedules according to project phases: general schedules and specific schedules
- Characteristics of a task: definition, duration, sequencing, dependencies, critical path
- Resource management: human, equipment, materials

Tutorials:

- drawing up general schedules: task capacity, Gantt charts, PERT
- Creating specific schedules: labour, production and credit hour curves, etc. Fixed-schedule and procurement schedules, etc.

Practical Work:

- Applications using digital tools or planning software such as: spreadsheets, GanttProject, Microsoft Project, etc.

Key learning outcomes

- scheduling tasks
- drawing up a potential task schedule and plotting a labour curve

Keywords: Scheduling, planning, task, resources

R 2-13 - Technology 3: Building Finishing Works

Timetable
Semester.....2
Term.....Feb. – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial.....9 hours
Total.....**18h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Recommend technical solutions for sustainable and more durable construction

Prerequisites

- Technology: basic knowledge of structural engineering
- Materials: basic knowledge of the main materials used in construction (concrete, steel, timber, ...)
- Physics: basic knowledge of thermal and acoustic properties

Objectives

- To explore traditional building finishing processes in the following areas: roofing, façades, joinery and glazing, thermal and acoustic insulation, plastering, floor and wall coverings
- To familiarise students with the technical vocabulary associated with the various processes

Syllabus

- Roofing: materials and installation methods for pitched roofs and flat roofs
- Facades: renders, cladding, facade finishes, etc.
- Joinery and glazing: different types of joinery, glass, windows (composition, installation, etc.), doors, shutters
- Thermal and acoustic insulation: materials, systems
- Plastering: partitions, ceilings
- Floor and wall coverings: tiles, vinyl flooring, textile coverings, parquet flooring, etc.

Key learning outcomes

- Be able to recognise and describe standard finishing elements of a building using the appropriate technical vocabulary
- Be able to explain in detail the construction techniques used to create standard finishing elements in a building, using the appropriate technical vocabulary
- Be able to read a technical drawing and identify the information required for finishing works

Bibliography

- *Reading Building Plans*, H. Richaud and B. Vuillerme, published by Nathan Technique, 1989
- *The House from A to Z*, G. Calvat, published by Alternatives, 2003
- *Building Handbook – Design, Construction and Standardisation*, D. Didier, M. Le Brazidec, P. Nataf, J. Thiesset, published by Nathan, 2005
- *Building Construction, Volume 1: Structural Work and Volume 2: Finishing Works*, G. Karsenty, published by Eyrolles, 1997 and 2001

Keywords: Building, finishing works, construction techniques, technical drawings

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R 2-14 – Technology 4: Engineering Structures – Civil Engineering

Timetable	
Semester	2
Period	Feb – June
Face-to-face in person	

Duration	
CM	7.5 hours
Tutorials	6 hours
Total	**1.30 pm**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

- Drawing resource: Drawing 1 (R1-14)

Syllabus

Lectures:

- Definitions and types of civil engineering structures: OAC, OANC, OE
- Definition and types of civil engineering structures
- Common crossing engineering structures: typical bridges, construction techniques, equipment
- Common civil engineering structures: infrastructure and equipment (transport, development), industrial buildings

Tutorials:

- Partial analysis of written documents (specifications, technical reports) and drawings (plans) for engineering structures or civil engineering works
- Sketches / diagrams / detailed drawings

Key learning points

- Classification of structures
- Vocabulary and description of common structures (construction methods)
- Procedure for constructing a standard bridge

Bibliography

- *Bridge Design and Construction*, Presses de l'École nationale des ponts et chaussées
- *Mémotech Civil Engineering*, Editions Eyrolles

Keywords: Infrastructure, bridges, standard structures, construction methods, procedures 71

R 2-15 - Technology 5: Building Drainage

Timetable
Semester.....2
Term.....Feb. – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....6 hours
Tutorial .....7.5 hours
Total **1.30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

Drawing resource: Drawing 1 (R1-14)

Objectives

- To understand how drinking water supply and sanitation systems operate in buildings.
- Be familiar with the principles of design, sizing and installation of drainage and supply networks.
- Apply hydraulic calculation rules to ensure the proper functioning and durability of the installations.

Syllabus

- Lectures:
  - general overview of water supply and drainage systems in buildings
  - classification of water: drinking water, wastewater, black water, rainwater
  - principles of the collection, conveyance and disposal of wastewater and rainwater
  - Drinking water supply: general layout, pressure boosting, head loss
  - Hydraulic sizing of pipes (flow rate, gradient, diameter)
  - basic concepts of venting, siphons and backflow prevention devices

- Tutorials:
  - Reading and interpreting drainage and water network plans
  - exercises in pipe sizing (sewage, stormwater and drinking water)
  - schematising internal and external networks

Key learning outcomes

- identifying the different types of water systems in a building
- master the rules for sizing and calculating pressure drops
- interpret plans and diagrams of water supply and drainage systems
- understand the hydraulic and sanitary operating principles of an internal system

Bibliography

- *Mémotech Civil Engineering*, Eyrolles Publishing

Keywords: Sanitation, drinking water, wastewater, stormwater, pipework, pressure drops, sizing, sewerage networks

R 2-16 – Materials 2: Structural Materials 1 – Concrete – Metals

Timetable
Semester.....2
Period.....Feb – June
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM	4.30 pm
Tutorial	4.30 pm
Tutorial	1h30
Total	24h30

Targeted competence(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Concrete 1/2

Prerequisites

Resources and SAÉ for Semester 1:

- SAÉ 1-1 Laboratory testing of materials: aggregates, cements, concrete
- R1-15 Introduction to environmental issues
- R1-16 Materials 1: Introduction to the properties of materials

Objectives

- To identify the various activities carried out by manufacturers and users of concrete
- Define and measure the main properties of aggregates used in the construction industry
- Compare different cements in terms of their performance properties and environmental impacts
- Define and measure the main properties of concrete and its environmental impacts
- Order and take delivery of concrete
- Formulate a standard concrete mix, produce concrete and carry out tests on fresh and hardened concrete

Syllabus

Concrete formulation forms the underlying framework of the course. One by one, the chapters address the stages of the formulation process, enabling students to understand concrete as a material and the key aspects of its performance. The constituents and their properties are therefore not covered at the outset. The reasoning applied to granular matrix materials can be applied to other materials with a granular matrix (embankments, drained embankments, ballast, bituminous materials, etc.)

- Introduction

  - General information; History; Definitions; Performance properties of standard conc[illegible] 206: designation, manufacture, transport and placement of concrete (on site or in a precast plant); Aerated concrete
  - Some figures on the concrete and ready-mixed concrete industries, the life cycle of concrete and the environment
  - Taking into account the environmental impacts of concrete in construction and the regulatory context
  - Concrete: health risks and accident risks
  - French/English/Spanish glossary of technical concrete terminology

- Chapter 1: Concrete as a compact stack of grains

  Compactness and porosity; stacking of grains; suspension of grains; grain size

- Chapter 2: Concrete: a compact, fluid and subsequently strong

  arrangement of grains Mixing water; the roles of water: consistency

  / strength

- Chapter 3: From fresh concrete to hardened concrete: hydration

  Different types of cement and their manufacture; admixtures; the main hydration reactions; physical aspects of hydration; the porosity of the hardened paste

- Chapter 4: The behaviour of concrete: material and structure: Early-age concrete and shrinkage

- Chapter 5: The behaviour of concrete: material and structure: Hardened concrete

  Mechanical behaviour of concrete at a given age; creep and shrinkage; regulatory aspects of hardened concrete

- Chapter 6: Concrete: a durable material

  Exposure classes according to the environment

- Chapter 7: An approach to concrete mix design

  The concept of specifications; the three principles of mix design; different methods of concrete mix design

Key learning points

- Analysis of a granular mixture: particle size analysis, bulk and true densities, porosity, etc., for an aggregate or a mixture of aggregates
- Concrete formulation
- Multi-criteria comparison of concrete mixes

Bibliography

- On the web:
  - www.efbeton.com (website of the École Française du Béton)
  - bybeton.fr (the brand bringing together the Federation of Concrete Industries (FIB), CimBéton (cement industry) and the National Union of Ready-Mix Concrete (SNBPE))
  - www.infociments.fr (information website on concrete from the French cement industry)
  - monbeaubeton.com (a website provided by the French cement industry, focusing on architecture and concrete design)
  - www.fib.org (Federation of the Concrete Industry)
  - www.snbpe.org (Ready-Mix Concrete Trade Association)

- www.cerib.com (Concrete Industry Study and Research Centre)
- www.synad.fr (Admixture Manufacturers' Association)
- www.unicem.fr (Quarry and Construction Materials Trade Association)
- www.ciments-calcia.fr of the group www.heidelbergcement.fr/fr
- www.eqiom.com
- www.lafarge.fr/, part of the www.holcim.com group
- www.imerys.com/fr
- www.vicat.fr
- www.cemex.fr

- Books:
  - *Aggregates, Soils, Cements and Concrete*, R. Dupain, R. Lanchon, J-C. Saint-Arroman, Casteilla, 2000
  - *Concrete as a Material: General Knowledge*, G. Chanvillard, ENTPE, published by Aléas, 1999
  - *The Comprehensive Guide to Concrete*, L. d'Aloia, J-M. Torrenti, published by Le Moniteur, 2014
  - *Building Construction, Volume 1: Structural Work*, G. Karsenty, published by Eyrolles, 1997
  - *New Guide to Concrete and its Constituents*, G. Dreux, J. Festa, published by Eyrolles, 1998
  - *Hydraulic Concrete*, J. Baron, R. Sauterey, Presses des Ponts et Chaussées, 1995
  - *A Practical Guide to the Use of Cements*, ATILH, published by Eyrolles, 1998
  - *Building with Concrete*, published by Le Moniteur, 2000
  - *Concrete: Fundamentals and Data for its Formulation*, ATILH, published by Eyrolles, 1997

Keywords: Aggregates, Cements, Concrete, Formulation

Steel 1/2

Prerequisites

Basic knowledge of the chemistry and physics of materials (see R1-16 Materials 1: Introduction to the Properties of Materials)

Objectives

- To understand the history of the steel industry
- To explore steel manufacturing methods
- To understand the role and applications of steel in the construction industry
- To interpret steel phase diagrams
- Gain knowledge of steel treatments
- Exploring the different categories and properties of steel
- Analysing and evaluating the properties of steel for technical applications

Syllabus

- History and applications of steel
- Production and processing methods
- Structure and crystallisation of steels
- Steel treatments and finishes
- Classification systems and steel designations
- Mechanical properties of steels
- Test methods for measuring the properties of steel

Key learning outcomes

- Analyse and explain the life cycle of steel, from ore extraction to scrap recycling
- Link the chemical composition and crystalline structure of steel to its physical and mechanical properties
- Justify the choice of steel as a construction material, drawing on its technical, economic and environmental advantages
- Distinguish between the different methods of steel production and forming, and identify their impact on the final product
- Interpret a phase diagram and predict changes in steel behaviour as a function of temperature and carbon content
- Ability to identify and classify steels in accordance with standards
- Proficiency in interpreting the results of mechanical tests on steel
- Ability to select the appropriate steel grades for specific technical applications

Bibliography

- Online:
  - www.cticm.com
  - www.acierconstruction.com
- Books:
  - *Building with Steel: Structures, Envelopes, Assemblies and Components*, Technical Design Series, LE MONITEUR, 1993, 263 pp.
  - *Durability of corrosion-resistant steel in concrete*, Treadaway, Cox, Brow, Proc. Instn. Civ. Engrs., Part 1, No. 86, pp. 305–331, 1989
  - *Guidance on the Use of Stainless-Steel Reinforcement*, Report of the Concrete Society Steering Committee, Technical Report, No. 51, 1998
  - *NF EN 10027-1, Steel designation systems*, 2017

Keywords: Steel, metallurgy

R 2-17 - Materials 3: Finishing materials 1

Timetable
Semester.....2
Term.....Feb. – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM.....7.5 hours
Tutorials.....6 hours
Total.....**1.30**
Targeted skill(s)
C1 – Analysing a construction project within its context
C2 – Prescribing technical solutions for sustainable and more durable construction

Prerequisites

- Technology: basic knowledge of building technology
- Materials: basic knowledge of the properties of materials

Objectives

- To identify and characterise the main physical, chemical and mechanical properties of finishing materials
- Explain the selection of a finishing material
- Raise awareness of environmental issues and the concept of life-cycle analysis

Syllabus

- Plastering: Plasterboard and renders
- Finishes: paints, ceramics (tiles), fabrics, carpets and finishing coatings
- Joinery: Glass

Key learning outcomes

- Identify and characterise finishing materials
- Understand the properties and stresses, and the fundamentals of chemistry and physics that guide the choice of finishing materials

Key terms: Plaster, glass, tiles, fabrics

R 2-18 – Materials 4: Building with materials

Timetable	
Semester	2
Period	Feb – June
Face-to-face in person	

Duration	
CM	9 hours
Tutorial	7.30
Total	**4.30 pm**

Assessment
Continuous assessment

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

None

Syllabus

- Materials and their relationship to architectural form:
  - Wood
  - Earth (raw and fired)
  - Stone
  - Concrete
  - Metal
  - Glass
- specifying in particular:
  - the method of extraction,
  - the processing of the material,
  - its application,
  - its use in construction,
  - its architectural effects.

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R 2-19 - Drawing 2: CAD – AutoCAD

Timetable	
Semester	2
Period	Feb – June
Face-to-face in person	

Duration	
Practical sessions	12 hours
Total	**12 hours**

Assessment
Assessed as SAÉ

Prerequisites

- Drawing resource: Drawing 1 (R1-14)
- Technology resources: Technology 1 (R1-12), Technology 3 (R2-13)

Syllabus

Tutorials:

- Use of Autodesk AutoCAD software and interfaces
- Partial 2D drawings of common structures: road and utilities works, buildings, civil engineering (object space)
- Dimensioning of elements
- Formatting of drawings (paper space), printing (PDF and hard copy)

Key learning outcomes

- Layer management
- Line types and weights
- To-scale printing

Bibliography

- *AutoCAD 2025 – Design, 2D and 3D drafting, presentation – All the advanced tools and features for professional projects*, Eni Publishing

Keywords: CAD, graphical language

R 2-20 – Site visits and conferences 2

Timetable	
Semester	2
Period	Feb. – June
Face-to-face in person	

Duration	
CM hours	9
Practical sessions hours	6
Total	**15h**

Assessment
Assessed as part of SAÉ

Prerequisites

None

Objectives

The site visits and lectures organised during the first three years at ISA BTP serve several educational purposes:

- to explore the diversity of the construction industry:
  - structures and systems: buildings, engineering structures, infrastructure, road and rail networks, roads and utilities, civil engineering works, marine structures, equipment, installations… ,
  - key players: client, project manager, engineering consultancy, contractors, subcontractors, health and safety coordinator, geotechnical engineer, technical inspector, laboratory technician…
  - professions: labourers, semi-skilled and skilled workers, managers, project managers, site managers, site supervisors, engineers, business owners, self-employed contractors, suppliers, technical sales representatives…
  - materials: 'conventional', innovative,
  - construction methods and working procedures,
- developing one's understanding of the construction industry: projects and sites ranging from routine to exceptional, local and national projects, technical terminology,
- linking this to the curriculum: Resources and SAÉ,
- developing curiosity and an open mind,
- encouraging interest in SAÉ work placements and facilitating the choice of the ISA4 and 5 pathways

Key learning outcomes

- develop listening and observation skills
- write a report on a site visit or take notes during lectures
- apply these discoveries and insights in the SAÉ

Keywords: Discovery, technologies, diversity, organisations, responsibilities

SAÉ 2-1 – Structural design and stability challenge: bridge, tower, structure, models

Timetable
Semester.....2
Period.....Feb. – June
Face-to-face in person

Assessment
Defences and Portfolio

Duration	1 week
Supervised hours	22 hours
Self-study	6 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- Basic knowledge of statics (equilibrium of forces, load transfer)
- Knowledge of fragile materials (e.g. spaghetti)
- Use of measuring and fabrication tools (glue gun, press)

Objectives

- To design a spaghetti structure that meets specific specifications
- Model the forces and predict the points of failure
- Build a prototype and test it under real-world conditions
- Analyse the results and provide a critical review

Programme

- Design: proposing a structure (tower, bridge, etc.) based on the challenge for the year
- Modelling: load application, identification of forces and theoretical failure points
- Construction: building the structure using spaghetti and glue (method to be decided: at school or at home)
- Testing: breaking the structure using a press (e.g. BED 100) and measuring the maximum load withstood
- Post-analysis: comparison of the results obtained with the predictions

Key learning outcomes

- Knowing how to apply the principles of statics to a simple structure
- Understand the importance of load transfer and the distribution of forces
- Develop a rigorous approach to design and manufacture
- Analysing and interpreting discrepancies between theory and practice

Keywords: Statics, load transfer, structure, design, retroanalysis, failure

SAÉ 2-2 – End-of-Year Project: new-build or refurbishment (all trades)

Timetable
Semester.....2
Period.....Feb. – June
Face-to-face in person

Assessment
Defences and Portfolio

Duration	2 weeks
Supervised hours	44 hours
Self-study	12 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- Drawing resources, in particular R2-19 'Drawing 2: CAD – AutoCAD'
- Organisation resources: R2-11 'Organisation 1: Quantity surveying and cost estimation' and R2-12 'Organisation 2: Task scheduling'
- Technology Resources: R1-12 "Technology 1: General Principles of Structural Works", R2-13 "Technology 3: Building Finishes" and R2-15 "Technology 5: Building Services"
- Resource R1-15 'Introduction to Environmental Issues'
- Materials Resources 1 to 4
- SAÉ 2-3 'Practical Placement'

Objectives

- To read and analyse contractual documents relating to the PROject or EXEcution phases: tender documents, drawings, written documents, assumptions notes, etc.
- Produce partial or detailed building plans
- Specify materials and construction methods in line with an environmental approach
- Describe the works and activities on site
- Carry out a bill of quantities for certain lots and estimate their cost using standard ratios
- Propose a project timeframe

Programme

- Reading and analysing the documents provided:
  - Defining the building's characteristics and intended uses
  - Understanding the materials and construction methods specified for the structure, the building envelope and the roof
- Drawing of additional elements or details: CAD using AutoCAD and hand-drawn sketches
- Description of associated works: demolition where necessary, phased construction, focus on wastewater drainage techniques
- Considerations and recommendations regarding alternative materials and construction methods
- Drawing up concise operating procedures
- Task sequencing, estimation of certain completion times, and drawing up a project schedule

The SAÉ comprises several written reports (deliverables), with regular feedback, and concludes with a group oral presentation. Site visits are usually organised to aid understanding of the project.

Key learning outcomes

- Understanding and compliance with specifications and regulations
- Production of supplementary CAD drawings
- Submission of all requested documents
- Collaborative work

Bibliography

- Building Handbook, Site Handbook – AFNOR – Nathan Publishers
- Mémotech – Casteilla Publishers

Keywords: Tender documents, contract lots, technical specifications, building specifications, construction methods, working procedures, quantity surveys, CAD, environmental approach, collaborative working

SAÉ 2-3 – Practical training

Timetable
Semester.....2
Period.....Feb – June
Face-to-face in person

Assessment
Report and oral defence

Duration	6 weeks

Target skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Objectives

- Exploring the building site and its organisation,
- Learn about the duties of a site worker and analyse working conditions
- To learn about the company and its organisation
- To learn about the technology and technical processes.
- Write and structure an internship report addressing the various required points in a precise and concise manner
- If the work placement is carried out in Spain: learn about the Spanish language and culture.

Required work

After completing the necessary steps to find a host company and confirming that the placement meets the objectives with the placement coordinator, students will be integrated into production teams and will be required to take part in practical on-site activities as part of **a 6-week hands-on work placement** in a construction company, covering all types of building sites and trades.

The internship assessment takes into account:

- the intern's conduct and the achievement of the set objectives, as assessed in particular by the company manager and the supervising tutor who monitors the intern,
- the placement report,
- the oral presentation of the placement,
- the work on health and safety and risk prevention undertaken in the 'Health and Safety – Organisation' module.

The placement report

The student must be able to write and structure a document addressing the following points precisely and concisely. Sentences must be written correctly and free from spelling or grammatical errors.
References must be cited correctly.

The report shall include:

- A cover page (including the student's name and the company's name, as well as the sector of activity, and keywords)
- An introduction including the outline and acknowledgements: equivalent to 2 pages;
- A presentation of the company: maximum 2 pages;
- A description of the project or activity: 2 pages plus illustrations and plans, unless the project is exceptional and requires further detail;
- A description of the activities undertaken and professional skills acquired: 1 page;
- **A detailed description of a technique, method, equipment, tool, etc. encountered during the placement**;
- A summary and conclusion: equivalent to one page;
- A list of six key terms and a glossary (for the relevant trade and country): equivalent to one page.

In total, the report must comprise fewer than 25 pages, plus any appendices (plans, calculation notes, documentation, etc.).

The internship defence

The oral defence will allow the student to present their placement in 10 minutes and to answer questions. It will comprise:

- an introduction, a summary
- a presentation of the company
- a presentation of the activities and learning outcomes of the placement
- a detailed discussion of a technical or scientific engineering aspect related to the work carried out during the placement
- a conclusion.

Evaluation of the work on safety and prevention undertaken within the EU Safety – Organisation

Working in groups of three, students give an oral presentation on their observations of a key aspect of prevention during their work placement.
The OPPBTP trainer and the group of students assess the relevance of their choice and their presentation.

Self-assessment

The work placement will also provide an opportunity for engineering students to assess their own performance. ISABTP is currently developing a tool to facilitate self-assessment. Instructions will be provided during the academic year as the tool is rolled out.

Second year

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Semester 3

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
R 3-1	Management 1: Organisational Theory – Industrial Economics of the Construction Industry	5.23%
R 3-2	Management 2: Management and Accounting Techniques	9.15%
R 3-3	English 3	8.5%
R 3-4	Spanish 3	8.5%
R 3–5	Mathematics 3 – Algebra and Analysis	28.1%
R 3–7	Chemistry	15.69%
R 3-12	Soils 1: Introduction to Geology and Hydrogeology	6.54%
R 3-14	Organisation 3: Preparing a building site	7.84
R 3-16	Materials 5: Structural Materials 2 – Timber – Composites	5.23
R 3-17	Materials 6: Finishing materials 2	5.23%
SAÉ for competence C1		**%**
SAÉ 3-1	Construction site organisation project	33.33%
SAÉ 3-2	Structural and stability design: lightweight structure	33.33
SAÉ 3-3	Building design project: digital model, tender documents, planning permission	33.33%

Competence C2 – Specifying technical solutions for sustainable and more durable construction

Resources for Competency C2		%
R 3-7	Chemistry	28.57 %
R 3-10	Column-beam structures – Load transfer – Bracing – Stability	11.9%
R 3-11	Steel Construction 1: General Principles – Simple Loads	15.48%
R 3-12	Soils 1: Introduction to Geology and Hydrogeology	11.9%
R 3-13	Health and Safety 3: Practical Application by Topic	4.76
R 3-15	Organisation 4: Formwork for the construction industry – Application to a digital model	8.33%
R 3-16	Materials 5: Structural Materials 2 – Timber – Composites	9.52%
R 3-17	Materials 6: Finishing materials 2	9.52%
SAÉ for competence C2		**%**
SAÉ 3-1	Construction site organisation project	33.33%
SAÉ 3-2	Structural and stability design: lightweight structure	33.33
SAÉ 3-3	Building design project: digital model, tender documents, planning permission	33.33%

Competence C3 – Dimensioning structures and systems

Resources for Competency C3		%
R 3–5	Mathematics 3 – Algebra and Analysis	23.71%
R 3-6	Thermodynamics 1: W – Q – 1st law – 2nd law – engine – efficiency	22.06%
R 3-8	RdM 3: Isostatic structures (3D, inclined) – Deformed – Instabilities – Tangential stresses	14.34%
R 3-9	RdM 4: Hyperstatic structures – Force method – Theorem of the three moments	27.21%
R 3-10	Column-beam structures – Load transfer – Bracing – Stability	5.51%
R 3-11	Steel Structures 1: General Principles – Simple Loads	7.17 %
SAÉ for competence C3		**%**
SAÉ 3-2	Structural design/stability project: lightweight structure	100%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
R 3-1	Management 1: Organisational theory – Industrial economics of the construction sector	11.27%
R 3-2	Management 2: Management and Accounting Techniques	19.72%
R 3-3	English 3	18.31%
R 3-4	Spanish 3	18.31%
R 3–13	Health and Safety 3: Implementation by topic	5.63
R 3-14	Organisation 3: Preparing a building site	16.9%
R 3-15	Organisation 4: Formwork for the building trade – Application to a digital model	9.86%
SAÉ for competence C4		**%**
SAÉ 3-1	Construction site organisation project	50%
SAÉ 3-3	Building design project: digital model, tender documents, planning permission	50%

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R 3-1 – Management 1: Organisational theory – Industrial economics of the construction sector

Timetable	
Semester	3
Period	Sept. – Dec.
Face-to-face teaching	

Duration	
CM	6 hours
Practical sessions	6 hours
Total	**12 hours**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

None

Objectives

- To understand the major trends and key theories
- To understand the functioning and specific organisational structure of the construction sector
- To analyse the challenges facing the construction sector at local and global levels, and its organisation.

Syllabus

- Major trends and key theories:
  - Classical school
  - Human relations movement
  - Managerial theories
  - Contemporary approaches to organisations
- The functioning and specific organisational structure of the construction sector
- The challenges facing the construction sector at local and global levels, and its organisation.

R 3-2 - Management 2: Management and Accounting Techniques

Timetable
Semester.....3
Period.....Sept. – Dec.
Face-to-face teaching

Assessment
Continuous assessment

Duration	
CM	10.30 am
Tutorial	10.30
Total	**9.00 pm**

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

None

Objectives

- To understand accounting principles and terminology
- Be able to read and analyse an income statement and a balance sheet
- To distinguish between issues of profitability and financing

Syllabus

- The role and functions of accounting: information and control requirements, key accounting principles, specialist terminology
- Accounting principles: recording transactions: accounts, the chart of accounts, the company's main entries and transactions, VAT, payments by commercial bills and calculating discount
- Commercial documents: quotations, invoices
- Year-end procedures: depreciation and provisions
- Summary documents: annual financial statements: profit and loss account, balance sheet
- Company profitability and the break-even point

Key learning points

- Understanding the double-entry bookkeeping system
- Knowing how to prepare financial statements
- Knowing how to read and interpret an income statement and a balance sheet
- Knowing how to draw up depreciation schedules and understanding their impact on the company's accounts
- Distinguish between different types of expenses and calculate a break-even point

Bibliography

General Accounting, Bernadette Collain, published by Dunod, 13 October 2021

Keywords: company profitability, accounting depreciation, balance sheet, profit and loss account

R 3-3 – English 3

Timetable
Semester.....3
Period.....Sept. – Dec.
Face-to-face in person

Assessment
Continuous assessment

Duration	
Tutorial	7.30 pm
Total	**7.30 pm**

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

ISA1-S2 English Level B1

Syllabus

Tutorials:

- **TOEIC Preparation**
- Listening: Practice with Parts 1–4 in business and technology contexts
- Reading: Parts 5–7, focusing on connectors and vocabulary in context
- Mini practice tests under timed conditions
- Final full-length TOEIC mock test

Key learning outcomes

By the end of this course, you will be able to:

- Achieve a TOEIC score of at least **650**.
- Demonstrate mastery of the grammar points tested in the TOEIC:
- Understand and respond to listening passages relating to money, business and technology.
- Read and analyse business and professional texts under time constraints.

Bibliography

- The Complete TOEIC® – 3rd edition
- The Official TOEIC® Bible

Keywords: TOEIC, grammar, business English

R 3-4 – Spanish 3

Timetable	
Term	3
Period	Sept. – Dec.
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
Tutorial	7.30 pm
Total	**7.30 pm**

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

Spanish S2

Objective

In order to reflect the progressive development of the target level, teaching is based on the Common European Framework of Reference for Languages (CEFR), which provides a common basis for the design of programmes, diplomas and certificates.

The overall language proficiency scale identifies three general levels, subdivided into six common levels (as broadly agreed):

- Level A: basic user, itself subdivided into introductory or discovery level (A1) and intermediate or everyday level (A2).
- Level B: independent user, subdivided into threshold level (B1) and independent level (B2). This corresponds to 'limited operational competence' or 'an appropriate response in everyday situations'.
- Level C: experienced user, subdivided into C1 (autonomous) and C2 (proficient)

  See details of language proficiency levels on the CEFR (Common European Framework of Reference for Languages) website.

In Semester 3, students must acquire the skills necessary to achieve level A2+ in international certification tests (such as DELE or SIELE):

This level certifies that the candidate is able to understand frequently used phrases and expressions relating to experiences of particular interest to them (basic information about themselves and their family, shopping situations, places of interest, leisure activities, etc.). In addition, particular focus will be placed on the world of the construction industry in Spain, in preparation for the cross-border project (S4) and the end-of-second-year work placement (carried out in the Spanish-speaking world).

Programme

Reading and understanding technical documentation in the Spanish-speaking construction sector

- Describe a system and explain how it works

- Deliver a simple presentation using professional Spanish
- Prioritise mastering a limited number of essential grammatical points that ensure a basic level of linguistic accuracy
- Learning the technical construction vocabulary required of a foreman

Key learning areas

- Master the technical construction vocabulary required of a foreman
- Use the vocabulary required to discuss familiar topics in the professional world with ease
- Apply the grammatical rules that enable you to express yourself clearly overall

Bibliography

- https://eduscol.education.fr/1971/cadre-europeen-commun-de-reference-pour-les-langues-cecrl
- https://leblogdespagnol.com/
- All resources dedicated to learning Spanish vocabulary, grammar or verb conjugation suitable for a B1 level

Keywords: CEFR, A2+, B1, workplace, team leader, project

R 3-5 - Mathematics 3 - Algebra and Analysis

Timetable	
Semester	3
Period	Sept. – Dec.
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	28h30
Practical sessions	31h30
Practical	4h30
Total	**64h30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

- All concepts and tools covered in the first year in analysis, algebra and probability
- Basic programming concepts

Objectives

- Solve ordinary differential equations using analytical methods; interpret the results from both a quantitative and qualitative perspective
- Understand and be able to apply the main results of linear algebra
- Understand the characteristics of curves and surfaces of degree 2 and be able to interpret them from an analytical perspective
- To apply and interpret differential calculus in several variables, as well as its applications to the study and representation of surfaces and curves

Syllabus

- Differential equations: linear and non-linear differential equations, small-scale differential systems
- Vector spaces and linear applications. Matrix reduction
- Quadratic, conic and quadric forms. Applications to the construction industry
- Differential calculus in higher dimensions

Key learning outcomes

- Solving first- and second-order linear differential equations
- Determining the eigenvalues and eigenvectors of a matrix
- Identify and characterise a conic section from its equation
- Calculate a gradient and a directional derivative, and find the extrema of a function of several variables

Bibliography

- Courses for BTS Technology programmes
- SCHAUM's series, McGraw-Hill
- Advanced Mathematics Course
- *Algebra course*, Xavier GOURDON, Ellipses
- Undergraduate science textbooks
- http://mabouzai.perso.univ-pau.fr/

Keywords: Differential equations, linear algebra, matrices, conics, quadric surfaces, differential calculus, optimisation

R 3-6 - Thermodynamics 1: W – Q – 1st law – 2nd law – engine – efficiency

Timetable	
Semester	3
Term	Sept. – Dec.
Face-to-face teaching	

Assessment
Comprehensive continuous assessment

Duration	
CM	15h
Tutorial	15 hours
Total	**30 hours**

Targeted skill(s)
C3 – Designing structures and systems

Prerequisites

Basic understanding of real-valued functions of a single real variable (definition, derivative, differential, integration)

Objectives

- To understand the definitions and fundamental concepts of thermodynamics
- To understand the ideal gas model and its equations of state
- To master the basic concepts of calorimetry
- Understand the concepts of energy and work, and apply the first law
- Understand the concept of entropy and apply the second law
- Apply the basic concepts of thermodynamics to thermoelastic systems such as thermal engines

Syllabus

- Essential mathematical concepts relating to real functions of several real variables
- Definitions and fundamental concepts of thermodynamics:
  - Thermodynamic system, state of a system, phases and homogeneity of a system
  - 'Common' state variables: pressure, temperature
  - Evolution of a system, equilibrium, transformation, equation of state, thermoelastic coefficients
  - Ideal gas model, ideal mixture of ideal gases
- First law
- Second law
- Application to thermal engines

Key learning points

- Identify a thermodynamic system and its state variables
- Apply the ideal gas equation of state (PV = nRT)
- Calculate energy exchanges (work and heat) during a process
- Apply the first law of thermodynamics (conservation of energy)
- Determine changes in entropy and apply the second law

Bibliography

There are numerous books on the subject, readily available in all university libraries. Among these works, the following are particularly noteworthy:

- *Thermodynamics*, by M. Bertin, J.P. Faroux and J. Renault, Dunod Université, 1976
- *Thermodynamics – Fundamentals and Applications*, by J.-N. Foussard and E. Julien, Dunod, 2005

Keywords: Thermodynamics, ideal gas, first law, second law, entropy, energy, heat engines

R 3-7 – Chemistry

Timetable	
Semester	3
Term	Sept. – Dec.
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	6 pm
Tutorial	18h
Total	**36 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

Chemical reactivity: reaction balance, acid-base reactions, redox reactions, transformations of matter

Objectives

- To understand the chemical reactions underlying the formation of construction materials (cement setting, etc.)
- Acquire a basic understanding of chemistry to interpret regulatory texts: water quality for concrete, pollutants, etc.
- To understand the reaction mechanisms involved in corrosion in order to gain a better grasp of them

Syllabus

- General principles: atomic theory, chemical reactivity. Interpretation of chemical mechanisms encountered in the construction industry (cement setting, concrete carbonation, leaching, etc.)
- Chemistry of aqueous solutions: acid-base reactions, redox reactions, complexation reactions, electrochemistry
- Production and interpretation of Pourbaix diagrams. Practical applications in the field of corrosion of metallic materials

Key learning outcomes

- Identifying and balancing chemical reactions in the construction industry (cement hydration, carbonation)
- Balance an acid-base reaction and calculate the pH of a solution
- Balance a redox reaction
- Read and interpret a Pourbaix diagram
- Identify the conditions under which a metallic material corrodes

Bibliography

- *The Essentials of Chemistry*, De Boeck Université, 1st edition, 2001, 136 pp.
- *Handbook of Chemistry and Physics*, David R. Lide, 86th edition, CRC, published by Taylor & Francis, 2006
- *15 Weeks of Chemistry Tests*, A.D. Baumy, C. Gros, Ellipses, 2000, 633 pp.
- *Chemistry: All in One. 2nd Year PC-PC**, B. Fosset, J-B. Baudin, F. Lahitète, V. Prevost, Dunod, 2006, 1080 pp.
- *General Chemistry*, R. Didier, 6th edition, Physical Sciences series, Lavoisier, 1997, 651 pp
- *Redox Reactions: Concepts and Experiments*, J. Sarrazin, M. Verdaguer, Ellipses, 1997, 320 pp.

Keywords: Materials chemistry, cement setting, carbonation, corrosion, Pourbaix diagram, redox reactions, acid-base

R 3-8 - RdM 3: Isostatic structures (3D, inclined) – Deformed – Instabilities – Tangential stresses

Timetable
Semester.....3
Period.....Sept. – Dec.
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....6 hours
Tutorial .....1.30 pm
Total **7.30**
Targeted skill(s)
C3 – Designing structures and systems

Prerequisites

- RDM Mechanics: RdM 1, RdM 2
- Mathematics: Integral calculus, differential equations

Objectives

- To extend the analysis of isostatic structures to three-dimensional and inclined cases
- Determine the deflections and displacements of beams
- To understand and verify the phenomena of elastic instability
- Master the calculation of tangential stresses for simple cross-sections

Syllabus

- Extension to spatial structures: 3D beams, inclined structures (Z-frames)
- Calculation of deformations: direct integration method, unit load method
- Castigliano's theorem for the calculation of displacements
- Elastic instabilities: Euler buckling, critical load, buckling lengths
- Tipping of unsupported beams under bending
- Distribution of tangential stresses: Jourawski's formula, shear flow
- Centre of shear and torsion for open and closed sections

Key learning points

- Calculate the deflection of an isostatic beam under different load conditions
- Determine the critical buckling load of a column and verify its stability
- Calculate the distribution of shear stresses in a beam section
- Apply Castigliano's theorem to determine displacements

Bibliography

- *Strength of Materials*, Stephen Timoshenko, Dunod
- *Structural Mechanics: Strength of Materials*, Claude Chèze, Ellipses
- *Treatise on Civil Engineering, Volume 2: Analysis of Structures and Continuous Media*, PPUR

Keywords: 3D isostatic structures, deformation, buckling, tangential stresses, instabilities

R 3-9 - RdM 4: Hyperstatic structures – Force method – Theorem of the three moments

Timetable	
Semester	3
Period	Sept. – Dec.
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
Lecture	10.30 am
Tutorial	11.30
Tutorial	3.00 pm
Total	**37**

Targeted skill(s)
C3 – Designing structures and systems

Prerequisites

- RDM Mechanics: RdM 1, RdM 2, RdM 3
- Calculation of deformations
- Mathematics: Solving linear systems
- Determining the degree of hyperstaticity of a structure

Objectives

- To master the force method for solving simple hyperstatic structures
- Apply the three-moment theorem to continuous beams
- Plot stress diagrams in hyperstatic structures

Syllabus

- Energy methods in structural analysis
- Castigliano's theorem, force methods
- Clapeyron's three-moment theorem for continuous beams
- Application to continuous beams with multiple spans

Key learning points

- Solve a simple hyperstatic structure using the method of forces
- Applying the three-moment theorem to calculate moments at supports

Bibliography

- Handout distributed to students: "Strength of Materials Course", D. Grégoire, ISA BTP
- *Strength of Materials: Beam Theory*, Jean-Louis Batoz and Gouri Dhatt, Hermès
- *Calculation of Hyperstatic Structures*, André Coin, Eyrolles

Keywords: Hyperstaticity, force method, theorem of three moments, continuous beams

R 3-10 – Column-beam structures – Load transfer – Bracing – Stability

Timetable
Semester.....3
Term .....Sept. – Dec.
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....6 hours
Tutorial.....9 hours
Total.....**15h**

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C3 - Designing structures and systems

Prerequisites

- RdM resources: S1 (R1-9), S2 (R2-9)
- R1-12: Technology 1: General principles of structural works
- R1-14: Drawing 1: Sketches – Plans – Sections (by hand)
- R2-16: Materials 2: Structural Materials 1 – Concrete – Metals

Objectives

- Define the principles of load transfer in a simple civil engineering structure based on plans and sections
- Identify and calculate the simple actions acting on the structure (dead loads, live loads)
- Determine the mechanical behaviour of simple structural elements (beams, columns, foundations)
- Understand and apply the load transfer methodology for simple structures
- Understand the different types of load transfer:
  - Loads transmitted via floors and roofs
  - Loads transmitted to walls
  - Loads transmitted to columns
- Know how to brace a simple building

Syllabus

- Limit States
- Determination of loads
- Combinations of loads
- Structural modelling
- Load transfer (vertical and horizontal forces)
- Principles of bracing

Key learning points

- Understanding the principle of force transmission in a simple structure based on 2D drawings
- Identifying and calculating the actions on the structure
- Determine the mechanical scheme (modelling + actions) of a simple structural element (beam, column)
- Position bracing elements on a simple building (timber, reinforced concrete, steel)

Keywords: Load transfer, Eurocodes, force transmission, load area, actions, bracing

R 3-11 – Steel Structures 1: General Principles – Simple Loads

Timetable
Semester.....3
Term .....Sept. – Dec.
Face-to-face teaching

Assessment
Continuous assessment

Duration	
CM	9 hours
Tutorial	10.30
Total	**7.30 pm**

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C3 - Designing structures and systems

Prerequisites

To undertake this course, students must first be able to:

- Identify the connections in a simple mechanical system
- Determine the degree of statically indeterminate a simple mechanical system is
- Solve a planar truss system
- Apply the principles of statics to a solid subject to two or three external constraints
- Use the RDM 1 course to plot diagrams of normal forces, shear forces and bending moments in a linear member
- Calculate the stresses at any point on a straight surface of a linear member, subjected to tensile-compressive, shear and/or bending forces
- Calculate the centre of gravity, moments of inertia about the principal axes, radius of gyration, and elastic and plastic bending moduli for a simple cross-section

This course will be based on a case study of a single-span, single-storey building. The case study will include a description of the structure (extracted from the technical specifications), plans of the main structure and a perspective view of it. As an appendix to the case study, students will also be provided with an extract from a manufacturer's catalogue of the main standardised steel sections available on the market.

Objectives

By the end of this course, students should be able to analyse the behaviour of a single-span, single-storey steel structure and to carry out or verify the design, in accordance with Eurocode 3, of a member subjected to simple tension or compression.

Upon completion of the chapter on structural behaviour, students should be able, using the documentation for a new building of the same type:

- Identify the elements of the main structure on the plans and the perspective drawing
- To identify, from the plans and perspective drawings, the connections between the elements of the main structure

- Identify the types of connections between these different elements
- To analyse how the structure behaves under vertical or horizontal loads
- To determine the path of forces from the surface bearing the loads to the foundations

Following the chapter on the design of members subjected solely to tension or compression in accordance with Eurocode 3, the student must be able, using the design documents for a new building of the same type and given wind and/or snow loads:

- To calculate the loads experienced by each member contributing to the stability of the structure
- Identify the members subjected solely to tension or compression
- To check the design of these members at the Ultimate Limit State (ULS) and the Serviceability Limit State (SLS)
- To calculate the design parameters of the structural member and to select, from the manufacturer's catalogue, the sections suitable for fulfilling the functions of these members

By the end of the chapter on buckling instability, the student must be able, using the design documents for a new building of the same type and given wind and/or snow loads:

- To explain the phenomenon of buckling
- To identify the members likely to be subject to buckling instability
- To check the design of members susceptible to buckling instability at the Ultimate Limit State (ULS)
- Analyse the consequences of the buckling of one structural member on neighbouring members

Syllabus

- Behaviour of steel structures: identification of members, types of connections, force paths
- Design of members under simple tension or compression in accordance with Eurocode 3
- Buckling instability: phenomenon, identification of susceptible members, Ultimate Limit State (ULS) verification
- Selection of sections from manufacturers' catalogues

Key learning points

- Identify the structural members of a steel building and their connections
- Determine the path of forces within a structure
- Verify a member under tension or compression in accordance with Eurocode 3 (ELU and ELS)
- Identify members subject to buckling and check their stability
- Select a suitable section from a manufacturer's catalogue

Bibliography

- *Steel Construction – Design of Building Structures*, Yvon Lescouarc'h, Presses de l'École Nationale des Ponts et Chaussées, 2008 (BU_693.7 LES)
- *Eurocode 3 and National Application Document – Design of Steel Structures – Part 1-1: General Rules and Rules for Buildings*, Various Authors, Ed. Eyrolles, 1996 (BU_624.1 EUR)
- *Design of Structures in accordance with Eurocode 3*, Jean MOREL, Eyrolles, 1997 (BU_624.1 MOR)
- *Steel Construction Formulary, Eurocodes 1 and 3, NV65 Rules, CM66 Rules + Addendum 80, Connection Standards, 3rd edition*, Pierre MAITRE, Le Moniteur, 2009 (BU_624.1 MAI)
- *Steel and Composite Steel-Concrete Structures – Calculation and Design in accordance with Eurocodes 3 and 4*, APK, published by Eyrolles, 1996 (BU_624.1 CON)
- *Steel Structures – Simple Structures – Technical and Design Guide for Steel Structural Members*, Various authors, published by CAPEB, CTICM, OTUA, 2008
- *Designing and Building with Steel*, M. Landowski, B. Lemoine, published by ArcelorMittal, 'Mémento acier' series, 2008
- *Memotech – Steel Structures*, C. Hazard, F. Lelong, B. Quinzain, published by Castella Educalivres, 1997
- *Steel Structures – CM66 Addendum 80 Eurocode 3*, Jean MOREL, published by Eyrolles, 1997
- http://www.cticm.org/
- http://www.otua.org/, http://www.construiracier.fr/
- http://www.access-steel.com/
- http://www.scmf.com.fr/
- https://elearn.univ-pau.fr/ Steel Structures Course by Ph. Maron

Keywords: Structural steelwork, Eurocode 3, steel structures, tension, compression, buckling, sections, design

R 3-12 – Sols 1: Introduction to geology and hydrogeology

Timetable
Semester.....3
Period.....Sept. – Dec.
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial.....3 hours
Tutorial.....3 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

None

Objectives

To acquire a basic understanding of geology and hydrogeology, enabling students to grasp the issues addressed in geotechnical engineering: the nature and structure of the soil and subsoil, and the identification of natural risks linked to the characteristics of the soil and subsoil.

Syllabus

- The different types of rock and their origin
- The evolution of rocks: deformation, metamorphism, weathering
- Soil, subsoil and hydrogeology

Key learning outcomes

- To understand the different types of rock and the natural changes they may undergo after formation
- To understand the chronostratigraphic scale and how it is constructed
- Identify the main natural hazards linked to the geological and hydrogeological characteristics of a site
- Obtain relevant geological information online via Infoterre

Bibliography

- *Geology: Objects, Methods and Models*, Dercourt J., Paquet J., 2006, Dunod
- *Elements of Geology, 17th edition by du Pomerol*, Renard M., Lagabrielle Y., Martin E., 2021, Dunod
- *Hydrogeology: Objects, Methods, Applications*, Gili E., Mangan C., Mudry J-N., 2012, Dunod

Keywords: Mineral, exogenous rock, endogenous rock, alluvial terrace, stratigraphic correlation, sedimentation conditions, unconformity, alterites, shrinkage-swelling hazard, flooding, unconfined aquifer, confined aquifer, aquifer recharge

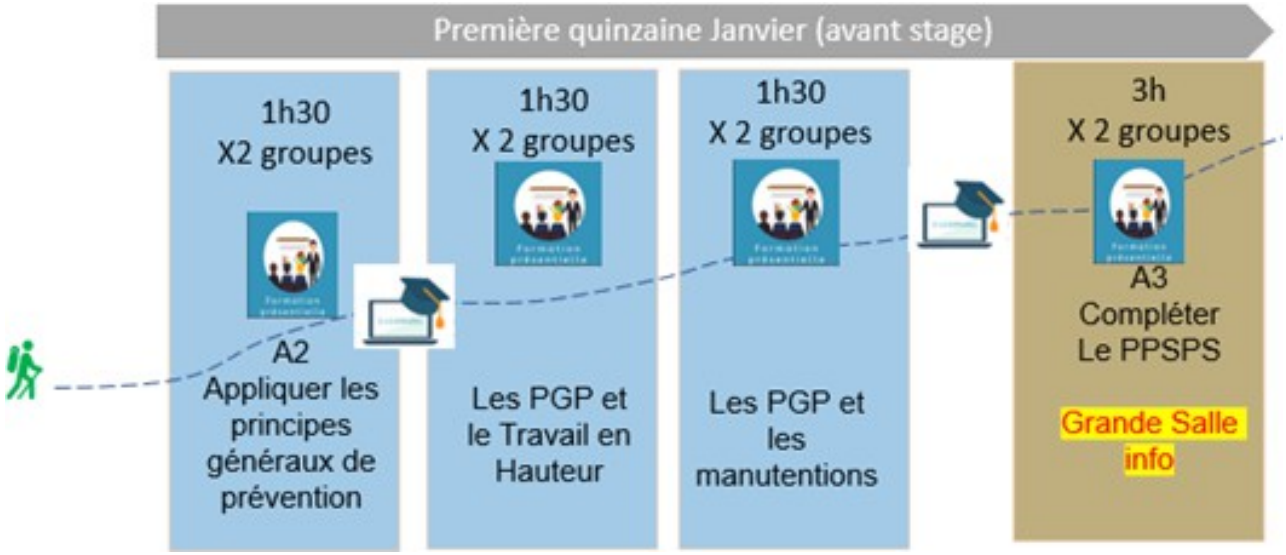
R 3-13 - Health and Safety 3: Implementation by topic

Timetable
Semester.....3
Term .....Sept. – Dec.
Face-to-face in person

Assessment
Continuous assessment

Duration
Tutorial.....6 hours
Total.....6 hours

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation



Prerequisites

General knowledge of health and safety, work placement experience

Objectives

Students will be able to analyse a work situation and identify preventative solutions by applying the PGP
To solve a problem, you need to identify the relevant data. Similarly, to 'read' a workplace situation and take preventative action, you need a simple and systematic method of analysis.

Programme

Session 1: General Principles of Prevention (1h30)

Understand the general principles of prevention and their regulatory basis.
Use feedback from your own workplace experience to assess the relevance of the criteria for selecting a 'key area' for prevention.
Apply a systematic approach to selecting solutions using the general principles of prevention

Session 2: Working at Height (1h30)

Be able to identify the risks of falls from height and propose solutions in line with the general principles of prevention

Content:
Work surface safeguards Scaffolding
Other risks of falls from height

Session 3 Manual and mechanical handling (1h30)

Be able to organise mechanical handling operations on a construction site. Manage manual handling operations.

Content:
Selection and use of lifting equipment
Selection and use of handling accessories or equipment How to avoid manual handling
Principles to apply when manual handling is necessary

Module 4: Completing the PPSPS (3 hours)

Using information about a company and a worksite, be able to assess the risks of an activity and understand the methodology involved
Familiarise yourself with the measures taken by a company to improve its task sheets. Understand the regulatory framework of the PPSPS

Teaching methods:
Group work in computer rooms using online tools at www.preventionbtp.fr and a sample information pack from a virtual company.

Final assessment

Mark for the submission of the Single Document and the PPSPS produced

R 3-14 - Organisation 3: Preparing a building site

Timetable	
Term	3
Period	Sept. – Dec.
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	10.30 am
Tutorial	7.30
Total	**18h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

- Quantity surveying: measurement and cost estimation
- Basic knowledge of structural and finishing works

Objectives

- To carry out the technical studies required to prepare a standard building site

Syllabus

- The technical specifications contained in a set of tender documents
- Construction methods and selection criteria
- Prefabrication
- Construction methods and selection criteria
- Structural work – Cycles (formwork rotations)
- Site set-up
- Site costs

Key lessons learnt

- Analysing the documents in a Tender Document (DCE)
- Selecting a construction method suited to a project
- Defining and planning site work procedures
- Drawing up a site layout plan
- Calculating and estimating site costs

Bibliography

- *Construction Site*, Vuillerme and Richaud, published by NATHAN
- *Construction Site Handbook, by* Didier, Girard, Le Brazidec, Nataf, Pralat and Thiesset, published by NATHAN-AFNOR
- *Managing Your Construction Site*, J. Armand and Y. Raffestin, published by LE MONITEUR

Keywords: Site preparation, tender documents, construction methods, site set-up, operating procedures, formwork cycles, site costs

R 3-15 - Organisation 4: Formwork for Building Construction – Application to a Digital Model

Timetable
Semester.....3
Period.....Sept. – Dec.
Face-to-face teaching

Assessment
Continuous assessment

Duration
Lecture.....3 hours
Tutorial .....7.5 hours
Total **10.30**

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- Resource R 1-12 'Technology 1: General principles of structural works'
- Resource R 1-14 'Drawing 1: Sketches – Plans – Sections'
- Resource R 2-12 'Organisation 2: Task scheduling'
- Resource R 3-14 'Organisation 3: Preparing a building site'
- Resource R 3-18 'Drawing 3: Digital Models – Revit'

Objectives

- To understand the installation and optimisation of building formwork
- Establish a sequence of works for constructing a standard storey of a building (vertical and horizontal) and allocate the appropriate equipment
- Depict equipment rotations on a digital model such as Autodesk Revit

Syllabus

- Vertical formwork technology (building)
- Workflow for vertical and horizontal formwork
- Phasing and sequencing of wall and floor construction using Revit (3D) software, incorporating safety features (brackets, parapets, guardrails, hatches, etc.)

Key learning points

- Selection of suitable formwork equipment
- Optimisation of the sequence and the necessary equipment
- Adherence to scheduling constraints and site safety requirements
- Production of deliverables for use by the site manager, summarising requirements for labour, materials and equipment

Bibliography

- Site Manual – Published by Nathan / Afnor
- Equipment suppliers' catalogues

Keywords: Formwork, formwork cycles, equipment optimisation, site scheduling, safety equipment, digital model

R 3-16 - Materials 5: Structural Materials 2 – Timber – Composites

Timetable
Semester.....3
Period.....Sept. – Dec.
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....6 hours
Practical sessions.....6 hours
Total.....**12**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

- Technology: basic knowledge of building technology
- Materials: basic knowledge of the properties of materials
- Structural analysis: compressive stress and internal forces in an isostatic beam

Objectives

- To identify and characterise the main physical, chemical and mechanical properties of timber and composite building materials
- Distinguish between the different stages of production for timber and composite materials
- Raise awareness of environmental issues and the concept of life-cycle analysis

Syllabus

Wood-based materials:

- State of the industry, presentation of job profiles
- Anatomy of wood
- Exploring the industry from forest management through to industrial applications
- Fire risk, durability and preservation
- Visual grading
- Compression tests, demonstrating anisotropy and sensitivity to moisture
- Developing a critical approach through life cycle assessment (LCA)

Composite Materials:

- State of the industry

- Discover the different types of composite
- Fibres, matrices, fillers and additives
- Chemical, physical and mechanical behaviour of composites

Key learning outcomes

- Identify and characterise wood and composite materials
- Understand the properties and stresses, and the fundamentals of chemistry and physics that guide the selection of timber and composite materials

Bibliography

- *Structural Composite Materials*, Paolo Vannucci
- *The National Survey on Timber Construction*, July 2023, ADEME
- *A practical guide for all professionals involved in timber construction – Working on a timber construction site*, IBC
- *Wood and its derivatives*, CNDB
- *Building with Wood*, Gauzin-Müller, Le Moniteur

Keywords: Timber – Composite – Materials – LCA

R 3-17 - Materials 6: Finishing materials 2

Timetable
Semester.....3
Term .....Sept. – Dec.
Face-to-face teaching

Assessment
Comprehensive continuous assessment

Duration
Lectures.....6 hours
Tutorials.....6 hours
Total.....**12**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

- Technology: basic knowledge of building technology
- Materials: basic knowledge of the properties of materials

Objectives

- To identify and characterise the main physical, chemical and mechanical properties of finishing materials
- Explain the selection of a finishing material
- Raise awareness of environmental issues and the concept of life-cycle analysis

Syllabus

Non-ferrous metals: copper, zinc and aluminium
Bituminous products: adhesives, sealants, membranes
Polymers: polyvinyl chloride (PVC), polyethylene (PE), polypropylene (PP), expanded polystyrene (EPS) and extruded polystyrene (XPS), polyester and epoxy resins

Key learning outcomes

- Identify and characterise finishing materials
- Understand the properties and stresses, and the fundamentals of chemistry and physics that guide the choice of finishing materials

Key words: copper, zinc, aluminium, plastic, polymer

Institut Supérieur Aquitain
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R 3-18 - Drawing 3: Digital Models – Revit

Timetable	
Semester	3
Period	Sept. – Dec.
Face-to-face teaching	

Duration	
Tutorial	10.30 am
Total	**10.30**

Assessment
Assessed as SAÉ

Prerequisites

- Drawing resources: Drawing 1 (R1-14), Drawing 2 (R2-21)
- Technology resources: Technology 1 (R1-12), Technology 3 (R2-13), Technology 5 (R2-15)

Syllabus

Tutorials:

- Using Autodesk Revit software and interfaces
- Understanding the classification of a 3D object in Revit: category, family, type, instance
- Creating 'Models' using the Architectural template: Architecture, Insert, Annotate, View, Manage and contextual ribbons, etc.
- Modelling a typical villa: plan views, sections, elevations, details, etc.
- Revit features: schedules, print sheets and scales, shadows, 3D sections, exporting to IFC for viewers

Key learning outcomes

- Knowing how to draw a small building (prerequisite for SAÉ 3-3)
- Inserting families, creating family types
- Working with a digital model: creating a bill of quantities (object parameters), taking measurements, dimensioning a view
- Exporting the model to IFC

Bibliography

- *Revit for BIM*, Eyrolles
- *Revit 2024 – Building Design*, Eni
- *Revit Families for BIM*, Eyrolles

Keywords: Digital model, parametric 3D, database 125

R 3-19 - Site visits and conferences 3

Timetable	
Semester	3
Period	Sept. – Dec.
Face-to-face teaching	

Duration	
Lecture	3 hours
Tutorial	3 hours 30 minutes
Total	**6h30**

Assessment
Assessed as SAÉ

Prerequisites

None

Objectives

The site visits and lectures organised during the first three years at ISA BTP serve several educational purposes:

- to explore the diversity of the construction industry:
  - structures and systems: buildings, engineering structures, infrastructure, road and rail networks, roads and utilities, civil engineering works, marine structures, equipment, installations… ,
  - key players: client, project manager, engineering consultancy, contractors, subcontractors, health and safety coordinator, geotechnical engineer, technical inspector, laboratory technician…
  - professions: labourers, semi-skilled and skilled workers, managers, project managers, site managers, site supervisors, engineers, business owners, self-employed contractors, suppliers, technical sales representatives…
  - materials: 'conventional', innovative,
  - construction methods and working procedures,
- developing one's understanding of the construction industry: projects and sites ranging from routine to exceptional, local and national projects, technical terminology,
- linking this to the curriculum: Resources and SAÉ,
- developing curiosity and an open mind,
- encouraging interest in SAÉ work placements and facilitating the choice of the ISA4 and 5 pathways

Key learning outcomes

- develop listening and observation skills
- write a report on a site visit or take notes during lectures
- apply these discoveries and insights in the SAÉ programmes

Keywords: Discovery, technologies, diversity, organisations, responsibilities

SAÉ 3-1 – Construction Site Organisation Project

Timetable	
Semester	3
Period	Sept. – Dec.
Face-to-face teaching	

Duration	1 week
Supervised hours	22 hours
Self-study	6 hours

Assessment
Defences and Portfolio

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- Basic knowledge of site organisation (resource 'Organisation 3: Preparing a building site')
- Proficiency in digital modelling tools (Revit, digital models)
- Basic knowledge of technical Spanish (Spanish Level 3)
- Understanding of administrative documents (Tender Documents, Planning Permission)
- Knowledge of health and safety, the environment and quality as applied to construction sites

Objectives

- To analyse a construction project within its context (C1)
- To specify technical solutions for sustainable construction (C2)
- Manage a construction site organisation (C4):
  - Select the appropriate human and material resources
  - Comply with health and safety standards
  - Produce consistent implementation documents (construction information plan, schedule, method statements)
  - Incorporate sustainable development requirements

Programme

- Analysis of the Tender Documents:
  - Understanding the client's expectations and the site's constraints
  - Identify key documents (planning regulations, access, utilities, etc.)
- Site organisation:
  - Drawing up a Site Layout Plan (SLP)

  - Drawing up a provisional schedule (Gantt chart)
  - Draft a methodology document (phasing, logistics, safety)
- Integration of constraints:
  - Health and safety, environment, quality and sustainable development
- Digital modelling:
  - Use of Revit for the project's digital model
- Oral presentation:
  - Presentation in Spanish to simulate an international tender process

Key learning outcomes

- Ability to interpret a tender document and extract key information
- Mastering planning tools (Gantt charts, PIC) and modelling tools (Revit)
- Anticipating risks (health and safety, environmental issues, nuisance) and proposing appropriate solutions
- Communicating effectively in Spanish in a professional context
- Working as part of a team and managing time and resource constraints

Keywords: tender documents, PIC, scheduling, site organisation, sustainable development, BIM, Revit, safety

SAÉ 3-2 – Structural design/stability project: lightweight structure

Timetable
Semester.....3
Period.....Sept. – Dec.
Face-to-face teaching

Assessment
Defences and Portfolio

Duration	1 week
Supervised hours	22 hours
Self-study	6 hours
Targeted skill(s)	
C1 – Analysing a construction project within its context	
C2 - Specify technical solutions for sustainable and more durable construction	
C3 – Designing structures and systems	

Prerequisites

- Strength of Materials 1 and 2
- Technology 1: General Principles of Structural Engineering
- Drawing 2: CAD – AutoCAD

Objectives

- To design the structural system of a lightweight structure
- To understand the role of bracing in the overall stability of a structure
- Carry out a complete load transfer analysis based on a simple project
- Work with the various forces acting on structures and their units
- Develop a comprehensive understanding of the path of forces within a structure

Syllabus

- Project analysis and definition of the load-bearing system
- Identification of permanent and variable forces
- Assessment of area, line and point loads
- Conversion and handling of units used in structural analysis
- Application of loads to a lightweight structure
- Identification of force paths down to the foundations
- Design of the stability and bracing system
- Analysis of the influence of bracing on the overall behaviour of the structure
- Presentation and justification of design choices

Key Learning Points

- Identify and quantify the various forces acting on a structure
- Carry out a consistent load transfer analysis, ensuring consistency in units and orders of magnitude
- Understand the transfer of loads between the various load-bearing elements
- Design a bracing system suitable for a lightweight structure
- Justify structural choices based on an analysis of the structure's overall behaviour

Bibliography

- Eurocode 0: Basis of structural design
- Eurocode 1: Actions on Structures
- Course materials and teaching resources on structural analysis

Keywords: Load transfer, Stability, Bracing, Lightweight structure, Actions on structures, Statics, Structural design

SAÉ 3-3 – Building design project: digital model, tender documents, planning permission

Timetable
Semester.....3
Period.....Sept. – Dec.
Face-to-face teaching

Assessment
Defences and Portfolio

Duration	1 week
Supervised hours	22 hours
Self-study	6 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- Drawing resources, in particular R3-18 'Drawing 3: Digital Models – Revit'
- Organisation resources: R2-11 'Organisation 1: Quantity Surveying and Cost Estimation' and R2-12 'Organisation 2: Task Scheduling'
- Technology resources: R1-12 'Technology 1: General Principles of Structural Works', R2-13 'Technology 3: Building Finishes' and R2-15 'Technology 5: Building Services'
- Resource R1-15 'Introduction to Environmental Issues'
- Materials Resources 1 to 6

Objectives

- To design a detached house with a living area of approximately 150 to 200 m², spread over three levels (basement, ground floor, first floor)
- Produce a detailed digital model in native format (.rvt) and open-source format (.ifc)
- Prepare the written and graphical documents required during the DESIGN phase for submitting a planning application: plans, sections, elevations, 3D views, details, specifications, detailed bill of quantities, environmental statement and landscaping plan. . .
- Specify (and justify) materials and construction methods
- Geolocation of the building and the impact of sunlight on the villa (shading, sun protection, solar gain, etc.)
- Quantity take-off for certain works packages (using Revit bill of quantities)
- Calculation of construction costs, based on ratios per contract lot
- Construction schedule by lot

Programme

- First design phase as individual work: digital model of 'one's villa'
- Peer review (SAÉ sub-groups) and selection of one of the villas for the second phase
- Second design phase involving group work
- Analysis of the client's requirements and discussions with them to finalise the specifications (including the level of detail)
- Preparation of written and graphic documents and compilation of the planning application
- Phase 3: oral presentation of the projects to the jury, comprising representatives of the client, during a project management competition

Key lessons learnt

- Understanding and meeting the client's requirements
- Submission of all required documents
- Collaborative working

Keywords: Design, collaborative work, planning permission, advanced digital model

Semester 4

Competency C1 – Analysing a construction project within its environment

Resources for Competency C1		%
R 4-1	Management 1: Sociology of work and stakeholder dynamics	6.06 %
R 4-2	Management 3: Legal Framework for Companies	10.61%
R 4-8	IT Tools 3: Programming – Automation – Interfacing – AI	7.58%
R 4-4	English 4	10.61%
R 4-5	Spanish 4	10.61%
R 4–6	Mathematics 4 – Analysis	16.67%
R 4–7	Statistics 2	9.85%
R 4-15	Soils 2: Soil Mechanics 1	18.18%
R 4-16	Organisation 5: Construction Waste Management	3.79%
R 4-20	Fire safety – Accessibility for people with reduced mobility	6.06%
SAÉ under competence C1		**%**
SAÉ 4-1	Cross-border project: building / ancillary trades	9.02%
SAÉ 4-2	End-of-Year Project: roads, engineering structures, developments, road and utility networks	13.52
SAÉ 4-3	Overseas practical placement	77.46%

Competence C2 – Specifying technical solutions for sustainable and more durable construction

Resources for Competency C2		%
R 4–8	IT tools 3: Programming – Automation – Interfacing – AI	10.03%
R 4–10	Physics Practical Work	13.38%
R 4-12	Reinforced Concrete 1: General Principles – Simple compression – Simple bending – Shear force – Iso-beams	17.06 %
R 4-13	Steel Structures 2: Combined Loads – Instabilities – Numerical Methods	13.04%
R 4-14	Timber 1: General Principles – Bracing – Tension – Compression – Simple Bending	15.38%
R 4-17	Organisation 6: Shoring and formwork	9.03
R 4-18	Organisation 7: Construction Methods for Civil Engineering Works	8.03%
R 4-19	Topography 2: Digital Surveys and Modelling of Structures	6.02 %
R 4-20	Fire safety – Accessibility for people with reduced mobility	8.03%
SAÉ for competence level C2		**%**
SAÉ 4-1	Cross-border project: building / ancillary trades	40%
SAÉ 4-2	End-of-Year Project: roads, engineering structures, developments, road and utility networks	60%

Competency C3 – Dimensioning structures and systems

Resources for Competency C3		%
R 4–6	Mathematics 4 – Analysis	11.3 %
R 4-7	Statistics 2	6.68%
R 4–9	Fluid Mechanics 1: Statics – Bernoulli – Euler – Load – Pump	20.55%
R 4-10	Physics Practical Work	6.85%
R 4-11	RdM 5: Hyperstatic systems – Displacement method	14.38%
R 4-12	Reinforced Concrete 1: General Principles – Simple Compression – Simple Bending – Shear Force – Iso-beams	8.73%
R 4-13	Steel Structures 2: Combined Loads – Instabilities – Numerical Methods	6.68%
R 4-14	Timber 1: General Principles – Bracing – Tension – Compression – Simple Bending	7.88%
R 4-15	Soils 2: Soil Mechanics 1	12.33%
R 4-17	Organisation 6: Shoring and formwork	4.62%
SAÉ for competence C3		**%**
SAÉ 4-2	End-of-Year Project: roads, engineering structures, infrastructure, road and utility networks	100%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
R 4-1	Management 1: Sociology of work and stakeholder dynamics	11.59 %
R 4-2	Management 3: Legal Framework for Companies	20.29%
R 4-4	English 4	20.29%
R 4-5	Spanish 4	20.29%
R 4–16	Organisation 5: Construction site waste management	7.25
R 4-18	Organisation 7: Civil Engineering Site Methods	11.59%
R 4-19	Topography 2: Digital surveys and modelling of structures	8.7%
SAÉ for competence C4		**%**
SAÉ 4-1	Cross-border project: building / secondary trades	9.02%
SAÉ 4-2	End-of-Year Project: roads, engineering structures, developments, road and utility networks	13.52
SAÉ 4-3	Overseas practical placement	77.46%

R 4-1 – Management 1: Sociology of Work and Stakeholder Dynamics

Timetable
Semester.....4
Period .....Jan. – June
Face-to-face in person

Assessment
Continuous assessment

Duration
Tutorial.....3 hours
Tutorial.....9 hours
Total.....**12**

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

R 3-1 - Management 1: Organisational theory – Industrial economics of the construction sector

Objectives

- Understand the mechanisms at work in social relations (social and behavioural psychology)
- To understand stakeholder dynamics and learning dynamics

Syllabus

- A review of organisational theory: different schools of thought on work organisation. A review of theories on human needs in the workplace
- The legacy of these behavioural theories – Concepts in psycho-sociology – Insights for group management – Psychosocial risks
- The concept of contingency
- Socio-technical systems & the ecosystemic approach
- Economic theories of organisations and their consequences / key players
- Modern organisational theories and their implications / key players
- Group sociology (cohesion and dynamics – cognitive science & innovation)
- Process theory (expectations – goals – the search for meaning – strategies – management)

Key learning points

- Identify the different schools of thought in organisational theory
- Analyse group dynamics and collective behaviour
- Apply management principles to real-life situations
- Recognise and prevent psychosocial risks
- Understand systemic approaches to organisations

Bibliography

- *Theory of Organisations*, J. Rojot, ESKA Publications
- *Organisational Management*, R. Daft, De Boeck
- *Social Psychology*, R.-V. Joule and J.-L. Beauvois, PUG

Keywords: Management, organisational theory, psycho-sociology, group dynamics, psychosocial risks, organisational behaviour

R 4-2 - Management 3: Legal Framework for Companies

Timetable	
Semester	4
Period	Jan. – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	10.30 am
Tutorial	10.30
Total	**9.00 pm**

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

None

Objectives

- To gain an understanding of company law
- To understand the legal frameworks governing general contractors and construction companies in particular
- To familiarise oneself with the different types of employment contracts

Syllabus

- General legal principles: Branches of law (particularly business law), courts (particularly the Commercial Court and the Employment Tribunal), sources of law, obligations
- Fundamentals of company law: the different types of commercial companies and their development, the specific features of the SCI
- Labour and contractual relations within the company: Standard forms of employment contracts and, more specifically, those commonly used in the construction sector (fixed-term contracts and site-specific contracts). Analysis of the construction sector's collective agreement (a source of labour law)

Key learning outcomes

- Distinguish between the different legal forms of companies (SARL, SAS, SA, SCI)
- Identify the competent courts depending on the type of dispute
- Understand the structure and content of an employment contract
- Apply the specific provisions of the construction industry collective agreement
- Distinguish between hire contracts and site contracts

Bibliography

- *Economics, Law and Management*, Patrick SIMON, Bréal
- *Employment Contracts: From Recruitment to Termination*, O. CHENEDE, D. JOURDAN, J. BARTHELEMY & Associates, DELMAS
- Labour Code
- National Collective Agreement for the Construction Industry

Keywords: Company law, employment contract, construction industry collective agreement, legal forms, labour law

R 4-3 - Presentation 3: Video production

Timetable
Semester.....4
Period .....Jan. – June
Face-to-face in person

Duration
Tutorial.....9 hours
Total.....9 hours

Assessment
Assessed as SAÉ

Prerequisites

None

Objectives

- Produce a 5-minute video (filming and editing) on the subject of the end-of-year work placement for ISA BTP 2 students.
- Understand the basics of filming:
  - Frame rate
  - Recording format
  - Different shot sizes
- Understand the basics of editing using DaVinci Resolve editing software:
  - Importing different elements (footage, photos, sound, music)
  - Basic editing
  - Creating titles and animating graphic elements (photos, shots)
  - Sound mixing
  - Recording a voice-over
  - Exporting for viewing on YouTube

Programme

Two 3-hour sessions

R 4-8 – IT Tools 3: Programming – Automation – Interfacing – AI

Timetable	
Semester	4
Period	Jan. – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	3 hours
Tutorial	12 hours
Total	**15**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

Mathematics S1 to S3

Objectives

To be able to use the basics of programming to create specific IT tools

Syllabus

Computing for Engineers:

- Development of customised tools with office software interfaces
- Application in a project, working independently to develop calculation tools for the construction industry (examples of possible projects: structural pre-dimensioning programme, calculation of influence lines for continuous beams, calculation of the geometric characteristics of a section of any shape)
- Languages: OOoBasic

Key learning outcomes

- Mastering the basics of programming in OOoBasic
- Create a functional user interface
- Develop a standalone calculation tool for the construction industry
- Validate and test a programme
- Documenting your code and application

Bibliography

- Online help for the various software programmes
- *OpenOffice.org Programming 2 – Macros and APIs*, Bernard Marcelly, Laurent Godard, Eyrolles, 2005, 725 pages
- general.developpez.com/cours/
- www.codes-sources.com/recherche.aspx?r=Ooobasic

Keywords: Programming, OOoBasic, user interface, construction industry calculation tools, automation

R 4-4 – English 4

Timetable
Semester.....4
Period .....Jan. – June
Face-to-face in person

Assessment
Continuous assessment

Duration
Tutorial .....21 hours
Total.....21 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

ISA2-S3 Level B1 in English

Syllabus

Tutorials:

- **IELTS Written and Oral Tasks Preparation**
- **Writing**:
  - Task 1: Summarise and describe key information from graphs, charts, tables or processes accurately.
  - Task 2: Develop a clear argument or discussion supported by relevant evidence and examples.
  - Use cohesive devices and transitions to ensure logical flow and coherence.
  - Use a range of academic vocabulary accurately and appropriately.
  - Write using both complex and simple grammatical structures with a high degree of accuracy.
  - Plan, draft and revise your writing within strict time limits.
  - Fully address all parts of the prompt whilst maintaining relevance and clarity.
- **Oral**:
  - Communicate fluently and coherently, maintaining a natural flow of speech and a logical sequence of ideas.
  - Use a wide range of vocabulary to discuss abstract, academic and familiar topics.
  - Apply accurate and varied grammatical structures to express complex ideas.
  - Pronounce words clearly and use intonation patterns effectively to enhance meaning.
  - Develop and organise extended responses, particularly in Parts 2 and 3 of the test.
  - Express, justify and evaluate opinions confidently in discussion.

Key learning outcomes

By the end of this course, you will be able to:

- Demonstrate confidence and composure in academic speaking contexts.
- Show a willingness to self-correct and improve your pronunciation and grammar.
- Interact politely and appropriately with the examiner.
- Display a positive attitude towards communicating ideas clearly and accurately.
- Approach academic writing as a structured, purposeful and formal communication process.
- Show a willingness to revise and refine work based on feedback.
- Maintain an objective and analytical tone when presenting ideas.
- Value accuracy, clarity and coherence as key qualities of effective writing.

Bibliography

- Barron's Writing for the IELTS
- Get the IELTS Band 9 Speaking PDF book by Cambridge IELTS Consultants

Keywords: IELTS, academic, written, oral

R 4-5 - Spanish 4

Timetable
Semester.....4
Term .....Jan. – June
Face-to-face in person

Assessment
Continuous assessment

Duration
Tutorial .....21 hours
Total.....21 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

Spanish S3

Objectives

In order to reflect the progressive development of the target level, teaching is based on the Common European Framework of Reference for Languages (CEFR), which provides a common basis for the design of programmes, diplomas and certificates.

The overall language proficiency scale identifies three general levels, subdivided into six common levels (as broadly agreed):

- Level A: basic user, itself subdivided into introductory or discovery level (A1) and intermediate or everyday level (A2)
- Level B: independent user, subdivided into threshold level (B1) and independent level (B2). This corresponds to 'limited operational competence' or 'appropriate responses in everyday situations'
- Level C: proficient user, subdivided into C1 (autonomous) and C2 (proficient)

See details of language proficiency levels on the CEFR (Common European Framework of Reference for Languages) website.

In Semester 4, students must acquire the skills necessary to achieve Level B1 in international certification tests (such as DELE or SIELE).

Level B1 certifies that the student is able to understand the main points when clear, standard language is used, and that the subject matter relates to familiar matters in work, study, the professional world, leisure, etc. They can cope with most situations encountered whilst travelling or in the professional world, produce coherent speech on familiar topics or those of personal interest, recount an event, an experience or a dream, describe a hope or a goal, and briefly explain reasons or provide explanations.

Particular emphasis will be placed on the themes of the city and the environment, from a civic and professional perspective, in relation to current issues.

Syllabus

- Describe and compare different urban environments (city, countryside, neighbourhoods, transport)
- Expressing one's opinion and discussing environmental issues (recycling, pollution, energy, sustainable development)

- Cope with practical situations: housing, public services, getting around town
- Read and understand a variety of documents (newspaper articles, official materials, awareness-raising posters)
- Deliver a simple, structured talk on a topical subject (presentation, debate, short talk)
- Describing a personal experience related to the city or the environment, and outlining plans or solutions

Key learning outcomes

- Mastering specific vocabulary related to the city (urban planning, transport, services) and to ecology and the environment (recycling, pollution, renewable energy, sustainability)
- Use past and future tenses to recount events and make predictions
- Express one's opinion, agreement or disagreement, and justify one's views
- Use logical and temporal connectors to structure a speech
- Develop fluency in speaking during simple yet more nuanced interactions

Bibliography

- https://eduscol.education.fr/1971/cadre-europeen-commun-de-reference-pour-les-langues-cecrl
- https://leblogdespagnol.com/
- All resources dedicated to learning Spanish vocabulary, grammar or verb conjugation suitable for a B1 level

Keywords: CEFR, B1, city, environment, sustainability, debate, opinion

R 4-6 - Mathematics 4 - Analysis

Timetable
Semester.....4
Period .....Jan. – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....15 hours
Tutorial .....15 hours
Tutorial.....3 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

Mathematics S1 to S3

Objectives

- To understand the basic concepts of the analysis of numerical sequences and series and to know how to apply them in the development of mathematical models
- To generalise integral calculus to higher dimensions and interpret it, particularly from a physical and/or mechanical perspective

Syllabus

- Numerical sequences and series
- Further topics in integration: multiple integrals, line integrals, applications

Key learning outcomes

- To study the convergence of a numerical series
- Be able to express common physical quantities in the form of integrals
- Be able to calculate these integrals in simple cases
- Calculate double and triple integrals
- Apply integral calculus to physical and mechanical problems

Bibliography

- Mr ABOUZAID's personal website: http://mabouzai.perso.univ-pau.fr/
- All books on mathematics for engineers
- SCHAUM's series, McGraw-Hill
- Courses in advanced mathematics

Keywords: Numerical series, entire series, multiple integrals, line integrals, convergence

R 4-7 – Statistics 2

Timetable
Semester.....4
Period .....Jan. – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....6 hours
Practical sessions.....6 hours
Tutorial 7.30
Total **7.30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

Mathematics S1 to S3

Objectives

Extract information from a statistical study and assess its relevance

Syllabus

Probability/Statistics:

- Further Probability
- Inferential statistics: sampling, estimation, hypothesis testing, linear regression
- Use of statistical software

Key learning outcomes

- Carrying out a representative sample
- Estimate a statistical parameter (mean, variance) with a confidence interval
- Conduct a hypothesis test and interpret the result
- Performing a linear regression and assessing the quality of the fit
- Using statistical software (R) to analyse data

Bibliography

- Online help for the R software
- Undergraduate science textbooks
- *Statistics and Probability, Volume 2*, Verlant St Pierre, Sigma series, Foucher Publishers
- *Probability, Data Analysis and Statistics*, G. Saporta, Éditions Technip

Keywords: Inferential statistics, sampling, estimation, hypothesis testing, linear regression, R software

R 4-9 – Fluid Mechanics 1: Statics – Bernoulli – Euler – Load – Pump

Timetable	
Semester	4
Term	Jan. – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	15h
Tutorial	15 hours
Total	**30 hours**

Targeted skill(s)
C3 – Designing structures and systems

Prerequisites

- Vector fields and vector operators (grad, div, rot)
- Double integrals
- Partial derivatives

However, these concepts will be revisited during the course where necessary.

Objectives

- To use and understand the fundamentals of fluid statics (equilibrium, static forces, Archimedes' principle)
- To understand and apply the conservation of volume in incompressible fluids
- To understand and apply Bernoulli's theorem and the theorem of momentum
- Calculate pressure losses in systems
- Understand how pumps work and be able to size a system

Syllabus

- Concept of a fluid: fluid particle, properties of fluids
- Fluid statics: equilibrium equations, static force, Archimedes' principle
- Fluid kinematics: Eulerian and Lagrangian variables, conservation equations. Incompressible case
- Fluid dynamics: Bernoulli's theorem and Euler's theorem
- Calculations of pressure losses in networks
- Pumps: operation and sizing

Key learning outcomes

- Calculate hydrostatic pressure and the pressure forces acting on a surface
- Applying Archimedes' principle to determine the buoyancy of a body
- Apply the continuity equation (conservation of mass)
- Use Bernoulli's theorem to solve flow problems
- Calculate linear and singular head losses in a network
- Design a pumping system

Bibliography

- *Fluid Mechanics: An Introduction*, P. Chassaing, Paperback
- *Exercises in Fluid Mechanics*, M. Morel and J.P. Laborde, Eyrolles
- *Fluid Mechanics*, R. Comolet, Dunod
- *General and Applied Hydraulics*, A. Lencastre, Eyrolles

Keywords: Fluid mechanics, statics, Bernoulli, pressure losses, pumps, hydraulics, flows

R 4-10 – Physics Practical Work

Timetable
Semester.....4
Period .....Jan. – June
Face-to-face in person

Assessment
Continuous assessment

Duration
Tutorials.....20 hours
Total.....20 hours

Targeted skill(s)
C2 – Specify technical solutions for sustainable and more durable construction
C3 - Designing structures and systems

Prerequisites

Physics S1, S2 and S3 (Alternating Current, Thermodynamics, Fluid Mechanics, Heat Transfer)

Objectives

- Apply theoretical concepts covered in lectures to practical experiments
- Verify theoretical results and quantify the margin of uncertainty
- To recognise the standard components of applied physics systems in buildings and assess their characteristics

Syllabus

The module comprises various practical exercises, based on standard components used in building services engineering, on construction sites or in basic electrical installations:

- Pumps, heat pumps, heat generation and distribution (electric boiler, two types of convector heaters)
- Airflow: measurements of air flow rates in ducts, study of pressure drops, verification of the generalised Bernoulli's theorem
- Refrigerated chamber: compression refrigeration cycle, heat exchangers, measurement of the coefficient of performance

Key learning outcomes

- Knowing how to set up and use measurement equipment in applied building physics
- Analysing and interpreting experimental results by comparing them with theoretical models
- Assess measurement uncertainties and the validity of simplifying assumptions
- Identify the components of a heating system and understand how they work

Bibliography

- Manufacturers' manuals distributed during the practical session

Keywords: Heat pump, airflow, refrigeration cycle, measurements, experimentation

R 4-11 - RdM 5: Hyperstatic systems – Method of displacements

Timetable	
Semester	4
Term	Jan. – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	10.30 am
Tutorial	10.30
Total	**9.00 pm**

Targeted skill(s)
C3 – Designing structures and systems

Prerequisites

- RDM Mechanics: RdM 1, RdM 2, RdM 3, RdM 4
- Force method for hyperstatic structures
- Mathematics: Matrix algebra, solving linear systems

Objectives

- To master the displacement method for solving hyperstatic structures
- To understand the matrix formalism of the stiffness method
- Be able to use structural analysis software

Syllabus

- Principles of the displacement method (stiffness method)
- Elemental stiffness matrix for rods and beams
- Assembling the global stiffness matrix
- Incorporating boundary conditions
- Application to continuous beams and plane frames
- Comparison of the force method and the displacement method
- Use of structural analysis software

Key learning points

- Constructing the stiffness matrix of a structure comprising bars or beams
- Solving a hyperstatic system using the displacement method
- Interpreting the results: nodal displacements, forces in the members

Bibliography

- Handout distributed to students: "Strength of Materials Course", D. Grégoire, ISA BTP
- *Finite Element Analysis of Structures*, Jean-Charles Craveur, Dunod
- *Finite Element Method*, Gouri Dhatt and Gilbert Touzot, Hermès

Keywords: Displacement method, stiffness matrix, hyperstaticity, finite elements

R 4-12 – Reinforced Concrete 1: General Principles – Simple Compression – Simple Bending – Shear Force – Iso-beams

Timetable	
Semester	4
Period	Jan. – June
Face-to-face in person	

Duration	
CM	12 hours
Tutorials	1.30 pm
Total	**25h30**

Assessment
Continuous assessment

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C3 - Designing structures and systems

Prerequisites

Knowledge of structural design, mechanical properties of materials (concrete and steel)

Objectives

- To understand how reinforced concrete works and the principles of design
- To master the calculation of members under simple compression and simple bending
- Be able to design isostatic beams in accordance with Eurocode 2

Syllabus

- Principles of reinforced concrete: concrete-steel composite action
- Regulations: Eurocode 2, limit states (ULS, SLS)
- Simple compression: columns, minimum reinforcement cross-sections
- Simple bending: rectangular diagrams, resisting moment
- Shear force: tangential stresses, transverse reinforcement
- Design of isostatic beams

Key learning points

- Designing a column under simple compression
- Calculating the longitudinal reinforcement for a beam under bending
- Determining shear reinforcement
- Verifying non-brittleness and bond conditions

Bibliography

- *Eurocode 2: Design of concrete structures*, NF EN 1992-1-1, 2005
- *Practical Guide to Eurocode 2*, Jean Roux, Eyrolles, 2016
- *Treatise on Reinforced Concrete*, Jean Perchat and Jean Roux, Eyrolles, 2013

Keywords: Reinforced concrete, Eurocode 2, bending, compression, shear force, design

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R 4-13 - Steel Structures 2: Combined Loads – Instabilities – Numerical Tools

Timetable	
Semester	4
Term	Jan. – June
Face-to-face in person	

Duration	
CM	9.0
0 am	
Tutorial	10.30
Total	**7.30**
pm	

Assessment
Continuous assessment

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C3 - Designing structures and systems

Prerequisites

In order to undertake this course, students must first be able to:

- to identify (from the plans and elevations of a single-span, single-storey building structure) the various main elements of that structure and the connections between them
- to analyse the path of vertical and horizontal forces from the surface bearing the loads down to the foundations
- calculate the forces acting on each of the structural elements
- to verify, at the Ultimate Limit State (ULS) and the Serviceability Limit State (SLS) and in accordance with Eurocode 3, the cross-sectional and stability design of elements subjected to tension or compression.

This course will be based on the project documentation for a single-storey multi-span building or a two-storey single-span building. The documentation will include a description of the structure (extracted from the technical specifications), plans of the main structure and a perspective view of it. As an appendix to the documentation, students will also be provided with an extract from a manufacturer's catalogue of the main standardised steel sections available on the market.

Objectives

By the end of this course, students should be able to analyse the behaviour of a single-storey multi-span or two-storey single-span steel structure and to carry out or verify the design, in accordance with Eurocode 3, of members subjected to tensile/compressive, shear and/or bending stresses.
Upon completion of the chapter on cross-section geometry, students should be able, for simple cross-sections (formed from assemblies of rectangular and/or circular surfaces) or for cross-sections formed by the assembly of two standardised sections

- to calculate the position of the centre of gravity of that cross-section
- to calculate the moment of inertia and the static moment of the cross-section about a principal axis
- to calculate the elastic and plastic bending moments of this cross-section.

Upon completion of the chapter on the design of members subjected to combined loads in accordance with Eurocode 3, the student must be able, based on the design documentation for a new building of the same type and a given wind and/or snow load:

- to calculate the loads experienced by each member contributing to the stability of the structure,
- to identify members subjected solely to bending as well as those subjected to multiple loads,
- to check the design of these members at the Ultimate Limit State (ULS) and the Serviceability Limit State (SLS).

By the end of the chapter on buckling instability of a member under bending and compression, the student must be able, using the design data for a new building of the same type and given wind and/or snow loads:

- to identify the members likely to be subject to buckling instability
- to check the design of members susceptible to buckling instability at the Ultimate Limit State (ULS)
- to analyse the consequences of the buckling of one structural member on neighbouring members.

Upon completion of the chapter on overturning instability, the student must be able, based on the design documents for a new building of the same type and given wind and/or snow loads:

- to explain the phenomenon of overturning
- to identify the structural members likely to be subject to overturning instability
- to verify the design of elements susceptible to overturning instability at the Ultimate Limit State (ULS)
- analyse the consequences of the buckling of a structural element on neighbouring elements.

By the end of the chapter on the ADVANCE DESIGN finite element analysis software, the student must be able, using the design data for a new building of the same type and given wind and/or snow loads:

- to construct a model of this building
- to apply permanent and operational loads to this model
- to carry out verification calculations for this model
- to analyse the results obtained in order to detect any modelling errors
- to produce a verification report on the design of this model.

Bibliography

- *Steel Structures*, Jean MOREL, Eyrolles, 1997
- *Steel and Composite Steel-Concrete Design*, APK, Eyrolles, 1996
- *An Introduction to the Structural Analysis of Steel-Frame Buildings*, Yvon Lescouarc'h, CTICM Series, 1997
- *CM 66 Rules and Addendum 80*, CTICM?, published by Eyrolles, 1998
- *Eurocode 3 and National Application Document – Design of Steel Structures and National Application Document*, Various Authors, published by Eyrolles, 1996.
- www.cticm.org
- www.steelbizfrance.com

R 4-14 – Timber 1: General Principles – Bracing – Tension – Compression – Simple Bending

Timetable
Semester.....4
Period .....Jan. – June
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorials	12 hours
Tutorial	3.30
Total	**23h**

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C3 - Designing structures and systems

Prerequisites

- Material resources: Materials 1 (R1–16), Materials 5 (R3–16)
- RdM resources: RdM 1 (R1-9), RdM 2 (R2-9), RdM 3 (R3-8)
- R3-10: Column-beam structures – Load transfer – Bracing – Stability

Syllabus

Lectures:

- Introduction: materials, benefits and properties of timber
- Deterioration: fungi, insects, protection
- Instabilities (general, local) and bracing Tutorials:

Practical application of Eurocode 5 (EC5)

- Analysis of a member subjected to simple tension
- Analysis of a column subjected to centred compression
- Analysis of a joist and a beam subjected to simple bending Practical

work:

- Determination of the mechanical properties of timber depending on the grain direction
- Effects of timber moisture content

Key learning points

- Determining characteristic values and design values in accordance with EC5
- Designing common structural members subjected to tension, compression and bending

Bibliography

- NF EN 1995-1 – Design and calculation of timber structures + National Annex
- *Timber Construction: The Eurocode Explained Through Examples*, published by Eyrolles

Keywords: Timber, timber frames, loads, Eurocode

R 4-15 - Floors 2: Soil Mechanics 1

Timetable	
Semester	4
Period	Jan. – June
Face-to-face in person	

Duration	
CM	18h
Tutorial	18h
Total hours	**36**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

- Introduction to geology and hydrogeology
- Mechanics: the concept of stresses

Objectives

- To identify a soil and assess its likely characteristics
- Conduct a geotechnical investigation programme
- To analyse and interpret a soil investigation report
- Calculate the stress distribution in a soil
- Assess the settlement of a soil subjected to a load

Syllabus

Definition and classification of soils

- Identification and classification of soils, physical properties of soils
- Properties of the mixture of solid, water and air
- Soil investigation methods
- Laboratory soil identification tests

Settlement and consolidation

- Stress tensor and strain tensor
- Stress distribution as a function of load type
- Total stresses and effective stresses (Terzaghi's equations)
- Calculation of settlements using the oedometer method

Key learning points

- Understand the remit of a geotechnical engineering consultancy
- Understand the characteristic physical properties of soil
- Be able to analyse an oedometer test
- Be able to determine the natural stress and the additional stresses generated by loads with specific geometries
- Be able to calculate settlement for different load cases, as well as the degree and duration of consolidation
- Understand techniques for accelerating settlement

Bibliography

- *Foundations and Earth Structures*, G. Philipponnat, B. Hubert, A. Isnard, Eyrolles
- *Soil Mechanics – Theory and Practice*, V. Robitaille and D. Tremblay, published by Modulo Éditeur
- *Elements of Soil Mechanics*, F. Schlosser, published by Presses de l'École Nationale des Ponts et Chaussées
- *Exercises in Soil Mechanics*, F. Schlosser, published by Presses de l'École Nationale des Ponts et Chaussées
- *Practical Problems in Soil Mechanics and Foundations*, G. Sanglerat, G. Olivari, B. Cambou, published by Dunod

Keywords: Physical quantities, geotechnical projects, effective stress, oedometer test, Terzaghi, settlement and consolidation

R 4-16 - Organisation 5: Management of construction site waste

Timetable
Semester.....4
Period .....Jan. – June
Face-to-face in person

Duration
CM 4h30
Tutorial.....3 hours
Total **7h30**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

- Resources (Construction) Materials: Materials 1 (R1-16) to Materials 6 (R3-17)
- Organisational resources: Organisation 1 (R2-11), Organisation 2 (R2-12), Organisation 3 (R3-14)

Syllabus

Lectures:

- Overview, legislative framework
- Types of construction waste
- On-site management: reduction, sorting, transport, recovery, storage
- Specific measures: new builds and refurbishments

Tutorials:

- Identifying waste from a building project
- Waste management organisation: sorting, containers, disposal methods, SOGED

Key learning points

- Classifying and quantifying (ratios) waste
- Drafting a SOGED

Bibliography

- Guide to *Better Managing Construction Site Waste*, FFB

Keywords: Circular economy, pollution, organisation, waste, traceability

R 4-17 – Organisation 6: Shoring and formwork

Timetable
Semester.....4
Period .....Jan. – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....6 hours
Tutorials .....7.5 hours
Total **1.30**

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C3 - Designing structures and systems

Prerequisites

- RdM resources: RdM 1 (R1–9), RdM 2 (R2–9), RdM 3 (R3–8)
- R3-10: Column-beam structures – Load transfer – Bracing – Stability

Syllabus

Lectures:

- Definitions of formwork and shoring, basic design requirements
- Design and construction parameters
- Common formwork and shoring in building construction
- Common formwork and shoring in civil engineering and

structural works Practical sessions:

- Formwork and shoring for a standard building floor: props, beams, formwork panels
- Formwork and shoring for a standard engineering structure: shoring towers, beams, formwork panels

Key learning points

- Vocabulary and technology of formwork and shoring
- Load distribution across structural elements: surface, linear and point loads
- Use of technical documentation for formwork and shoring equipment

Bibliography

- *Shoring of building floors*, OPPBTP
- Eurocode 1, in particular NF EN 1991-1-6: Loads during construction
- NF EN 13670: Execution of concrete structures (including Annex C)
- NF DTU 21: Building works – Construction of concrete structures
- Booklet 65: Construction of civil engineering works in reinforced or prestressed concrete
- AFGC Recommendations Manual

Keywords: Formwork, shoring, construction, load transfer, temporary structures

R 4-18 – Organisation 7: Construction Methods for Public Works

Schedule
Semester.....4
Period .....Jan. – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....6 hours
Practical sessions.....6 hours
Total.....**12**

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C4 – Managing a construction organisation

Prerequisites

- Drawing resource: Drawing 1 (R1-13)
- Technology Resource 2: Roads, Drainage and Earthworks (R1-14)
- Technology Resource 4: Engineering Structures – Civil Engineering (R2-14)

Objectives

- To understand the roles of an engineer and/or technician working in the Methods department of major public works groups in France.
- To provide students with practical experience of the methods used in preparing a civil engineering worksite (a standard engineering structure such as an overpass or underpass).

Syllabus

- **Lectures**:
  - Overview of the main construction groups in France
  - Presentation of the VINCI group (^{1st}group)
  - Presentation of the BOUYGUES Group (^{2nd}group)
  - Presentation of the EIFFAGE Group (^{3rd}group)
  - Overview of the METHODS department at BOUYGUES TRAVAUX PUBLICS
  - Overview of the main responsibilities of a METHODS department
  - Some examples of documents produced by the METHODS department (3D representation of a structure, phasing, operating procedures, site layout plan, provisional works schedule, plan for a specific formwork system such as a mobile formwork unit, or a layout plan for constructing a wall)
- **Tutorials**:

- Study of an engineering structure (P.R.A.D.-type viaduct for the tramway to cross the [illegible] road, including:
  - Study of the phasing of an abutment (3D representation, phasing and preliminary quantity surveys)
  - Study of the construction phasing for a pier (3D representation, construction phasing and preliminary quantity surveys)
  - Phasing study for the deck (3D rendering, phasing and preliminary quantity surveys)
  - GANTT chart-based work planning
  - Study of the layout of PERI formwork for the construction of the 8 piers
  - Study of the formwork required for the construction of the cross-braces
  - Study of the lifting equipment for the precast beams (mobile wheeled crane) and site layout plan

Key lessons learnt

- Technical vocabulary in the field of civil engineering structures
- Technical vocabulary relating to construction methods (phasing, kinematics, operating procedures, scheduling, site layout plan, etc.)
- Knowledge of site preparation for civil engineering works such as engineering structures or civil engineering

Bibliography

- CIMBETON Technical Collection: T41 Concrete and Engineering Structures, Volume 1: Common Concrete Bridges

Keywords:

- **Engineering Structures**: abutment, pier, deck, crossbeam, pier wall, front wall, return wall, riverbank protection wall, transition slab, cantilever, fair-faced concrete, pile, footing, joist, girder, stiffener, shaft, boss, steel framework, prestressed beams, permanent formwork, floor slabs, cornice, carriageway joint, retaining structure, shoring, formwork, reinforcement, concreting, waterproofing and asphalt surfacing
- **Methods**: phasing, preliminary quantity surveys, main phase, execution sub-phase, sequence of operations, operating procedures, scheduling, formwork layout, site set-up plan

R 4-19 - Surveying 2: Digital Surveys and Modelling of Structures

Timetable	
Semester	4
Period	Jan. – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	4h30
Tutorial	4h30
Total hours	**9**

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

R 1-11: Surveying 1: General Principles – Levelling and Setting Out

Objectives

- Understand the fundamental principles of 3D digitisation: laser scanning and photogrammetry
- Understand the steps involved in creating a point cloud
- Be able to analyse the accuracy of a point cloud
- To understand the deliverables of these technologies: orthoimages, point clouds, 3D meshes, etc.
- Discover the areas of application in civil engineering, public works and finishing works
- Explore 3D modelling using point clouds: REVIT, etc.

Programme

- Laser scanning: principles and fundamentals
- Photogrammetry: principles and fundamentals
- 3D deliverables: orthoimage, point cloud and 3D mesh
- Data checking and validation
- Point cloud modelling
- Overview of typical ISABTP application areas

Key learning points

- Ability to analyse the technology used to generate the point cloud
- Be able to verify the point cloud
- Be able to understand and control point cloud modelling

Bibliography

- 3D Scanning of Built Heritage, published by Le Moniteur, H. Macher and C. Bagieu

Keywords: Point cloud, 3D modelling, 3D mesh, data quality assessment

R 4-20 – Fire safety – Accessibility for people with reduced mobility

Timetable
Semester.....4
Period .....Jan. – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....6 hours
Practical sessions.....6 hours
Total.....**12**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

General knowledge of building technology and regulations

Objectives

- To master the regulations relating to fire safety in buildings
- To understand the requirements regarding accessibility for people with reduced mobility
- Be able to design projects that comply with safety and accessibility standards

Syllabus

- Fire safety regulations: Building Code, decrees and regulations
- Classification of buildings: public access buildings, residential buildings, high-rise residential buildings
- Fire behaviour of materials, fire resistance of structures
- Fire compartmentation, smoke extraction, emergency exits
- Accessibility for people with reduced mobility: regulations and standards
- Minimum dimensions, access routes, suitable equipment

Key learning points

- Identifying the regulations applicable to a project
- Design circulation routes and emergency exits in accordance with regulations
- Determining the dimensions of fire safety systems
- Incorporate accessibility requirements for people with reduced mobility from the design stage

Bibliography

- *Building and Housing Code*, Articles R. 121-1 to R. 143-46
- *Fire Safety in Public Buildings*, Jean-Paul Koscielny, Le Moniteur, 2020
- *Accessibility and Disability*, Patrick Cros, Le Moniteur, 2019

Keywords: Fire safety, public access buildings, accessibility, people with reduced mobility, regulations

R 4-21 – Site visits and conferences 4

Timetable	
Term	4
Period	Jan. – June
Face-to-face in person	

Duration	
Lecture	3 hours
Tutorial	5½ hours
Total	**8h30**

Assessment
Assessed as SAÉ

Prerequisites

None

Objectives

The site visits and lectures organised during the first three years at ISA BTP serve several educational purposes:

- to explore the diversity of the construction industry:
  - structures and systems: buildings, engineering structures, infrastructure, road and rail networks, roads and utilities, civil engineering works, marine structures, equipment, installations… ,
  - key players: client, project manager, engineering consultancy, contractors, subcontractors, health and safety coordinator, geotechnical engineer, technical inspector, laboratory technician…
  - professions: labourers, semi-skilled and skilled workers, managers, project managers, site managers, site supervisors, engineers, business owners, self-employed contractors, suppliers, technical sales representatives…
  - materials: 'conventional', innovative,
  - construction methods and working procedures,
- developing one's understanding of the construction industry: projects and sites ranging from routine to exceptional, local and national projects, technical terminology,
- linking this to the curriculum: Resources and SAÉ,
- developing curiosity and an open mind,
- encouraging interest in SAÉ work placements and facilitating the choice of the ISA4 and 5 pathways

Key learning outcomes

- develop listening and observation skills
- write a report on a site visit or take notes during lectures
- apply these discoveries and insights in the SAÉ

Keywords: Discovery, technologies, diversity, organisations, responsibilities

SAÉ 4-1 – Cross-border project: building / secondary trades

Timetable
Semester.....4
Period .....Jan. – June
Face-to-face in person

Assessment
Defences and Portfolio

Duration	1 week
Supervised hours	22 hours
Self-study	6 hours
Targeted skill(s)	
C1 – Analysing a construction project within its context	
C2 - Specify technical solutions for sustainable and more durable construction	
C4 - Manage a construction organisation	

Prerequisites

- To have successfully completed the basics of structural design and dimensioning, as well as the fundamental concepts of construction and the BIM environment, through the ISA1 and ISA2 modules (semester 3).
- A working knowledge of Spanish as taught in ISA1 and ISA2 (semester 3).

Objectives

These sessions aim to develop students' technical, organisational and intercultural skills through the **collaborative completion of a construction project**. Participants will be required to:

- Design and model a building in 3D within a **BIM environment**.
- Draw up a **plan for the building's structure and technical installations**.
- Produce a **construction schedule** and bill of **quantities**.
- Work as part of an international team and communicate in **foreign languages** (particularly Spanish).
- Develop their **independence**, **creativity** and **project management** skills in an intercultural context.

Programme

A joint project between three partner institutions: **EUPLA (Zaragoza), ISA BTP (Anglet, UPPA) and UPV/EHU (San Sebastián)**. The project is structured around **a series of meetings**, alternating between design workshops, technical and cultural visits, and opportunities for discussion.

Key learning outcomes

- To design and model a building project incorporating structural, technical and environmental aspects.
- To work within a multidisciplinary and international team, drawing on intercultural communication skills.

- Using digital design tools (**BIM**) and understanding the interactions between design, planning and execution.
- Analyse and present a technical project in a clear, structured and well-reasoned manner.

Keywords: cross-border, BIM, 3D modelling, civil engineering, technical architecture, collaborative project, site management, intercultural communication, cross-border cooperation, Spain, France, mobility

SAÉ 4-2 – End-of-Year Project: roads, engineering structures, infrastructure, roads and utilities

Timetable
Semester.....4
Period .....Jan. – June
Face-to-face in person

Assessment
Defences and Portfolio

Duration	2 weeks
Supervised hours	44 hours
Self-study	12 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 – Designing structures and systems
C4 - Managing a construction organisation

Prerequisites

- Drawing resources, in particular R2-19 'Drawing 2: CAD – AutoCAD'
- Organisation resources, in particular R4-16 'Organisation 5: Construction site waste management', R4-17 'Organisation 6: Shoring and Formwork' and R4-18 'Organisation 7: Civil Engineering Construction Methods'
- Technology resources, in particular R1-13 'Technology 2: General Principles of Roads and Utilities – Roads – Earthworks
', R2-14 'Technology 4: Engineering Structures – Civil Engineering' and R5-17 'Technology 6: Introduction to Planning and Urban Development'
- Materials Resources 1 to 4
- RdM Resources 1 to 5
- English resources

Objectives

- Read and analyse contractual documents from the PROject or EXEcution phases: tender documents, drawings, written documents, assumptions notes, etc.
- Produce partial or detailed plans for roads, engineering structures and site developments
- Gain an overall view of the site development
- Understand the mechanical functioning of the structure: in both the permanent and temporary phases
- Describe the works and manage site organisation

Syllabus

- Reading and analysing the documents provided:
  - Defining the characteristics and intended uses of structures
  - Functions and role of the structures within an overall development plan
  - Understanding the specified materials and construction methods
- Drafting of summary sheets (French, English)
- Drawing of supplementary elements or details: CAD using AutoCAD and hand-drawn sketches
- Technical studies of structures:
  - Construction methods: overall layout and details, infrastructure and superstructure, materials
  - Loads on structures, load combinations, limit states
  - Mechanical modelling: connections/supports, transverse/longitudinal analysis, stability, stresses
- Site organisation studies:
  - Preliminary works
  - Resources: material, human
  - Construction waste management
  - Scheduling / planning
  - Phasing / cycles
  - Lifting operations or specific tasks: launch, prefabrication, procurement, etc.

The SAÉ involves several written assignments (to be submitted in French and English), with regular feedback, and concludes with a group oral presentation, part of which is in English. Site visits are usually organised to aid understanding of the project.

Key learning outcomes

- Understanding and compliance with specifications and regulations
- Production of supplementary CAD drawings
- Submission of all required drawings
- Collaborative work

Bibliography

- Construction Manual – AFNOR – Nathan Publishers
- Mémotech – Casteilla Publishers

Keywords: Tender documents, contract lots, technical specifications, project briefs, development, construction methods, working procedures, CAD, structural actions, phasing, collaborative work

SAÉ 4-3 – Practical placement abroad

Timetable
Semester.....4
Period .....Jan. – June
Face-to-face in person

Assessment
Video clip

Duration	9 weeks

Targeted skills
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Objectives

This work placement is to be carried out in Spain or a Spanish-speaking country with two objectives:

- to discover Spanish culture and improve your language skills;
- to gain a better understanding of the construction industry:
  - To learn about the technical and interpersonal aspects of a team leader's (or site manager's) role,
  - Take part in supervising and managing workers, and dealing with communication issues,
  - Gain an insight into the company and its organisation,
  - An introduction to technology, techniques and work organisation: applying the knowledge acquired at school on site as a skilled worker, in particular: reading plans, quantity surveys, setting out and checks...

Work required

After completing the necessary steps to find a host company and confirming that the placement meets the objectives with the placement coordinator, students will be integrated into production teams and will be required to take part in practical on-site activities as part of an **8-week placement as a skilled labourer or foreman** within a construction company, across all types of building sites and trades, **in Spain or a Spanish-speaking country**.

The assessment of the placement takes into account:

- the intern's conduct and the achievement of the set objectives, as assessed in particular by the company manager and by the supervising tutor who monitors the intern,
- the video in Spanish

The video in Spanish about the work placement

The video, lasting 3 to 5 minutes, must include both filmed footage and spoken segments. The language used must be exclusively Spanish. This video will include:

- A brief presentation of the company and its activities
- A presentation of the activities carried out and the skills acquired during the work placement

- A detailed technical section highlighting, as far as possible, consideration of safety and environmental issues. This section must go beyond a simple description and must include an analysis (comparison of systems, multi-criteria analysis (cost, time, physical strain, safety, environment, etc.) . . .)
- A conclusion

The format is open but must allow for an assessment of the technical quality of the work and the personal contribution.

Self-assessment

The placement will also provide an opportunity for the engineering student to self-assess.
The ISABTP is currently developing a tool to facilitate self-assessment. Instructions will be provided during the academic year depending on its roll-out.

Third year

•Aquitaine Higher Institute

SCHOOL D NGEN EURS

ISAConstruction

FORMAT or lWGČulEUR

Semester 5

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
R 5-2	Management 4: Financial situation – Financing – Investments	24.28%
R 5-3	English 5	20.81%
R 5-4	Spanish 5	20.81%
R 5-14	Soils 4: Laboratory Tests	18.5%
R 5-16	Organisation 8: Construction Economics – Cost Estimation for a Simple Structure	15.61%
SAÉ for competence C1		**%**
SAÉ 5-1	Construction design office: calculation notes, operational deliverables, construction drawings	100%

Competency C2 – Specifying technical solutions for sustainable and more durable construction

Resources for Competency C2		%
R 5-5	Mathematics 5 – Tools	20.79 %
R 5-6	Thermodynamics 2: Phase Changes	12.87%
R 5–7	Thermodynamics 2: heat balances and heat exchangers	12.87%
R 5-9	RdM 7: Modelling and optimisation of structures	13.86%
R 5-10	Reinforced Concrete 2: Simple Bending – Deflections – T-beams – Durability – Anchors – Digital Tools	19.8 %
R 5-12	Timber 2: Review of general principles and bracing – MOB – Combined loads – Joints	13.86%
R 5-15	Health and Safety 4: Integration of safety and site preparation	5.94%
SAÉ for competence C2		**%**
SAÉ 5-1	Construction design office: calculation notes, operational deliverables, construction drawings	100%

Competency C3 – Dimensioning structures and systems

Resources for Competency C3		%
R 5-5	Mathematics 5 – Tools	9.83%
R 5-6	Thermodynamics 2: phase change	6.08%
R 5-7	Thermodynamics 2: heat balances and heat exchangers	6.08%
R 5-8	RdM 6: Introduction to Continuum Mechanics	19.66%
R 5-9	RdM 7: Modelling and Optimisation of Structures	6.55
R 5-10	Reinforced Concrete 2: Simple bending – Deflections – T-beams – Durability – Anchors – Numerical tools	9.36%
R 5-11	Structural analysis – Modelling in accordance with the Eurocodes	12.17 %
R 5-12	Timber 2: General overview and bracing – MOB – Combined loads – Joints	6.55%
R 5-13	Soils 3: Soil Mechanics 2	18.72%
R 5-14	Soils 4: Laboratory Tests	4.99%
SAÉ for competence C3		**%**
SAÉ 5-1	Detailed design consultancy: calculation notes, operational deliverables, detailed drawings	100%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
R 5-2	Management 4: Financial situation – Funding – Investments	26.42 %
R 5-3	English 5	22.64%
R 5-4	Spanish 5	22.64%
R 5-15	Health and Safety 4: Integrating safety and site preparation	11.32%
R 5-16	Organisation 8: Construction Economics – Costing a simple structure	16.98%
SAÉ for competence C4		**%**
SAÉ 5-1	Construction design office: calculation notes, operational deliverables, construction drawings	100%

R 5-1 – Introduction to research

Timetable	
Semester	5
Period	Sept. – Dec.
Face-to-face teaching	

Duration	
CM	4h30
Tutorial	1h30
Total hours	**6**

Assessment
Assessed as SAÉ

Prerequisites

No prerequisites other than knowledge of mathematics, physics, mechanics and materials acquired during the first two years

Objectives

The aim is to familiarise engineering students with how a research team operates, whether in the public or private sector. The introductory research module will enable students to gain a better understanding of research in the broadest sense, whether they wish to be directly involved in it or to draw on R&D in their future careers.

More specifically, the module will enable them to:

- To learn about the various careers in research
- To understand the various methods of funding a research project, whether public or private (calls for proposals, grants, CIR, CII, JEI, JEU, etc.)
- To understand how to set up a research project (state of the art, objectives, methodology, budget, deliverables)
- To familiarise themselves with the different levels of technological maturity and the tools available to support commercialisation
- To familiarise themselves with the research environment at ISA BTP, and in particular to learn about the PhD theses being undertaken there

Programme

- Lecture providing an overview of research stakeholders, their roles, research funding, tools to support commercialisation, and the research environment at ISA BTP
- Introduction to innovative bio-inspiration
- Tour of the school's experimental laboratories
- An inspiring walk in Montaury Park
- My mentor's PhD thesis at ISA BTP (see description below)

My mentor's PhD thesis at ISA BTP: a dual challenge for ISA BTP engineering students and PhD students!

Inspired by a similar event organised between PhD students and sixth-formers since 2015 at UPPA, the aim of this initiative is twofold:

- To raise engineering students' awareness of research work, its structure and the within the school and oral presentation of a topic within a limited time frame
- To enable PhD students to explain their thesis topic in layman's terms, improve their teaching skills and engage with students from different backgrounds

Working in pairs (or groups of three), engineering students are paired with a PhD student from the school who is based on the Basque Coast. During the semester, the students contact their mentor by email and together arrange a one-hour meeting to discuss their mentor's thesis and discover their working environment. The students then draw up a short profile, which they must present orally in exactly four minutes to a large audience. As some PhD students are not French-speaking, the interviews may take place in English, but the presentation must be in French. The oral presentation serves as the assessment for the module, and the relevant year group, the PhD students, the thesis supervisors and the entire teaching team at ISA BTP are invited to attend. In exactly 4 minutes, the engineering students must summarise the essence of their mentor's PhD thesis (topic, context, objectives, implications, etc.). 240 seconds – not a second more!

Critical learning

No critical learning outcomes for this module

Bibliography

- Documents provided by the PhD students
- Presentation sheets on ISA BTP's research laboratories
- Online resources on research funding (ANR, CIR, etc.)

Keywords: Research, R&D, PhD, funding, commercialisation, research careers, science communication

R 5-2 - Management 4: Financial situation - Funding - Investments

Calendar
Semester.....5
Period.....Sept. – Dec.
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM.....10.30 am
Tutorial.....10.30
Total.....9.00 pm

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

Resource R 3-2 – Management 2: Management and accounting techniques

Objectives

- To understand the company's financing issues and analyse its financial position
- To understand how a company's results are generated and its profitability
- Apply the financial calculation methods required for decision-making
- Calculate and simulate a suitable financing method, taking into account profitability and liquidity constraints

Syllabus

- Financial analysis and management: analysis of the balance sheet and profit and loss account, the company's financial structure, cash flow, return on investment and profitability
- Investment decisions: formulating investment problems and calculating various decision-support indicators
- Financial calculations and financing: calculating various loan repayment terms; calculating various financial indicators relating to a financing transaction

Key learning outcomes

- Analysing a balance sheet and an income statement
- Calculating key financial ratios (liquidity, profitability, debt)
- Compare different financing arrangements (loans, leasing, etc.)
- Draw up a provisional financing plan

Bibliography

- *General Accounting*, Bernadette Collain, Dunod, 13 October 2021
- *Financial Analysis*, Béatrice and Francis Grandguillot, Editions Gualino, 12 August 2025

Keywords: financial management, investment, financing, balance sheet, financial ratios, cash flow

R 5-3 - English 5

Timetable
Semester.....5
Period.....Sept. – Dec.
Face-to-face in person

Assessment
Continuous assessment

Duration
Tutorial .....18 hours
Total.....18 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

ISA2-S4 English Level B1

Syllabus

Tutorials:

- **TOEIC Preparation**
- Listening: Practice with Parts 1–4 in business and technology contexts
- Reading: Parts 5–7, focusing on connectors and vocabulary in context
- Mini practice tests under timed conditions
- Development of reading skills (skimming, scanning, inference, recognising connectors, time management).
- Review of key grammar points: verb tenses, phrasal verbs, gerunds and infinitive forms
- Vocabulary expansion: AWL lists 1–4 and key areas (Food, Travel, Hotels).
- Completion of mock TOEIC exams to track progress and adjust learning strategies.

Key learning outcomes

By the end of this course, you will be able to:

- Achieve a TOEIC score of at least **700**.
- Demonstrate mastery of the grammar points tested in the TOEIC:
- Understand and respond to listening passages relating to food, travel and hotels.
- Read and analyse business and professional texts under time constraints.
- Use and recognise vocabulary from the Academic Word List (AWL) 1–4 in reading and listening contexts.

Bibliography

- The Complete TOEIC® – 3rd edition
- The Official TOEIC® Bible

Keywords: TOEIC, grammar, business English

R 5-4 – Spanish 5

Timetable
Term 5
Term .....Sept. – Dec.
Face-to-face teaching

Assessment
Continuous assessment

Duration
Tutorial .....18 hours
Total.....18 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

Spanish S4

Objectives

In Semester 5, students must acquire the skills necessary to aim for level B2 in international certification tests (such as DELE or SIELE).

Level B2 certifies that the learner can understand the main points of concrete or abstract topics in a complex text, including a technical discussion within their field of specialisation. They can communicate with such spontaneity and fluency that interaction with a native speaker is natural and effortless for both parties. They can express themselves clearly and in detail on a wide range of topics, put forward a reasoned opinion, and outline the advantages and disadvantages of different options.

Programme

- Understanding and analysing press articles, technical documents or debates on social, economic, environmental and professional issues
- Express and defend a personal opinion in a clear and structured manner
- Develop oral and written arguments using examples, nuances and complex connecting words
- Describe and analyse social and professional phenomena in the Spanish-speaking world (urban planning, ecology, innovation, society, culture, current affairs)
- Participate actively in a discussion by expressing and qualifying one's disagreement
- Write structured texts (short reports, summaries, detailed professional emails)

Key learning outcomes

- Master a rich and nuanced vocabulary in the professional, societal and environmental fields
- Use complex verb tenses with ease (present and imperfect subjunctive, conditional, reported speech)
- Develop comprehension strategies for long and demanding texts

- Structure a text using a variety of logical connectors (cause, consequence, concession, hypothesis)
- Adapting language register (formal/informal) to suit the situation
- Understand cultural differences and know how to respond appropriately

Bibliography

- https://eduscol.education.fr/1971/cadre-europeen-commun-de-reference-pour-les-langues-cecrl
- https://leblogdespagnol.com/
- All resources dedicated to learning Spanish vocabulary, grammar or verb conjugation suitable for a B2 level

Keywords: CEFR, B2, DELE, SIELE, argumentation, opinion, society, culture, environment, professional, current affairs

R 5-5 – Mathematics 5 – Tools

Timetable
Semester.....5
Period.....Sept. – Dec.
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....12 hours
Tutorials.....6 hours
Tutorial.....1.30 pm

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C3 - Designing structures and systems

Mathematics V

Prerequisites

- Linear algebra tools covered in the first year
- Basic properties of periodic functions
- Complex number calculus
- Integral calculus in one variable
- Concepts of numerical series
- Programming in Python

Objectives

- To be able to perform and interpret a Fourier analysis on a 1D or 2D periodic signal
- Be able to perform and use Laplace transforms and inverse Laplace transforms (particularly for solving differential equations)
- To be familiar with classical methods for solving linear systems (Gaussian pivot, matrix decompositions)
- To be able to implement and use tools for the numerical solution of linear systems

Syllabus

- Fourier series, Laplace transform:
  - Fourier series: calculation of Fourier coefficients, harmonic decomposition, application to the calculation of sums
  - Discrete Fourier transform: calculation, interpretation and signal filtering

  - Laplace transform: calculation of the Laplace transform, principle of the inverse transform, applications to solving equations

- Algorithmic methods for solving linear systems

Key learning outcomes

- Calculate the Fourier coefficients of a periodic function
- Interpret the frequency spectrum of a signal
- Calculating the Laplace transform of a function
- Solve a differential equation using the Laplace transform
- Apply Gauss's pivot method to solve a linear system
- Implement a method for solving a linear system in Python

Bibliography

- Courses for BTS Technology programmes
- SCHAUM's series, McGraw-Hill
- *Advanced Mathematics Course*
- *Algebra Course*, Xavier GOURDON, Ellipses
- Undergraduate science textbooks
- http://mabouzai.perso.univ-pau.fr/

Keywords: Harmonics, frequencies, Fourier, Laplace, Gaussian pivot, linear systems

Refresher Course

This mathematics refresher module takes place over a week of classes before the start of the academic year. It is intended for students entering their third year who hold a Bachelor's degree in Civil Engineering.

Prerequisites

A thorough understanding of the mathematical tools and methods covered in the BTS or IUT programme

Objectives

To cover or revise the main mathematical tools studied in the first and second years, which are necessary for the other science subjects in the forthcoming programme

Syllabus

- Differential equations: linear and non-linear differential equations, small-scale differential systems
- Matrix calculus: matrix multiplication, determinants, diagonalisation
- Functions of several variables: differential equations, partial derivatives, graphical representations, examples of PDEs
- Integral calculus: finding antiderivatives, calculating areas, multiple integrals, line integrals. Applications to the construction industry
- Programming: basics of computer programming

Key learning outcomes

- Solving first- and second-order differential equations
- Calculating the determinant and diagonalising a matrix
- Calculating the partial derivatives of a function of several variables
- Calculate multiple integrals
- Programming basic algorithms in Python

Bibliography

- Undergraduate courses in advanced mathematics or mathematics for physicists
- http://mabouzai.perso.univ-pau.fr/

Keywords: Refresher course, differential equations, matrix calculus, integrals, programming

R 5-6 – Thermodynamics 2: Phase Change

Timetable
Term 5
Period .....Sept. – Dec.
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial 10.30
Total .....7.30 pm

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C3 - Designing structures and systems

Prerequisites

Thermodynamics 1

Objectives

- Understand the phase-change process of a pure substance
- Be able to represent this in an appropriate thermodynamic diagram
- Be able to calculate power and efficiency for thermal engines

Syllabus

- Latent heat and phase change in pure substances
- Properties of pure substances
- First-order phase-change process
- Property diagrams for the phase-change process
- Applications to thermal machinery: gas power cycle

Key learning points

- Identify and characterise the different states of a pure substance
- Calculate the latent heat associated with a phase change
- Use thermodynamic diagrams
- Analyse a thermodynamic cycle and calculate its efficiency
- Design a simple thermal machine (heat pump, refrigerator)

Bibliography

There are a great many books on the subject, readily available in all university libraries. Amongst these works, the following are particularly noteworthy:

- *Thermodynamics*, by M. Bertin, J.P. Faroux and J. Renault, Dunod Université, 1976
- *Thermodynamics – Fundamentals and Applications*, by J.-N. Foussard and E. Julien, Dunod, 2005

Keywords: Phase change, latent heat, thermodynamic diagrams, heat engines, cycles, efficiency

R 5-7 - Thermal Engineering 2: Heat Balances and Heat Exchangers

Timetable
Semester.....5
Period.....Sept. – Dec.
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial.....10.30
Total .....7.30 pm

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C3 - Designing structures and systems

Prerequisites

Thermal 1, Mathematics: solving differential equations

Objectives

- Be able to formulate hypotheses
- Carry out a heat balance
- To analyse temperature curves
- Propose solutions for improvement

Syllabus

Study of heat transfer in various scenarios:

- Fin model
- Internal heat generation
- Heat exchangers
- Concepts of variable flow conditions and stored heat
- Inertia, phase shift
- Selection of assumptions and boundary conditions for the problem
- Study of temperature trends and analysis

Key learning points

- Mastering methods for solving heat transfer problems under transient conditions
- Analysing the influence of thermal inertia and phase shift on system behaviour
- Formulate and solve a heat balance by making appropriate assumptions
- To size and characterise heat exchangers
- Interpret temperature curves and propose optimisations

Bibliography

- *Heat Transfer: Lectures and Basic Data*, Taine J., Petit J.-P., Dunod, 1995
- *Heat Transfer*, Bouvenot A., Masson, 1980
- *Heat Transfer*, Holman J.P., 7th edition, McGraw-Hill, 1990
- *Heat Transfer*: *A Case-Study Approach*, Triboix A., Bouvenot J.B., Eyrolles, 2015
- *Heat Transfer*, Ouin J., Casteilla, 1998

Keywords: Fin, variable flow regime, inertia, phase shift, heat balance

R 5-8 - RdM 6: Introduction to Continuum Mechanics

Timetable	
Semester	5
Period	Sept. – Dec.
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	4.30 pm
Tutorial	3.00 pm
Total	**31h30**

Targeted skill(s)
C3 – Designing structures and systems

Prerequisites

- Mathematics (vector fields and operators, double integrals, differential and partial differential equations, linear applications, associated matrices, matrix calculus, eigenvalues and eigenvectors, determinants)
- Strength of Materials (isostatic systems)
- First-year mechanics practicals (delta triangle lab)

Learning Outcomes

By the end of this module, you will be able to:

- Have a general understanding of elastic mechanics, of which Strength of Materials is a special case
- Define and work with the quantities used to characterise the mechanical state of a continuous medium (displacement, deformation, stresses)
- Characterise the stress and strain state of a linear elastic solid with simple geometry
- Plot and use Mohr's circles to characterise a plane stress or strain state
- Solve an elastostatic problem involving small perturbations of simple geometry
- Apply criteria at the elastic limit to design a structure

Syllabus

- Introduction
  - a What is the continuous medium?
  - b Why study the continuous medium?
- Kinematics and the concept of deformation
  - a Kinematics of continuous media
  - b The concept of deformation

- Internal forces and the concept of stress
  - a Schematisation of external forces and the fundamental principle of statics
  - b Schematisation of internal forces and the concept of stress
- Mohr's circle
  - a Illustration
  - b Practical construction of the circle in 2D
  - c Three-dimensional case
- Linear elasticity
  - a Laws of behaviour
  - b Summary of equations
  - c Solving an elastostatic problem using small perturbations
- Elastic design criteria
  - a Rankine criterion
  - b Tresca criterion
  - c Von Mises criterion

Key learning points

- Calculating deformations from a vector field of displacements
- Decomposing stresses into normal and shear stresses
- Determine the principal stresses, maximum shear stresses and their respective directions in 2D using a Mohr's circle
- Solve an elastostatic problem in Cartesian, cylindrical or spherical coordinates
- Design for stress or displacement
- Apply the Rankine, Tresca and von Mises criteria

Bibliography

- Online course on E-learn
- *Mechanics of Continuous Media*, J. Coirier and C. Nadot-Martin, Dunod
- *Continuum Mechanics*, J. Salençon, Éditions de l'École Polytechnique

Keywords: Continuum mechanics, deformation, stresses, Mohr's circle, elasticity, design criteria

R 5-9 - RdM 7: Modelling and optimisation of structures

Timetable
Semester.....5
Period.....Sept. – Dec.
Face-to-face teaching

Assessment
Continuous assessment

Duration
Lecture.....3 hours
Tutorial.....9 hours
Tutorial.....9h
Total.....21h

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C3 – Designing structures and systems

Prerequisites

- Structural Mechanics: RdM 1 to RdM 6
- Fundamentals of steel and reinforced concrete structural analysis
- RDM software
- Principles of bracing

Objectives

- Introduction to optimisation through dimensioning
- Introduction to shape-based optimisation
- Introduction to topological optimisation

Syllabus

- Optimisation of truss beams
- Optimisation of beams with variable spacing
- Application to the structural optimisation of a simple building: comparison of a frame column and a St Andrew's cross

Key learning points

- Impact of optimisation choices on modelling
- Modelling a beam structure: concepts of internal relaxation and fixed supports

Bibliography

- *Structural Optimisation*, Grégoire Allaire, Éditions de l'École Polytechnique
- *Finite Element Analysis of Structures*, Robert D. Cook, Wiley
- *Structural Dynamics*, Anil K. Chopra, Pearson
- Documentation for software used in practical sessions

Keywords: Numerical modelling, finite elements, structural optimisation, modal analysis, advanced computing

R 5-10 - Reinforced Concrete 2: Simple bending – Deflections – T-beams – Durability – Anchors – Digital tools

Timetable
Semester.....5
Period.....Sept. – Dec.
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....12 hours
Tutorials.....12 hours
Tutorial.....6
Total.....**30**

Target skill(s)
C2 – Specify technical solutions for sustainable and more durable construction
C3 - Designing structures and systems

Prerequisites

- Resources (Construction) materials: Materials 1 (R1-16) to Materials 6 (R3-17)
- Organisational Resources: Organisation 1 (R2-11), Organisation 2 (R2-12), Organisation 3 (R3-14)

Syllabus

Lectures:

- Overview, legislative framework
- Types of construction waste
- On-site management: reduction, sorting, transport, recovery, storage
- Specific measures: new builds and refurbishments

Tutorials:

- Identifying waste from a building project
- Organisation of waste management: sorting, containers, disposal methods, SOGED

Key learning points

- Classifying and quantifying (ratios) waste
- Drafting a SOGED

Bibliography

- Guide to *Better Managing Construction Site Waste*, FFB

Keywords: Circular economy, pollution, organisation, waste, traceability

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R 5-11 – Structural Analysis – Modelling to Eurocodes

Timetable	
Semester	5
Period	Sept. – Dec.
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	6 hours
Practical	7.5 hours
Tutorial	6.00

Targeted skill(s)
C3 – Designing structures and systems

Prerequisites

- Organisation of work in semesters 1 to 4
- Technology in Semesters 1 to 4
- Mathematics: Double integrals
- Physics: dynamics of incompressible fluids
- Mechanics: Torque

Objectives

- To model a real-world structure
- Apply the regulations to determine the loads acting on a structure (Eurocode 0 and Eurocode 1) in order to determine the design load combinations
- Using structural analysis software:
  - Draw a modelled structure
  - Apply the various actions acting on the structure
  - Determine the combinations

Programme

- Eurocode 0
- Eurocode 1
- Application examples
- Identification and representation of the load-bearing structure in two or three dimensions
- Definition of connections and permanent, variable and accidental loads
- Analysis of the compatibility between construction methods and load paths
- Practical application of load transfer – Case study
- Use of load transfer software 205

Key learning outcomes

- Identifying permanent, variable and accidental actions on a structure
- Apply Eurocode 0 to determine combinations of actions for ULS and SLS
- Calculate wind actions in accordance with Eurocode 1
- Calculate snow loads in accordance with Eurocode 1
- Perform a load transfer analysis on a simple structure
- Use structural analysis software to model loads

Bibliography

- *NV65 (amended 99) and N84 (amended 2000) standards*, Eyrolles
- *Eurocode 0 (NF EN 1990)*, AFNOR
- *Wind and snow loads on structures, Eurocode 1 (NF EN 1991)*, AFNOR
- Eurocode Guide: *Wind Loads on Buildings*, Calculation of Wind Pressures and Forces on Building Envelopes, based on Eurocode 1, by M. CHENAF, E. BELLOIR, C. FLORENCE, published by CSTB, 2010
- Eurocode Guide: *Snow* Loads *on Buildings*, Calculation of Snow Loads on Roofs in accordance with Eurocode 1, by M. CHENAF, E. BELLOIR, C. FLORENCE, published by CSTB, 2010
- Notes: Eurocodes available on i-reef via the intranet

Keywords: Eurocode 0, Eurocode 1, actions, wind, snow, combinations, load distribution, modelling

R 5-12 - Timber 2: Overview and bracing - MOB - Combined loads - Joints

Timetable	
Semester	5
Term	Sept. – Dec.
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	9 hours
Tutorial	12 noon
Total	**9 pm**

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C3 - Designing structures and systems

Prerequisites

- RdM resources: RdM 2 (R2-9), RdM 3 (R3-8)
- R3-10: Column-beam structures – Load transfer – Bracing – Stability
- R4-14: Timber 1: General principles – Tension – Compression – Simple bending

Syllabus

- Lectures:
  - Roofs and roof structures (traditional and prefabricated)
  - design of trusses and portal frames
  - design of joints
  - Timber frames: timber-framed houses (MOB), floors, decking

- Tutorials:
  Practical application of Eurocode 5 (EC5)
  - Analysis of members subjected to combined bending: purlins, columns
  - Analysis of a joint
  - Analysis of a beam with a variable cross-section

Key learning points

- designing common structural members in accordance with EC5
- optimising cross-sections according to loads

Bibliography

- NF EN 1995-1 – *Design and calculation of timber structures* + National Annex
- *Timber Construction: The Eurocode Explained Through Examples*, Eyrolles

Keywords: Timber, timber frames, loads, Eurocode, joints, optimisation

R 5-13 – Soils 3: Soil Mechanics 2

Timetable	
Semester	5
Period	Sept. – Dec.
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
Lectures	15 hours
Tutorial	9 hours
Tutorial	6 am
Total	30

Targeted skill(s)
C3 – Designing structures and systems

Prerequisites

- Geology
- Continuum mechanics
- Fluid mechanics
- Soil Mechanics 1

Objectives

- To understand the behaviour of water in soils
- Apply the principles of soil hydraulics to analyse the phenomena of infiltration, drainage and consolidation
- To assess the stability conditions of natural and man-made slopes, taking into account the effects of water
- Develop the ability to diagnose and design solutions to prevent the risks of landslides and embankment failure

Syllabus

- Hydraulics of saturated soils
  - Pore pressures and hydraulic head
  - Permeability and Darcy's law
  - Measurement of the permeability coefficient (in the laboratory and in situ)
  - Flow in soils: groundwater table, flow lines, flow networks
  - The 'fox effect' and the hydraulic stability of foundations

- Slope stability
  - Types of landslides

- Stability analysis methods
- Influence of hydraulic conditions
- Slope stabilisation techniques
- Introduction to the TALREN software

Key learning points

- Apply the principles of soil hydraulics to predict pressures and flow rates
- Apply limit equilibrium methods to assess the stability of a slope
- Incorporating the effect of water into stability calculations
- Ability to propose technical solutions tailored to specific civil engineering problems

Bibliography

- *Soil Mechanics – Theory and Practice*, V. Robitaille and D. Tremblay, published by Modulo
- *Elements of Soil Mechanics*, F. Schlosser, published by Presses de l'École Nationale des Ponts et Chaussées
- *Exercises in Soil Mechanics*, F. Schlosser, published by Presses de l'École Nationale des Ponts et Chaussées
- *Practical Problems in Soil Mechanics and Foundations*, G. Sanglerat, G. Olivari, B. Cambou, eds. Dunod
- *Stabilisation of Landslides*, Technical Guide of the Central Laboratory for Bridges and Roads
- *Foundations and Earthworks*, G. Philipponnat, B. Hubert, A. Isnard, ed. Eyrolles

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R 5-14 - Soils 4: Laboratory Tests

Timetable
Semester.....5
Period.....Sept. – Dec.
Face-to-face teaching

Assessment
Continuous assessment

Duration
Tutorial .....16 hours
Total.....16 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

- R3-12 – Introduction to geology and hydrogeology
- R4-15 - Soil Mechanics 1
- R5-13 - Soil Mechanics 2

Objectives

- To familiarise students with the conduct of laboratory tests designed to identify soils in accordance with the GTR and LCPC classification standards
- Carry out mechanical tests to determine a comprehensive geotechnical model of a soil based on samples taken in situ

Programme

Carrying out and analysing the following tests:

- Sieve analysis
- Determination of Atterberg limits
- Methylene blue value
- Sand equivalent test
- Oedometer test for soil compressibility
- Compaction test – Standard Proctor
- Casagrande 211 straight-line shear test

Key learnings

- Classifying soil according to standards
- Determine the soil strength parameters crucial for stability
- Determining compressibility parameters and predicting settlement
- Determine the moisture content and optimal density using the Standard Proctor test for quality control of earthworks and compacted earth structures
- Analysing and validating the reliability of laboratory results by identifying experimental errors and verifying consistency with the theoretical behaviour of the soil

Bibliography

Standards:

- NF P94-093
- NF EN ISO 17892-12
- NF P94-068
- NF P94-090-1
- NF P 94-071-1

Keywords: Laboratory testing, soils, geotechnics, characterisation, Proctor, Atterberg, particle size distribution

R 5-15 - Health and Safety 4: Integration of safety and site preparation

Timetable	
Semester	5
Period	Sept. – Dec.
Face-to-face teaching	

Duration	
CM	1h30
Tutorial	7h30
Total hours	**9**

Assessment
Continuous assessment

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

Health and Safety Resources 1 (R1-10), 2 (R2-10), 3 (R3-13).

Objectives

Students will be able to analyse a work situation and identify preventative solutions by applying the PGP.

Syllabus

Module 1: Earthworks.

Be able to organise earthworks, taking into account the condition of the site and the environment:

- Notifications of proposed works and Notifications of Intention to Commence Works
- Earthworks machinery
- Slope stability
- Trench excavation works

Section 2: Delayed-effect risks in the construction industry.

Being able to identify factors contributing to arduous working conditions:

- Occupational diseases
- Hazardous chemical agents
- Dust
- Noise
- Vibrations

Section 3: Managing joint operations between companies

Understanding the background to co-activity management and the organisational arrangements to be put in place:

- Overview of the Act of 31 December 1993
- Role of the Health and Safety Coordinator
- PPSPS
- Decree of 20 February 1992 and prevention plans

R 5-16 – Organisation 8: Construction Economics – Cost Estimation for Simple Structures

Timetable	
Semester	5
Period	Sept. – Dec.
Face-to-face teaching	

Duration	
CM	4h30
Tutorial	9 hours
Total	**1.30 pm**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 – Managing a construction organisation

Prerequisites

- Technology Resources: R 1-12, R 1-13, R 2-13, R 2-14
- R 1-14: Drawing 1: Sketches – Plans – Sections
- R 2-11: Organisation 1: Quantity surveying and cost estimation
- SAÉ 5-1: Detailed Design Office: calculation notes, operational deliverables, detailed drawings

Objectives

- To analyse costing methods for a simple structure and identify their impact on site organisation
- Define costing methods
- Produce a detailed cost breakdown
- Define the characteristics of a project and the company
- Identify monitoring and management tools
- Identify the legal aspects
- Define the break-even point

Programme

- Reminders / general information: terminology, basic formulas, fundamental concepts
- Project-specific characteristics: itemised cost breakdown, studies and impact on the project (structure, ground conditions, etc.), market, competition, tender documents
- Company-specific characteristics: scheduling, procurement, overheads, depreciation, wages
- Monitoring and management tools: dashboard, cash flow, production records and monitoring (progress tracking), target schedule

- Legal aspects: quotation/invoice, advance payment/amendment, retention
- Organisational aspects: break-even point, relationship between cost estimation and technical choices
- Other methods: pre-established prices (price list and price ranges), provisional estimates (feasibility study)

Key learning points

- Calculation of a net outlay
- Calculating a cost price
- Calculating a selling price
- Using a price schedule

Keywords: Construction economics, cost estimation, break-even point, project management, costing, production cost, price schedule

R 5-17 – Technology 6: Introduction to Planning and Urban Design

Timetable
Semester.....5
Term .....Sept. – Dec.
Face-to-face teaching

Duration
CM .....6 hours
Tutorials.....3 hours
Total.....9 hours

Assessment
Assessed as SAÉ

Prerequisites

No prerequisites

Objectives

- To understand the fundamental principles of sustainable development and urban planning, as well as their role in the transformation of territories.
- To analyse a territory at different scales in order to identify its constraints, its potential and the challenges associated with its development.
- To utilise key urban and spatial planning documents within the context of a development project.
- Gain an understanding of contemporary issues relating to land use efficiency, climate change, biodiversity and urban regeneration.

Programme

- Fundamentals of spatial planning: territorial assessment, governance, consultation and project management.
- Living environment, mobility, urban regeneration, land-use efficiency and the Zero Net Land Take (ZAN) target.
- Environment, climate, water management, biodiversity, energy and territorial resilience.
- Regulatory urban planning: SCOT, PLUi, PADD, OAP, written and graphic regulations, easements and risks.
- Operational tools for spatial planning and urban planning (ZAC, brownfield regeneration, urban projects).
- Case studies applied to territorial analysis and the urban planning assessment of projects.

Key learning outcomes

- Carry out a multi-criteria territorial assessment and identify planning challenges at different scales.
- Analyse a project's alignment with the objectives of sustainable development, urban regeneration and land-use efficiency.
- Identify the town planning regulations applicable to a project and verify its regulatory compliance.
- Take environmental, technical and regulatory constraints into account when designing a development project.

Bibliography

- Guide to Sustainable Development
- Charter for Public Spaces – 'Ilots de Fraicheur'
- 12 Priority Measures from the Roadmap for Decarbonisation of the Urban Planning Sector
- The 'super-islands' model in Barcelona: an example of urban regeneration
- Practical Guide to Limiting Land Sealing
- The 'Hameau des Noés' eco-village
- https://www.cerema.fr/fr/actualites/rehabiliter-friches-opportunites-methodologie
- https://plu.lillemetropole.fr
- https://www.scot-lille-metropole.org/scot-de-lille-metropole/le-scot-en-bref/
- https://plu.lillemetropole.fr/je-consulte-le-plu3

Keywords: Spatial planning, urban planning, territorial development, territorial assessment, consultation, SCOT, PLUi, PADD, OAP, ZAC, urban regeneration, brownfield sites, land-use efficiency, ZAN, mobility, climate resilience, ecological transition.

R 5-18 - Site visits and conferences 5

Timetable
Semester.....5
Period.....Sept. – Dec.
Face-to-face in person

Duration
CM .....9 hours
Tutorials.....6 hours
Total.....**15h**

Assessment
Assessed as part of SAÉ

Prerequisites

None

Objectives

The site visits and lectures organised during the first three years at ISA BTP serve several educational purposes:

- to explore the diversity of the construction industry:
  - structures and systems: buildings, engineering structures, infrastructure, road and rail networks, roads and utilities, civil engineering works, marine structures, equipment, installations… ,
  - key players: client, project manager, engineering consultancy, contractors, subcontractors, health and safety coordinator, geotechnical engineer, technical inspector, laboratory technician…
  - professions: labourers, semi-skilled and skilled workers, managers, project managers, site managers, site supervisors, engineers, business owners, self-employed contractors, suppliers, technical sales representatives…
  - materials: 'conventional', innovative,
  - construction methods and working procedures,
- developing one's understanding of the construction industry: projects and sites ranging from routine to exceptional, local and national projects, technical terminology,
- linking this to the curriculum: Resources and SAÉ,
- developing curiosity and an open mind,
- encouraging interest in SAÉ work placements and facilitating the choice of the ISA4 and 5 pathways

Key learning outcomes

- develop listening and observation skills
- write a report on a site visit or take notes during lectures
- apply these discoveries and insights in the SAÉ

Keywords: Discovery, technologies, diversity, organisations, responsibilities

SAÉ 5-1 – Detailed design office: calculation notes, operational deliverables, detailed drawings

Timetable
Semester.....5
Period.....Sept. – Dec.
Face-to-face teaching

Assessment
Defences and Portfolio

Duration	2 weeks
Supervised hours	36 hours
Self-study	20 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- Knowledge of structural design and structural analysis
- Basics of the design of steel and reinforced concrete elements
- Basics of Eurocodes 0 and 1
- Reading and interpreting structural drawings
- Introduction to modelling and technical drawing software

Objectives

- To analyse the various loads acting on the structure(s) (permanent loads, service loads, weather loads)
- To design and dimension load-bearing and bracing elements, in accordance with current standards, for different types of structure (lightweight structures, reinforced concrete structures)
- To analyse the implications of construction methods on structural design
- Produce construction documents for a design consultancy: design assumptions, drawings, calculation notes and technical deliverables

Syllabus

Study of a car park:

- Analysis of the set of drawings provided (DCE-type drawings): identification of the structural elements to be modelled and dimensioned
- Stability and bracing analysis of the lightweight structure; dimensioning of the main elements using Advance Design, a software package for structural modelling and analysis, as well as simple 2D RDM models and manual calculations

- 'BET Method'-type study: taking into account construction constraints (such as scheduling, to design the reinforced concrete (RC) structure of the car park using prefabricated elements
- Sizing of the main reinforced concrete members, analysis of connections and joints
- Production of working drawings (EXE) (formwork plans, reinforcement plans, workshop and site plans, assembly drawings) and associated calculation notes

Key lessons learnt

- Modelling, designing and dimensioning the structural stability elements of a structure according to the material used
- Preparing construction documents for a structural project (drawings, calculation notes, deliverables)
- Applying technical knowledge to justify design and calculation choices

Bibliography

- Eurocodes 0 and 1: Foundations of structural analysis for the basic principles and requirements of the design
- Eurocodes 2 and 3: Concrete and steel structures

Keywords: Design office, implementation, calculation notes, working drawings, reinforced concrete, steel structure

SAÉ 5-2 – Design Office Engineering Assistant Placement

Timetable
Semester.....5
Period.....Sept. – Dec.
Face-to-face teaching

Assessment
Report and presentation

Duration	8 weeks

Targeted skill(s)

This description is currently being drafted.

A dedicated working group has been set up to define and formalise the details relating to this learning and assessment situation.

The final version of the description is scheduled to be completed by 15 July 2026 at the latest.

Semester 6

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
R 6-1	Management 2: HRM, recruitment and induction of employees	6.42%
R 6-2	Module 5: Construction and Insurance Law	11.01%
R 6-3	English 6	9.17%
R 6-4	Spanish 6	9.17%
R 6-5	Statistical tools: Reliability – Multidimensional data analysis	23.85%
R 6-8	Energy efficiency in buildings	20.18%
R 6-14	Materials 7: Eco-materials and innovative materials	11.01%
R 6-15	Materials 8: Defects	9.17%
SAÉ for competence C1		**%**
SAÉ 6-1	Sustainable construction and environmental impact challenge (or competition)	11.84%
SAÉ 6-2	Collaborative project involving engineering and architecture students: design, models, structure, systems	23.68%
SAÉ 6-3	Engineering assistant placement: design or construction work	64.47%

Competence C2 – Prescribing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
R 6-6	Thermodynamics 3: Humid air	6.93 %
R 6-8	Energy efficiency of buildings	21.78%
R 6-10	Foundations: soil mechanics, structure	9.9%
R 6-11	Reinforced Concrete 3: Continuous beams – Compound bending – Design of standard members - Numerical tools	18.81%
R 6-12	Steel Construction 3: Joints – Digital Tools	14.85%
R 6-13	Surveying 3: Applications in Building and Civil Engineering	5.94%
R 6-14	Materials 7: Eco-materials and innovative materials	11.88%
R 6-15	Materials 8: Defects	9.9%
SAÉ for competence C2		**%**
SAÉ 6-1	Sustainable construction and environmental impact challenge (or competition)	11.84%
SAÉ 6-2	Collaborative project between engineering and architecture students: design, models, structure, systems	23.68%
SAÉ 6-3	Engineering assistant placement: design or construction work	64.47%

Competence C3 – Designing structures and systems

Resources for Competency C3		%
R 6-5	Statistical tools: Reliability – Multidimensional data analysis	20.8 %
R 6-6	Thermodynamics 3: Moist air	5.6%
R 6-7	Fluid Mechanics 2: Kinematics – Potential – Boundary Layer – Similarity – Sound	19.2%
R 6–9	RdM 8: Dynamics of solids – Kinetics	19.2%
R 6-10	Foundations: soil mechanics, structural mechanics	8%
R 6-11	Reinforced Concrete 3: Continuous beams – Compound bending – Design of standard members - Digital tools	15.2%
R 6-12	Metal Construction 3: Joints – Digital tools	12%
SAÉ for competence C3		**%**
SAÉ 6-1	Sustainable Construction and Environmental Impact Challenge (or competition)	11.84%
SAÉ 6-2	Collaborative project between engineering and architecture students: design, models, structure, systems	23.68%
SAÉ 6-3	Engineering assistant placement: design or construction work	64.47

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
R 6-1	Management 2: HRM, recruitment and induction of employees	15.56%
R 6-2	Module 5: Construction and Insurance Law	26.67%
R 6-3	English 6	22.22%
R 6-4	Spanish 6	22.22%
R 6-13	Surveying 3: Applications in building and civil engineering	13.33%
SAÉ for competence C4		**%**
SAÉ 6-1	Sustainable Construction and Environmental Impact Challenge (or competition)	11.84%
SAÉ 6-2	Collaborative project between engineering and architecture students: design, models, structure, systems	23.68%
SAÉ 6-3	Engineering assistant placement: design or construction work	64.47%

R 6-1 – Management 2: HRM, recruitment and induction of employees

Timetable
Semester.....6
Period .....Jan. – May
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....6 hours
Tutorials .....4½ hours
Total **10.5**

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

R 4-1: Management 1: Sociology of work and stakeholder dynamics

Objectives

- To understand the components of a work team and how it evolves
- To understand the causes of conflicts and the tools for resolving them
- To understand cultural influences within a group
- To learn about and practise tools for managing multicultural teams

Programme

- **4 lecture sessions, each lasting 1 hour 30 minutes**:
  - Introduction to HRM: functions, responsibilities and the evolution of the role
  - Lecture 1: From group to team and main types of leadership
  - Lecture 2: Conflict management
  - Lecture 3: Multicultural management
- **3 practical sessions in small groups, each lasting 1 hour 30 minutes**:
  - Practical Task 1: Assessing the level of integration within a professional team using the provided assessment grids
  - Practical Exercise 2: Analysis of a conflict situation and recommendations
  - Practical Exercise 3: Diagnosis of the challenges in a multicultural situation and proposed responses

Key learning outcomes

- Developing factors that promote collective performance in the workplace
- Identifying the signs of conflict, preventing and managing them, and minimising the damage they cause
- Understand the components of different types of culture, strengthen bonds and reduce the tensions that arise from them

Bibliography

- Mintzberg, H. (1982). *Structure and Dynamics of Organisations*.
- Allard-Poesi, F. (2012). *Team Management –3rd edition*. Dunod.
- Chevrier, S. (2014). *Managing International Teams*. Presses de l'Université Laval.
- Demorgon, J. et al. (1999). *A Guide to Intercultural Training*. FeniXX.
- Landry, S. (2010). *Work, Affection and Power in Small Groups*. Presses de l'Université du Québec.
- Graen, G. B., & Uhl-Bien, M. (1995). *A relationship-based approach to leadership: The development of leader-member exchange (LMX) theory of leadership over 25 years: Applying a multi-level, multi-domain perspective*. *The Leadership Quarterly*.
- Hersey, P., & Blanchard, K. H. (1982). *Grid®principles and situationalism: Both! A response to Blake and Mouton*. Group & Organisation Studies, 7(2), 207–210.

Keywords: Team, Leadership, conflict management, multicultural management

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R 6-2 – Management 5: Construction and Insurance Law

Timetable
Semester.....6
Period .....Jan. – May
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial.....9 hours
Total.....**18h**
Targeted skill(s)
C1 – Analysing a construction project within its context
C4 – Managing a construction organisation

Prerequisites

insurance policies, tenancy agreements and construction contracts

Objectives

- To understand the principles of liability under construction law – civil and professional liability
- To understand the mechanisms of professional insurance, the application of cover, and the organisational implications; to develop the reflexes needed to be prepared in the event of a dispute, litigation or any other difficulties
- The concept of a lease, the landlord/tenant relationship, commercial leases and professional leases

Syllabus

- The court system, the functioning of the justice system, and key principles
- Health and safety: employers' obligations
- Public access buildings (ERP), definitions and safety regulations
- Contracts: construction contracts, CCMI contracts, property development
- Invoicing
- Warranties: two-year, ten-year, etc. Final acceptance and its consequences, examples and case studies
- DO insurance
- Leases: business, commercial 227

Bibliography

- Textbooks from the Le Moniteur series
- Civil Code
- Justice.gouv.fr
- Service-public.fr

R 6-3 – English 6

Timetable
Semester.....6
Term.....Jan. – May
Face-to-face in person

Assessment
Continuous assessment

Duration
Tutorial .....15 hours
Total.....15 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Managing a construction organisation

Prerequisites

English ISA3-S5 Level B1+

Syllabus

Tutorials:

- **TOEIC Preparation**
- Listening: Practice with Parts 1–4 in business and technology contexts
- Reading: Parts 5–7, focusing on connectors and vocabulary in context
- Mini practice tests under timed conditions
- Development of reading skills (skimming, scanning, inference, recognising connectors, time management).
- Review of key grammar points: conditional sentences (zero, first, second, third and mixed), word formation (nouns, verbs, adjectives, adverbs) and linking words (cause, contrast, addition, sequence).
- Vocabulary expansion: AWL lists 5–8 and key areas (money, business, technology).
- Completion of mock TOEIC exams to track progress and adjust learning strategies.

Key learning outcomes

By the end of this course, you will be able to:

- Achieve a TOEIC score of at least **785**.
- Demonstrate mastery of the grammar points tested in the TOEIC:
- Understand and respond to listening passages relating to money, business and technology.
- Read and analyse business and professional texts under time constraints.
- Use and recognise vocabulary from the Academic Word List (AWL) 5–8 in reading and listening contexts.

Bibliography

- The Complete TOEIC® – 3rd edition
- The Official TOEIC® Bible

Keywords: TOEIC, grammar, business English

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R 6-4 – Spanish 6

Timetable
Semester.....6
Term.....Jan. – May
Face-to-face in person

Assessment
Continuous assessment

Duration
Tutorial .....15 hours
Total.....15 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

Spanish S5

Objectives

In Semester 6, teaching focuses on preparing for official Spanish language qualifications (DELE, SIELE). The aim is to consolidate and expand B2-level skills, enabling students to:

- To sit international exams in the best possible conditions
- To ensure sufficient linguistic fluency to function effectively in a Spanish-speaking academic or professional context

The target is B2 level: in-depth comprehension; fluent and nuanced oral and written expression; and the ability to interact without difficulty with native speakers and to defend a well-argued point of view.

Syllabus

- Familiarisation with the DELE and SIELE exams: structure, duration, assessment criteria
- Systematic practice in the four assessed skills: listening comprehension, reading comprehension, written expression, and oral expression and interaction
- Grammar and vocabulary consolidation to achieve the accuracy and correctness expected at B2 level
- Development of specific strategies for time management, understanding lengthy texts and producing coherent and well-argued written work
- Mock exams under real exam conditions

Key learning outcomes

- Understanding complex texts, identifying main ideas and relevant details
- Producing clear, structured and well-argued written work on a variety of topics (society, culture, the world of work, current affairs)
- Interacting spontaneously and confidently in spoken English, expressing and defending one's opinions with nuance
- Using an appropriate register (formal/informal) depending on the situation
- Develop strategies for self-correction and managing stress during exams 231

Bibliography

- https://eduscol.education.fr/1971/cadre-europeen-commun-de-reference-pour-les-langues-cecrl
- https://leblogdespagnol.com/
- Official DELE and SIELE resources: guides, sample exams, past papers
- Preparation books for B2-level certification exams (DELE/SIELE)

Keywords: CEFR, B2, DELE, SIELE, argumentation, opinion, comprehension, expression, exam, mock exam

R 6-5 – Statistical tools: Reliability – Multidimensional data analysis

Timetable
Semester.....6
Period .....Jan. – May
Face-to-face in person

Assessment
Continuous assessment throughout

Duration
CM .....12 hours
Tutorial .....15 hours
Tutorial .....12 noon

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Reliability

Prerequisites

- Probability of a continuous variable

Objectives

- To be able to model and assess the reliability of simple or complex systems

Syllabus

- Study of the various mathematical tools applied to the reliability analysis of systems

Key learning outcomes

- Modelling the reliability of simple systems
- Assessing the reliability of complex systems
- Applying mathematical tools to reliability analysis

Bibliography

- *Statistics and Probability T2*, Verlant St Pierre, Sigma series, Foucher

Keywords: Reliability, systems, probability

Multidimensional data analysis

Prerequisites

- One-dimensional descriptive statistics
- Linear algebra
- Chi-squared test

Objectives

- To master data analysis techniques in order to explore and uncover the complex structures contained within large data tables, and to make the information intelligible so as to transform it into knowledge

Syllabus

- Principal Component Analysis (PCA)
- Correspondence Analysis (CA)
- Hierarchical classification
- Supplementary topics: Multiple Correspondence Analysis (MCA), Discriminant Analysis

Key learning points

- Apply principal component analysis methods
- Use classification techniques to explore multidimensional data
- Interpret the results of a factor analysis
- Transform complex information into actionable knowledge

Bibliography

- *Probability, Data Analysis and Statistics*, G. Saporta, Technip
- *Data Analysis*, M. Volle, Economica
- *Data Analysis*, R.F. Husson, S. Lê and J. Pagès, Presses Universitaires de Rennes

Keywords: Data analysis, PCA, AFC, hierarchical classification, multidimensional data

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R 6-6 - Thermodynamics 3: Moist Air

Timetable	
Semester	6
Term	Jan. – May
Face-to-face in person	

Duration	
CM	4h30
Practical hours	6
Total	**10h30**

Assessment
Continuous assessment

Targeted skill(s)
C2 – Specify technical solutions for sustainable and more durable construction
C3 - Designing structures and systems

Prerequisites

Thermodynamics 1 and 2

Objectives

- To understand the physical properties of air and the characteristic parameters of moist air
- To be proficient in using the moist air diagram
- To understand the phenomenon of condensation on walls

Syllabus

- Physical properties of air
- Characteristic parameters of moist air
- Study of the moist air diagram
- Analysis of vapour transfer through walls
- Identifying areas of condensation in walls
- Identifying technical solutions to prevent condensation in walls

Key learning points

- Knowing how to plot points on the psychrometric chart and interpret all the associated physical characteristics
- Calculating vapour transfer in a wall by creating a spreadsheet
- Interpreting the results and proposing technical solutions 235

Bibliography

- *Memotech Energy Engineering*, P. Dal Zotto, J-M. Larre, A. Merlet, L. Picau
- Engineering Techniques

Keywords: Humid air, condensation, psychrometric chart, vapour transfer

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R 6-7 - Fluid Mechanics 2: Kinematics – Potential – Boundary Layer – Similarity – Sound

Timetable
Semester.....6
Term.....Jan. – May
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial.....9 hours
Total.....**18h**
Targeted skill(s)
C3 – Designing structures and systems

Prerequisites

R 5-7 — Fluid mechanics 1: hydrostatics, pressure, Archimedes' principle

Objectives

- To consolidate the fundamentals of fluid statics and link them to dynamics
- To master dimensional analysis and similarity
- Move from the global to the local scale via Reynolds' transport theorem, through to the Navier–Stokes equations.

Syllabus

- Revision: fluid statics, pressure, Archimedes' principle
- Dimensional analysis and similarity (Buckingham's π, Re, Fr, We, Ma)
- Dynamics: Bernoulli's principle and applications (flow measurement, lift)
- Kinematics: streamlines, streaklines, pathlines
- Material derivative and Reynolds' transport theorem
- Equations: continuity and incompressible Navier–Stokes equations; simplified form (Couette flow)

Key learning outcomes

- Constructing dimensionless groups and selecting the appropriate similarity criterion
- Applying Bernoulli's equation whilst critically evaluating its assumptions
- Using the material derivative and the Reynolds transport theorem to establish local continuity
- Writing and interpreting the Navier–Stokes equations;

analysing Couette 237

Bibliography

- Fluid Mechanics, C. Carlier, Masson
- General and Applied Hydraulics, A. Lencastre, Eyrolles

Keywords: fluid statics, dimensional analysis, similarity, Bernoulli, kinematics, material derivative, Reynolds transport theorem, Navier–Stokes

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ISA BTP
FORMATION INGÉNIEUR

R 6-8 – Energy efficiency in buildings

Timetable
Semester.....6
Period .....Jan. – May
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....12 hours
Tutorials .....1.30 pm
Tutorial 7.30
Total .....

Target skill(s)
C1 – Analysing a construction project within its context
C2 - Recommend technical solutions for sustainable and more durable construction

Prerequisites

Thermodynamics 1 and 2, Thermodynamics 3

Objectives

- To understand the challenges relating to user comfort
- Understand the properties of different materials in order to address these issues

Syllabus

- Introduction to comfort
- Calculation of heat loss
- Analysis of thermal bridges
- Summer comfort
- Regulations and certification schemes
- Project: carry out a comprehensive thermal study, analyse the results and propose solutions

Key learning points

- Carry out a comprehensive thermal assessment of a building, taking into account heat loss and thermal bridges
- Assess and optimise thermal comfort in summer and winter based on the building's characteristics
- Apply current thermal and energy regulations
- Analysing the results of a thermal simulation and proposing solutions for improvement
- Compare different construction solutions in terms of energy efficiency and comfort 239

Bibliography

- Current thermal regulations
- Supplier documentation

Keywords: Thermal comfort, heat loss, thermal bridges, regulations, energy efficiency

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FORMATION INGÉNIEUR

R 6-9 - RdM 8: Dynamics of solids – Kinetics

Calendar
Half-year 6
Period .....Jan. – May
Face-to-face in person

Duration
CM .....9 hours
Tutorial.....9 hours
Total.....**18h**

Assessment
Continuous assessment

Targeted skill(s)
C3 – Designing structures and systems

Prerequisites

- Solid mechanics (statics, kinematics)
- Basics of calculating element stiffness (bars, beams)
- Concepts of differential calculus and differential equations

Objectives

- To model a simple vibrating system with 1 degree of freedom (1 DDL / SDOF – Single Degree of Freedom)
- To write and solve the equation of motion for different cases (free undamped, free damped, forced)
- Determine the stiffness of an elementary structure and deduce its natural frequency
- To understand the phenomena of resonance and damping

Syllabus

- Mass–spring–damper model: deriving the equation of motion
- Free vibrations: undamped, damped
- Response to harmonic excitation
- Calculation of the stiffness of simple elements (rods, beams) and relationship to natural frequency
- Applications to practical cases

Key learning outcomes

- Be able to formulate the equation of motion for a system with one degree of freedom
- Be able to analytically solve a second-order differential equation in mechanics
- Be able to calculate and interpret a natural frequency
- Understand the impact of damping on the vibrational response

Keywords: Dynamics, vibrations, SDOF, natural frequency, resonance, damping 241

R 6-10 – Foundations: soil mechanics, structures

Timetable
Semester.....6
Period .....Jan. – May
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....9 hours
Practical sessions.....6 hours
Total.....**15h**

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C3 – Designing structures and systems

Prerequisites

Previous modules on soil mechanics and structural analysis

Objectives

- To be familiar with the relevant standards governing geotechnical investigation.
- To master in-situ testing methods and their interpretation.
- Apply test results to calculate the bearing capacity of shallow foundations.
- To determine the expected settlement of shallow foundations based on in situ measurements.
- Understand and be able to apply the construction regulations for the structural design of shallow foundations.

Syllabus

- Standards for geotechnical investigations.
- In situ geotechnical tests.
- Definition of loads for limit state design.
- Shallow foundations: isolated, strip, combined and raft foundations.
- Calculation methods: use of in situ tests to calculate the bearing capacity and settlements of a shallow foundation
- Calculation of permissible displacements
- Structural design of foundations (stress distribution, bending, shear and punching shear, reinforcement design, construction details)
- Construction supervision and performance monitoring

Key learning outcomes

- Identify, based on in situ tests, the relevant soil parameters for foundation design
- Design shallow foundations
- Assess settlement and bearing capacity of shallow foundations
- Integrate safety, costs and environmental constraints

Bibliography

Calculation of Shallow and Deep Foundations, Sébastien Burlon, Fahd Cuira, Roger Frank – published by Presses des Ponts, 2019

Keywords: shallow foundations, bearing capacity, settlements, limit state design

R 6-11 – Reinforced Concrete 3: Continuous beams – Compound bending – Design of standard members – Numerical tools

Timetable
Semester.....6
Period .....Jan. – May
Face-to-face in person

Assessment
Continuous assessment throughout the course

Duration
CM.....10.30 am
Tutorial 12.00
Tutorial.....6
Total **28h30**

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C3 - Designing structures and systems

Prerequisites

- Reinforced Concrete modules ISA1 and ISA2
- RdM modules: isostatic and hyperstatic beams

Syllabus

Lectures:

- Revision of simple bending design under ELU and ELS
- Design of reinforcement for shear force VEd
- ELS calculations: crack widths and deflections
- Design of continuous beams: structural analysis, limited redistribution of moments Tutorials:
- Design of an anchorage
- Comprehensive analysis of an isostatic beam: bending moments under ULS and SLS (stresses, crack width, harmful deflection), end fixings, shear forces, bar layout, reinforcement plans
- Analysis of a continuous beam: moment redistribution

Practical Exercises:

- Applications using Graitec: design of common structural elements

Key learning points

- Verification of a beam under ultimate limit state (ULS): cracked and uncracked
- Elastic structural analysis with moment redistribution

Bibliography

- Eurocode 2 NF EN 1992-1-1: 'Design of concrete structures: General rules and rules for buildings'
- *Treatise on Reinforced Concrete in accordance with Eurocode 2*, Le Moniteur Edition
- *Design of Concrete Structures*, Eyrolles Edition

Keywords: Limit states, longitudinal and transverse reinforcement, anchorage, structural analysis

R 6-12 – Steel Construction 3: Joints – Digital Tools

Timetable
Semester.....6
Period .....Jan. – May
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....7.5 hours
Tutorials .....7.5 hours
Tutorial 7.30
Total 19.30

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C3 - Designing structures and systems

Prerequisites

In order to undertake this course, students must first be able to:

- To identify (from the plans and elevations of a single-storey multi-span or two-storey single-span building structure) the various main elements of that structure and the connections between them
- To analyse the path of vertical and horizontal forces from the surface bearing the loads down to the foundations
- To calculate the forces acting on each of the structural elements
- To verify, in accordance with Eurocode 3, the cross-sectional and stability design of elements subjected to tension, shear and/or bending at the Ultimate Limit State (ULS) and the Serviceability Limit State (SLS)
- To model a single-storey multi-span or two-storey single-span building using finite element analysis software (ADVANCE DESIGN)

This course will be based on the project documentation for a single-storey multi-span or two-storey single-span steel-framed building. The documentation will contain a description of the structure (extract from the technical specifications), the plans of the main structure and a perspective view of it. Appended to the project brief, students will also be provided with an extract from the manufacturer's catalogue of the main standardised steel sections available on the market.

Objectives

By the end of this course, students should be able to analyse the behaviour of a steel structure in a single-storey multi-span or two-storey single-span building and to carry out or verify the design of bolted or welded connections, as well as column base connections, in accordance with Eurocode 3.

Upon completion of the chapter on bolted connections, students should be able, for a bolted connection between two structural members:

- To determine the forces that must be transmitted by the connection
- To list the various checks required to verify the connection's performance in accordance with Eurocode 3

- Apply the relevant formulae to verify the strength of the bolted connection

By the end of the chapter on welded joints, students should be able, for a welded joint between two structural members, to:

- To determine the forces that must be transmitted by the connection
- To list the various checks required to verify the strength of the joint in accordance with Eurocode 3
- Apply the relevant formulae to verify the strength of the welded joint

Upon completion of the chapter on the ADVANCE DESIGN finite element analysis software, students should be able, using the design data for a new building of the same type and given wind and/or snow loads:

- To develop a model of a connection using 'Steel Connection Designer'
- Apply the loads to the connection
- To check the design results proposed by the software
- To analyse the differences between the manual calculation and the results obtained by the software

Syllabus

- Design of bolted joints in accordance with Eurocode 3
- Design of welded joints in accordance with Eurocode 3
- Connections at the base of columns
- Use of the ADVANCE DESIGN software and the 'Steel Connection Designer' module
- Comparison of manual calculations with software results

Key lessons learnt

- Calculating forces in a bolted or welded connection
- Verifying the strength of a bolted joint in accordance with EC3 (diametral pressure, shear, pull-out)
- Dimensioning a weld bead in accordance with EC3
- Designing and verifying a column base connection
- Modelling an assembly using structural analysis software
- Critically analyse the results produced by structural analysis software

Bibliography

- *Steel Construction – Design of Building Structures*, Yvon Lescouarc'h, Presses de l'École Nationale des Ponts et Chaussées, 2008 (BU_693.7 LES)
- *Eurocode 3 and National Application Document – Design of Steel Structures – Part 1-1: General Rules and Rules for Buildings*, Various Authors, Ed. Eyrolles, 1996 (BU_624.1 EUR)
- *Design of Structures in accordance with Eurocode 3*, Jean MOREL, Eyrolles, 1997 (BU_624.1 MOR)
- *Steel Construction Handbook, Eurocodes 1 and 3, NV65 Rules, CM66 Rules + Addendum 80, Connection Standards, 3rd edition*, Pierre MAITRE, Le Moniteur, 2009 (BU_624.1 MAI)

- *Steel and Composite Steel-Concrete Structures – Calculation and Design in accordance with Eurocodes 3 and 4*, APK, published by Eyrolles, 1996 (BU_624.1 CON)
- *Steel Structures – Simple Structures – Technical and Design Guide for Steel Structural Members*, Various authors, published by CAPEB, CTICM, OTUA, 2008
- *Designing and Constructing with Steel*, M. Landowski, B. Lemoine, published by ArcelorMittal, 'Mémento acier' series, 2008
- *Memotech – Steel Structures*, C. Hazard, F. Lelong, B. Quinzain, published by Castella Educalivres, 1997
- *Steel Structures – CM66 Addendum 80 Eurocode 3*, Jean MOREL, published by Eyrolles, 1997
- http://www.cticm.org/
- http://www.otua.org/, http://www.construiracier.fr/
- http://www.access-steel.com/
- http://www.scmf.com.fr/

Keywords: Joints, bolts, welding, Eurocode 3, connections, column bases, structural analysis software

R 6-13 - Surveying 3: Application to building and civil engineering

Timetable
Semester.....6
Period .....Jan. – May
Face-to-face in person

Assessment
Continuous assessment

Duration
Lecture.....3 hours
Practical .....6 hours
Total.....**9**

Targeted skill(s)
C2 – Prescribe technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- R 1-11 – Surveying
- R 4-19 - Surveying 2

Objectives

- To successfully carry out routine surveying operations arising during the execution of building and civil engineering projects
- To understand, when working alongside surveyors, the purpose of the methods used, to assess and utilise the results, and thereby to guide their own work
- To practise the systematic calculation of point coordinates, which enables computerisation
- To practise checking calculations to eliminate errors before any error calculations are carried out

Syllabus

- Survey of existing conditions; site survey
- Transfer of data and preparation of a topographical plan
- Radius-based setting-out
- Setting out of bench marks
- Use of a laser level
- Setting out simple structures using rectangular or polar coordinates
- Stakeout of earthworks, slopes, longitudinal and cross-sections
- Calculation of earthworks volumes

Bibliography

Modern Topography and Topometry, Volume 1: Measurement and Representation Techniques and Volume 2: Calculations, Milles and Lagofun, published by EYROLLES.

Keywords: topography, setting out, surveys, earthwork volumes

R 6-14 – Materials 7: Eco-materials and innovative materials

Timetable
Semester.....6
Period .....Jan. – May
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial.....9 hours
Total.....**18h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

- R 1-15: Introduction to environmental issues
- Resources 1 to 7: R 1-16, R 2-16, R 2-17, R 2-18, R 3-16, R 3-17, R 6-14, R-8
- Technology Resources

Objectives

- To understand the causes of defects and carry out an assessment based on the structure's location
- To describe the mechanisms underlying defects in building materials
- To identify the main defects according to the building materials
- Recommend measures to prevent or remedy defects
- Be able to adapt the formulation of cementitious materials in response to aggressive agents
- Be able to apply the performance-based approach in accordance with standard NF EN 206+A2
- Steel corrosion: measurement of corrosion potentials. Design of cathodic and anodic protection methods.

Syllabus

- **Chapter 1** – Deterioration of cementitious materials: mechanisms, durability management, standards-based approach
- **Chapter 2** – Defects in metallic materials: introductory and economic data on corrosion; reaction mechanisms; different forms of corrosion; examples of corroded structures; the influence of the environment on corrosion; corrosion rate; passivation; metals and corrosion.
- **Chapter 3** – Corrosion control: design, passive protection, active protection by coating, active protection by contact.
- Analysis of a technical dossier for a cathodic protection project (presentation by a professional)
- Practical approach (in practical sessions): on a reinforced concrete wall, measuring corrosion potentials, identifying defects and measuring protective current (with input from a professional).

Key learning outcomes

- Be able to formulate concrete according to exposure classes (standard NF EN 206+A2)
- Understanding the mechanisms behind defects in cementitious materials
- Be able to adapt the constituents of concrete to increase its durability
- Understand the mechanisms of corrosion
- Understanding the different types of corrosion protection
- Design a cathodic protection system

Bibliography

- PerfDub project report
- InfoCiments website
- AFNOR standard NF EN 206+A2
- Book: 'Corrosion and the Protection of Steel in Concrete'
- LERM documentation, LERM website

Keywords: Defects, cementitious materials, aggressive agents, freeze-thaw cycles, leaching, sulphate attack, chloride attack, carbonation, performance-based approach, corrosion mechanisms, corrosion potential, active protection, passive protection.

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R 6-15 – Materials 8: Defects

Timetable
Semester.....6
Period .....Jan. – May
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....9 hours
Practical sessions.....6 hours
Total.....**15h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

- R1-15 - Introduction to environmental issues
- Materials Resources 1 to 7: R 1-16, R 2-16, R 2-17, R 2-18, R 3-16, R 3-17, R 6-14
- Technology Resources

Objectives

- To be able to identify the stages in the life cycle of each component that contributes to the environmental impacts of building materials
- Propose construction alternatives through the choice of materials to reduce the environmental impacts of buildings
- Understand the regulatory framework governing the use of materials in construction (both common and non-standard techniques)
- Be able to use the NF EN 206+A2/CN 2022 standard to formulate, specify and characterise concrete for a specific use
- Understand the key principles of hempcrete construction
- Understand the main principles of earth construction
- Understand the main principles of straw construction

Syllabus

Chapter 1 – Cementitious materials: description and role of constituents, environmental impacts of constituents, formulations for different types of concrete, performance characterisation, strategies for reducing the environmental impacts of cementitious materials

Chapter 2 – NF EN 206+A2/CN 2022: details, analysis and application of this standard relating to

concrete 253

Chapter 3 – Low-carbon construction: data on the environmental impacts of construction; examples of alternatives for material manufacturing processes; examples of alternatives for material constituents

Chapter 4 – Examples of low-carbon construction solutions: hempcrete, rammed earth, straw. For each type of solution, the following are discussed: constituents and formulations, construction and installation techniques, advantages and points to bear in mind

Key lessons

- Principles of concrete formulation
- Parameters and tests for characterising concrete in the fresh and hardened states
- Main environmental impacts of construction
- Principles of low-carbon construction
- Key principles of construction using hempcrete, rammed earth and straw (formulation and installation)
- Key environmental benefits of the construction solutions presented

Bibliography

- Standard NF EN 206+A2/CN 2022
- InfoCiment website
- Professional guidelines: 'Building with Hemp', 'Straw Construction'
- CRATerre – Treatise on earth construction

Keywords: eco-materials, low-carbon construction, environmental impacts, concrete, hemp, straw, rammed earth

R 6-16 – Site visits and conferences 6

Timetable	
Semester	6
Period	Jan. – May
Face-to-face in person	

Duration	
CM	9 hours
Tutorials	7 hours
Total	**16 hours**

Assessment
Assessed as part of SAÉ

Prerequisites

None

Objectives

The site visits and lectures organised during the first three years at ISA BTP serve several educational purposes:

- to explore the diversity of the construction industry:
  - structures and systems: buildings, engineering structures, infrastructure, road and rail networks, roads and utilities, civil engineering works, marine structures, equipment, installations… ,
  - key players: client, project manager, engineering consultancy, contractors, subcontractors, health and safety coordinator, geotechnical engineer, technical inspector, laboratory technician…
  - professions: labourers, semi-skilled and skilled workers, managers, project managers, site managers, site supervisors, engineers, business owners, self-employed contractors, suppliers, technical sales representatives…
  - materials: 'conventional', innovative,
  - construction methods and working procedures,
- developing one's understanding of the construction industry: projects and sites ranging from routine to exceptional, local and national projects, technical terminology,
- linking this to the curriculum: Resources and SAÉ,
- developing curiosity and an open mind,
- encouraging interest in SAÉ work placements and facilitating the choice of the ISA4 and 5 pathways

Key learning outcomes

- develop listening and observation skills
- write a report on a site visit or take notes during lectures
- apply these discoveries and insights in the SAÉ

Keywords: Discovery, technologies, diversity, organisations, responsibilities

SAÉ 6-1 – Sustainable Construction and Environmental Impact Challenge (or competition / challenge)

Timetable
Semester.....6
Period .....Jan. – May
Face-to-face in person

Assessment
Defences and Portfolio

Duration	1 week
Supervised hours	18 hours
Self-study	10 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 – Designing structures and systems
C4 - Managing a construction organisation

Prerequisites

- R1-15 – Introduction to environmental issues
- R6-15 - Materials 8

Objectives

- Tackling the challenge of sustainable construction
- To minimise a project's environmental impact
- To innovate in environmental approaches

Programme

- One-week team challenge
- Alternative: taking part in a competition or challenge
- Life cycle assessment (LCA)
- Selection of low-carbon materials and processes
- Bioclimatic design
- Energy optimisation
- Circular economy and recycling

Key lessons learnt

- Designing or improving a project with low environmental impact
- Carry out a simplified life cycle assessment
- Selecting sustainable and innovative solutions
- Making the case for environmental benefits

Bibliography

- *Sustainable Construction*, P. Berdier, Le Moniteur
- *LCA in the building sector*, ADEME
- *Eco-design*, B. Lebot, Dunod

Keywords: Sustainable construction, environmental impact, LCA, eco-design, innovation, challenge

SAÉ 6-2 – Collaborative project between engineering and architecture students: design, models, structure, systems

Timetable
Semester.....6
Period .....Jan. – May
Face-to-face in person

Duration	2 weeks
Supervised hours	36 hours
Self-study	20 hours

Assessment
Defences and Portfolio

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- Resources: Technology R 1-12, R 2-13, R 5-17
- Materials Resources 1 to 8
- RDM and Structures Resources
- Physics Resources

Objectives

- To work in groups with student architects
- To take part in the design of a building in accordance with specific specifications
- To study the functions of a building
- Suggest construction techniques for the designed structure

Programme

This project is carried out in collaboration with the Bordeaux School of Architecture and Landscape Architecture. Engineering students and architecture students come together for two three-day sessions to work on a project.

The different stages of the project are:

- Review of the project brief
- Design of the structure
- Study of its mechanical operation (which determines the design)
- Analysis of the construction techniques that could be used

Students may be asked to:

- Specify the general layout and dimensions
- Propose the interior volumes and the external appearance of the structure (envelope, roof, structure)
- Propose the technical arrangements that could be envisaged
- Specify the construction timetable
- Draw up a provisional estimate of the expected cost of the works

Key learning points

- Collaborate effectively within a multidisciplinary team (engineers and architects)
- Analyse a set of specifications and propose suitable solutions
- Design a load-bearing structure consistent with the architectural design
- Propose technical construction solutions
- Estimating the costs and timelines of a project
- Communicate and present a project to a panel

Bibliography

- Technical documentation on building systems
- Product catalogues and construction systems
- Best practice guidelines and applicable DTU standards

Keywords: Multidisciplinary project, architecture, design, structure, construction techniques, collaboration, specifications

SAÉ 6-3 – Assistant Engineer Placement: Design or Construction

Timetable
Semester.....6
Period .....Jan. – May
Face-to-face in person

Assessment
Report

Duration	7 weeks

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 – Managing a construction organisation

This course description is currently being drafted.

A dedicated working group has been set up to define and formalise the details relating to this learning and assessment scenario.

The final version of the description is scheduled to be completed by 15 July 2026 at the latest.

Fourth year

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Semester 7 – BCR Programme

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
R 7-1	Management 6: Project Management	9.04%
FISE 7-3	English S7	13.55%
FISE 7-5	Differential systems	17.17%
R 7-6	RdM 9: Structural modelling and optimisation 1	9.94%
FISE 7-7	Organisation 9: Electrical Installations – Construction Site Applications	4.52%
BCR 7-1	Soil Mechanics 1: Earth pressure, retaining structures	8.43%
BCR 7-2	Structural Design 1: Reinforced Concrete	12.05
BCR 7-3	Technology of Historic Buildings 1	9.04%
BCR 7-4	Assessment 1: Structure	7.23%
BCR 7-5	Materials with a low environmental impact	9.04%
SAÉ for competence C1		**%**
SAÉ 7-1	Case study: an engineer's approach and ethics	33.33%
SAÉ 7-2	Engineering Assistant Placement: fields related to the programme	66.67

Competency C2 – Proposing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
FISE 7-3	English S7	21.23%
FISE 7-7	Organisation 9: Electrical installations – Construction site applications	7.08
BCR 7-1	Soil Mechanics 1: Earth pressure, retaining structures	13.21%
BCR 7-2	Structural Design 1: Reinforced Concrete	18.87%
BCR 7-3	Technology of Historic Buildings 1	14.15
BCR 7-4	Assessment 1: Structure	11.32%
BCR 7-5	Materials with a low environmental impact	14.15%
SAÉ for competence C2		**%**
SAÉ 7-2	Engineering assistant placement: fields related to the course	100%

Competency C3 – Designing structures and systems

Resources for Competency C3		%
FISE 7-5	Differential systems	22.18%
R 7-6	RdM 9: Structural modelling and optimisation 1	12.84%
FISE 7-7	Organisation 9: Electrical Installations – Construction Site Applications	5.84%
BCR 7-1	Soil Mechanics 1: Earth pressure, retaining structures	10.89%
BCR 7-2	Structural Design 1: Reinforced Concrete	15.56%
BCR 7-3	Technology of Historic Buildings 1	11.67%
BCR 7-4	Assessment 1: Structure	9.34%
BCR 7-5	Materials with a low environmental impact	11.67%
SAÉ for competence C3		**%**
SAÉ 7-2	Engineering assistant placement: fields related to the course	100%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
R 7-1	Management 6: Project management	18.87%
R 7-2	Management 3: HRM, behavioural psychology and conflict management	33.96%
FISE 7-7	Organisation 9: Electrical Installations – Construction Site Applications	9.43%
BCR 7-3	Technology of Historic Buildings 1	18.87%
BCR 7-5	Materials with low environmental impact	18.87%
SAÉ for competence C4		**%**
SAÉ 7-1	Case study: an engineer's approach and ethics	33.33%
SAÉ 7-2	Engineering assistant placement: fields related to the course	66.67%

Semester 7 – GCM programme

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
R 7-1	Management 6: Project Management	7.82%
FISE 7-3	English S7	11.73%
FISE 7-5	Differential systems	14.86%
R 7-6	RdM 9: Structural modelling and optimisation 1	8.6%
FISE 7-7	Organisation 9: Electrical Installations – Construction Site Applications	3.91%
GCM 7-1	Soil mechanics: earth pressure, retaining structures	10.95
GCM 7-2	Structural Design 1: Reinforced Concrete	10.95%
GCM 7-3	Wave theory – Introduction to propagation	16.95%
GCM 7-4	Maritime and Port Structures 1	3.26%
GCM 7-5	Earthworks	7.04%
GCM 7-6	Bridges 1	3.91%
SAÉ for competence C1		**%**
SAÉ 7-1	Case study: an engineer's approach and ethics	33.33%
SAÉ 7-2	Engineering Assistant Placement: fields related to the programme	66.67

Competency C2 – Proposing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
FISE 7-3	English S7	39.3 %
FISE 7-7	Organisation 9: Electrical installations – Construction site applications	13.1%
GCM 7-4	Maritime and Port Structures 1	10.92%
GCM 7-5	Earthworks	23.58%
GCM 7-6	Bridges 1	13.1%
SAÉ for competence C2		**%**
SAÉ 7-2	Engineering Assistant Placement: fields related to the course	100%

Competency C3 – Designing structures and systems

Resources for Competency C3		%
FISE 7-5	Differential systems	18.48 %
R 7-6	RdM 9: Structural modelling and optimisation 1	10.7%
FISE 7-7	Organisation 9: Electrical installations – Construction site applications	4.86%
GCM 7-1	Soil mechanics: earth pressure, retaining structures	13.61%
GCM 7-2	Structural Design 1: Reinforced Concrete	13.61%
GCM 7-3	Wave theory – Introduction to propagation	21.07%
GCM 7-4	Maritime and Port Structures 1	4.05%
GCM 7-5	Earthworks	8.75%
GCM 7-6	Bridges 1	4.86%
SAÉ for competence C3		**%**
SAÉ 7-2	Engineering Assistant Placement: fields related to the course	100%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
R 7-1	Management 6: Project management	19.54%
R 7-2	Management 3: HRM, behavioural psychology and conflict management	35.18%
FISE 7-7	Organisation 9: Electrical installations – Construction site applications	9.77%
GCM 7-4	Maritime and Port Structures 1	8.14%
GCM 7-5	Earthworks	17.59%
GCM 7-6	Bridges 1	9.77%
SAÉ for competence C4		**%**
SAÉ 7-1	Case study: an engineer's approach and ethics	33.33%
SAÉ 7-2	Engineering Assistant Placement: fields related to the programme	66.67%

Semester 7 – H&E specialisation

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
R 7-1	Management 6: Project Management	8.34%
FISE 7-3	English S7	12.52%
FISE 7-5	Differential systems	15.86%
R 7-6	RdM 9: Structural modelling and optimisation 1	9.18%
FISE 7-7	Organisation 9: Electrical Installations – Construction Site Applications	4.17%
H&E 7-1	Secondary structures 1: facades and technology	5.42%
H&E 7-2	Thermodynamic systems	11.13%
H&E 7-3	Heat exchangers	11.13%
H&E 7-4	Industrial equipment and installations	5.56%
H&E 7-5	Dynamic thermal simulations 1	5.01%
H&E 7-6	GAO – Geometric models	11.68%
SAÉ for competence C1		**%**
SAÉ 7-1	Case study: an engineer's approach and ethics	33.33%
SAÉ 7-2	Engineering Assistant Placement: fields related to the programme	66.67

Competency C2 – Proposing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
FISE 7-3	English S7	22.78 %
FISE 7-7	Organisation 9: Electrical installations – Construction site applications	7.59%
H&E 7-1	Secondary structures 1: facades and technology	9.87%
H&E 7-2	Thermodynamic systems	20.25%
H&E 7-3	Heat exchangers	20.25%
H&E 7-4	Industrial equipment and installations	10.13%
H&E 7-5	Dynamic thermal simulations 1	9.11%
SAÉ for competence C2		**%**
SAÉ 7-2	Engineering Assistant Placement: fields related to the course	100%

Competence C3 – Designing structures and systems

Resources for Competency C3		%
FISE 7-5	Differential systems	20.04%
R 7-6	RdM 9: Structural Modelling and Optimisation 1	11.6%
FISE 7-7	Organisation 9: Electrical Installations – Construction Site Applications	5.27%
H&E 7-1	Secondary Structures 1: Facades and Technology	6.85
H&E 7-2	Thermodynamic systems	14.06%
H&E 7-3	Heat exchangers	14.06%
H&E 7-4	Industrial equipment and installations	7.03%
H&E 7-5	Dynamic thermal simulations 1	6.33%
H&E 7-6	GAO – Geometric models	14.76%
SAÉ for competence C3		**%**
SAÉ 7-2	Engineering Assistant Placement: fields related to the course	100%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
R 7-1	Management 6: Project management	25.32%
R 7-2	Management 3: HRM, behavioural psychology and conflict management	45.57%
FISE 7-7	Organisation 9: Electrical Installations – Construction Site Applications	12.66%
H&E 7-1	Secondary Structures 1: Facades and Technology	16.46%
SAÉ for competence C4		**%**
SAÉ 7-1	Case study: an engineer's approach and ethics	33.33%
SAÉ 7-2	Engineering Assistant Placement: fields related to the course	66.67%

Semester 7 – RIS specialisation

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
R 7-1	Management 6: Project Management	10.19%
FISEA 7-3	English S7	15.28%
FISEA 7-5	Differential Systems	10.19%
R 7-6	RdM 9: Modelling and optimisation of structures 1	11.21%
RIS 7-1	Road Infrastructure 1	5.09%
RIS 7-2	Rail infrastructure 1	4.07%
RIS 7-3	Bridges 1	5.09%
RIS 7-5	VRD 1	5.09%
RIS 7-6	Hydrogeology and hydraulic structures 1	6.79%
RIS 7-7	Urban planning	7.13%
RIS 7-8	Drinking water network: operation and flow diagram	4.58%
RIS 7-9	Geotechnical surveys	4.07
RIS 7-10	GTR classification of materials	6.11%
RIS 7-11	Earthworks 1	5.09%
SAÉ for competence C1		**%**
SAÉ 7-3	Work placement period	100%

Competency C2 – Prescribing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
FISEA 7-3	English S7	22.33%
RIS 7-1	Road infrastructure 1	7.44%
RIS 7-2	Rail infrastructure 1	5.96%
RIS 7-3	Bridges 1	7.44%
RIS 7-5	VRD 1	7.44%
RIS 7-6	Hydrogeology and hydraulic structures 1	9.93%
RIS 7-7	Urban Planning	10.42%
RIS 7-8	Drinking water network: operation and flow diagram	6.7 %
RIS 7–9	Geotechnical studies	5.96%
RIS 7-10	GTR classification of materials	8.93%
RIS 7-11	Earthworks 1	7.44%
SAÉ for competence C2		**%**
SAÉ 7-3	Work placement period	100%

Competence C3 – Dimensioning structures and systems

Resources for Competency C3		%
FISEA 7-5	Differential systems	17.8 %
R 7-6	RdM 9: Structural modelling and optimisation 1	19.58%
RIS 7-1	Road Infrastructure 1	8.9%
RIS 7-2	Rail infrastructure 1	7.12%
RIS 7-3	Bridges 1	8.9%
RIS 7-5	VRD 1	8.9%
RIS 7-6	Hydrogeology and Hydraulic Structures 1	11.87%
RIS 7-8	Drinking water network: operation and flow diagram	8.01%
RIS 7-11	Earthworks 1	8.9%
SAÉ under C3 responsibility		**%**
SAÉ 7-3	Work placement period	100%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
R 7-1	Management 6: Project management	16%
R 7-2	Management 3: HRM, behavioural psychology and conflict management	28.8%
RIS 7-1	Road Infrastructure 1	8%
RIS 7-2	Rail infrastructure 1	6.4%
RIS 7-3	Bridges 1	8%
RIS 7-5	VRD 1	8%
RIS 7-8	Drinking water network: operation and flow diagram	7.2 %
RIS 7-10	GTR classification of materials	9.6%
RIS 7-11	Earthworks 1	8 %
SAÉ for competence C4		**%**
SAÉ 7-3	Work placement period	100%

Semester 7 – MHS pathway

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
R 7-1	Management 6: Project Management	10.42%
FISEA 7-3	English S7	15.62%
FISEA 7-5	Differential Systems	10.42%
R 7-6	RdM 9: Modelling and optimisation of structures 1	11.46%
MHS 7-1	Design of Assembled Structures 1: Timber 1	6.94%
MHS 7-2	Design of Assembled Structures 2: Metal 1	6.94%
MHS 7-3	Structural analysis: prefabricated elements	6.94%
MHS 7-5	Methods 1: project context, construction methods, work rates, lifting, PIC	5.21%
MHS 7-6	Formwork tools: design, sizing	5.21%
MHS 7-7	Temporary stability and shoring 1: common elements	5.21%
MHS 7-8	Numerical modelling and BIM 1	6.25
MHS 7-9	Project Coordination 1: technical and planning aspects	4.69%
MHS 7-10	Organisation and management of prefabrication 1	4.69%
SAÉ for competence C1		**%**
SAÉ 7-3	Work placement period	100%

Competency C2 – Prescribing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
FISEA 7-3	English S7	23.08%
MHS 7-1	Design of Assembled Structures 1: Timber 1	10.26%
MHS 7-2	Design of Assembled Structures 2: Steel 1	10.26%
MHS 7-3	Structural analysis: prefabricated elements	10.26%
MHS 7-5	Methods 1: project context, construction methods, work rates, lifting, PIC	7.69
MHS 7-6	Formwork tools: design, sizing	7.69%
MHS 7-7	Temporary stability and shoring 1: common elements	7.69
MHS 7-8	Numerical modelling and BIM 1	9.23
MHS 7-9	Project Coordination 1: technical and planning aspects	6.92%
MHS 7–10	Organisation and management of prefabrication 1	6.92%
SAÉ for competence C2		**%**
SAÉ 7-3	Work placement period	100%

Competence C3 – Dimensioning structures and systems

Resources for Competency C3		%
FISEA 7-5	Differential systems	15.38%
R 7-6	RdM 9: Structural modelling and optimisation 1	16.92%
MHS 7-1	Design of Assembled Structures 1: Timber 1	10.26%
MHS 7-2	Design of assembled structures 2: steel 1	10.26%
MHS 7-3	Structural analysis: prefabricated elements	10.26%
MHS 7-5	Methods 1: project context, construction methods, work rates, lifting, PIC	7.69
MHS 7-6	Formwork tools: design, sizing	7.69 %
MHS 7-7	Temporary stability and shoring 1: common elements	7.69%
MHS 7-9	Coordination of Design and Construction 1: technical aspects, planning	6.92%
MHS 7-10	Organisation and management of prefabrication 1	6.92%
SAÉ for competence C3		**%**
SAÉ 7-3	Work placement period	100%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
R 7-1	Management 6: Project management	17.24%
R 7-2	Management 3: HRM, behavioural psychology and conflict management	31.03%
MHS 7-5	Methods 1: project context, construction methods, work rates, lifting, PIC	8.62%
MHS 7-6	Formwork tools: design, sizing	8.62%
MHS 7-7	Temporary stability and shoring 1: common elements	8.62%
MHS 7-8	Numerical modelling and BIM 1	10.34
MHS 7-9	Project Coordination 1: technical and planning aspects	7.76
MHS 7–10	Organisation and management of prefabrication 1	7.76%
SAÉ for competence C4		**%**
SAÉ 7-3	Work placement period	100%

R 7-1 – Management 6: Project Management

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration
Lecture.....3 hours
Tutorial.....9 hours
Tutorial.....3 hours
Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

- Scientific and technological foundation enabling work on simple topics relating to technological innovation or design
- Project management (scheduling, planning)

Objectives

- To carry out a multidisciplinary technical project as part of a team, applying methods and tools for the analysis and design of products and/or systems, whilst drawing on scientific and technical knowledge to address a real-world problem
- Apply project monitoring, communication and organisational methods to ensure smooth and effective communication amongst all project stakeholders (client, technical experts)
- Master project management tools and methods: (costs/budgets, deadlines, performance, risks)

Programme

In response to a programme set by a stakeholder from within or outside ISA BTP (company, researcher, etc.) on a research and development topic, students will work in groups to devise and implement a technical solution.

The student groups will be supervised by:

- A tutor (a member of the ECTI association) responsible for non-technical support
- A project lead (lecturer), responsible for technical support
- An academic coordinator responsible for organising all the projects

Key learning outcomes

- Drafting a project specification approved by the client (including a project schedule)
- Deliver a 'pitch' presentation
- Drafting meeting minutes and monitoring the project
- Work collaboratively as part of a team
- Manage cost, deadline and performance constraints

Bibliography

- *Project Management*, J.-C. Corbel, Éditions d'Organisation
- *Project Management*, AFITEP, AFNOR
- Agile project management methods

Keywords: Project management, R&D, innovation, specifications, teamwork, pitch

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ÉCOLE D'INGÉNIEURS

ISA BTP
FORMATION INGÉNIEUR

R 7-2 - Management 3: HRM, behavioural psychology and conflict management

Timetable
Term 7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....7.5 hours
Tutorials.....6 hours
Total **1.30**

Targeted skill(s)
C4 – Managing a construction organisation

Prerequisites

- R 4-1: Management 1: Sociology of work and stakeholder dynamics
- R 6-1: Management 2: HRM, recruitment and induction of employees

Objectives

- To understand the components of human psychology
- To understand the relationships between these components
- To discover tools for changing behaviour in the workplace
- Develop a strategy for behaviour change
- Put this strategy into practice

Programme

- **6 lecture sessions, each lasting 1½ hours**:
  - Behaviour and management: human behaviour, management tools
  - The mechanics of behaviourism: the origin and development of thought, irrational behaviour and logical fallacies
  - Behavioural management tools: the habit loop, the MINDSPACE and EAST methods
- **6 practical sessions in small groups, each lasting 1h30**:
  - Development of management procedures incorporating behavioural psychology tools: safety, cheating, hygiene, motivation, etc.

Key learning outcomes

- Understanding the different dimensions of human psychology
- Understanding the mechanisms of cognitive engagement with the environment and logical biases
- Mastery of behaviour modification tools
- Assessment of the effects and limitations of the tools

Bibliography

- Lewin, K. (1947). *Group decision and social change*. Readings in Social Psychology, 3(1), 197–211.
- Ariely, D. *The Economics of Everyday Life*.
- Nicholson, N. (1997). *Evolutionary psychology: Towards a new view of human nature and organisational society*. Human Relations, 50(9), 1053–1078.
- Blake, R., & Mouton, J. (1969). *The Two Dimensions of Management*. Les Éditions d'Organisation.
- Kahneman, D. (2003). *Psychology Can Shed Light on Economics*. La Recherche, no. 365, June 2003.
- Kahneman, D., & Tversky, A. (1974). *Judgement under Uncertainty: Heuristics and Biases*. Science, New Series, vol. 185, no. 4157, pp. 1124–1131.

Keywords: Behavioural psychology, cognitive biases

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ISA BTP
FORMATION INGÉNIEUR

R 7-6 - RdM 9: Structural Modelling and Optimisation 1

Timetable	
Semester	7
Period	Oct. – Jan.
Face-to-face	

Assessment
Continuous assessment

Duration	
CM	1h30
Practical hours	6
Tutorial hours	9
Total	16.30

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

- Concrete and EC2 modules: ISA 1, 2 and 3
- Steel and EC3 courses: ISA 1, 2 and 3
- Mechanics: ISA 1, 2 and 3

Objectives

- To optimise the design and mechanical behaviour of structures in order to minimise stresses in load-bearing members
- To optimise the geometry of mechanical models of 'thin-walled structures'
- To optimise design in accordance with current regulations (Eurocodes)
- To understand the various optimisation approaches: structural form, design system, optimisation based on legal load requirements
- To study and apply the concepts of funicular forms, arches and under-tension systems

Programme

- Mechanical analysis of complex buildings and structures
- Structural design of concrete and steel structures
- Optimisation of structural form and design systems
- Analysis of cable-supported structures and arches
- Study of tension-bearing systems and their applications 277

Key learning outcomes

- Identify optimisation strategies suited to a given structure
- Model and dimension complex concrete and steel structures
- Apply the concepts of catenary shapes and sub-tension in practical situations
- Incorporate regulatory requirements (Eurocodes) into the optimised design
- Compare several structural solutions and select the most appropriate one

Bibliography

- Eurocodes 2 and 3
- Engineering Techniques
- *Design of Building Structures*, Y. Jalil, Éditions du Moniteur
- *Form and Forces*, E. Allen and W. Zalewski, Wiley

Keywords: Structural optimisation, funicular forms, arches, tension, design, Eurocodes

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ÉCOLE D'INGÉNIEURS

ISA BTP
FORMATION INGÉNIEUR

FISE 7-3 - English S7

Timetable	
Semester	7
Period	Oct. – Jan.
Face-to-face in person	

Assessment
Continuous assessment

Duration	
Tutorial	22.30
Total	**22h30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 – Prescribing technical solutions for sustainable and more durable construction

Prerequisites

Level B1

Objectives

- To achieve level B2 in expression, according to the CEFR
- Develop clear and natural communication skills, both spoken and written
- To defend a point of view on general topics, highlighting the pros and cons
- Write clear and well-structured texts on a variety of topics

Programme

- Oral presentations on complex topics
- Debates and reasoned discussions
- Public speaking exercises in a professional context
- Writing short, concise documents (reports, summaries, memos)
- Role-play: negotiations and exchanges in a professional setting

Key learning outcomes

- Mastering the communication skills required at B2 level
- Expressing oneself spontaneously and correctly in English
- Producing clear, precise and coherent written work
- To present and defend ideas orally
- Interact effectively in a professional context 279

Bibliography

- CEFR (Common European Framework of Reference for Languages) – official website
- Resources for preparing for international qualifications (TOEIC, IELTS, Cambridge)

Keywords: CEFR, B2, business English, speaking, writing, argumentation

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ISA BTP
FORMATION INGÉNIEUR

FISE 7-5 – Differential Systems

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorials.....6 hours
Tutorial.....1.30 pm

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

- Quantitative and qualitative solution of ordinary differential equations
- Basic programming in Python

Objectives

- To be able to solve and interpret linear differential systems in all dimensions
- To develop a qualitative understanding of non-linear differential systems
- Be able to implement various numerical methods for solving differential systems and compare them

Syllabus

- Exact solution of linear differential systems
- Qualitative analysis of non-linear differential systems
- Numerical solution of differential systems: Euler and RK methods.

Key learning outcomes

- Mastering techniques for solving linear differential systems
- Interpreting solutions in an engineering context
- Qualitatively analyse non-linear dynamic behaviour (equilibrium points, phase portraits)
- Be able to use numerical tools to study differential systems 281

Bibliography

- *Differential Equations*, A. Haraux, Ellipses
- *Advanced Mathematics Course*, Ramis, Deschamps, Odoux
- Lecture notes available at `http://mabouzai.perso.univ-pau.fr/`

Keywords: Differential systems, differential equations, phase portrait, Runge-Kutta

FISE 7-7 - Organisation 9: Electrical Installations – Construction Site Applications

Timetable	
Semester	7
Period	Oct. – Jan.
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	7.30 am
Tutorial	7.30
Total	**15 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Basic knowledge of electricity
- Construction site management modules

Objectives

- To understand the basic principles of electrical installations on building sites
- To be familiar with the regulations governing electrical safety on construction sites
- Sizing a temporary electrical installation for a construction site
- Identifying electrical hazards and preventive measures

Programme

- Regulations and standards applicable to electrical installations on construction sites
- Basic principles of electricity: voltage, current, power
- Sizing installations: power calculations, selection of cables and protective devices
- Electrical equipment on construction sites: switchboards, distribution boxes, sockets
- Electrical safety: risks, protective measures, authorisations
- Electrical diagrams and installation plans

Key learning points

- Applying electrical regulations on construction sites
- Calculating a construction site's power requirements
- Selecting the correct cable sizes and electrical protection devices
- Identify electrical risks and propose preventative measures
- Reading and interpreting a site electrical diagram

Bibliography

- NF C 15-100: Low-voltage electrical installations
- UTE C 18-510 Practical Guide: Electrical authorisations
- *Electrical installations on construction sites*, OPPBTP
- Suppliers' technical guides (Legrand, Schneider Electric)

Keywords: Electrical installation, construction site, safety, sizing, regulations, authorisation

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FORMATION INGÉNIEUR

FISEA 7-3 - English S7

Timetable	
Semester	7
Period	Oct. – Jan.
Face-to-face in person	

Assessment
Continuous assessment

Duration	
Tutorial	22.30
Total	**22h30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

Level B1

Objectives

- To achieve level B2 in expression, according to the CEFR
- Develop clear and natural communication skills, both spoken and written
- To defend a point of view on general topics, highlighting the pros and cons
- Write clear and well-structured texts on a variety of topics

Programme

- Oral presentations on complex topics
- Debates and reasoned discussions
- Public speaking exercises in a professional context
- Writing short, concise documents (reports, summaries, memos)
- Role-play: negotiations and exchanges in a professional setting

Key learning outcomes

- Mastering the communication skills required at B2 level
- Expressing oneself spontaneously and correctly in English
- Producing clear, precise and coherent written work
- To present and defend ideas orally
- Interact effectively in a professional context 285

Bibliography

- CEFR (Common European Framework of Reference for Languages) – official website
- Resources for preparing for international qualifications (TOEIC, IELTS, Cambridge)

Keywords: CEFR, B2, business English, speaking, writing, argumentation

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FORMATION INGÉNIEUR

FISEA 7-5 – Differential Systems

Timetable	
Semester	7
Period	Oct. – Jan.
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	9 hours
Tutorials	6 hours
Total	**15h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

- Quantitative and qualitative solution of ordinary differential equations
- Basic programming in Python

Objectives

- To be able to solve and interpret linear differential systems in any dimension
- To develop a qualitative understanding of non-linear differential systems
- Be able to implement various numerical methods for solving differential systems and compare them

Syllabus

- Exact solution of linear differential systems
- Qualitative analysis of non-linear differential systems
- Numerical solution of differential systems: Euler and RK methods.

Key learning outcomes

- Mastering techniques for solving linear differential systems
- Interpreting solutions in an engineering context
- Qualitatively analyse non-linear dynamic behaviour (equilibrium points, phase portraits)
- Be able to utilise numerical tools for the study of differential systems 287

Bibliography

- *Differential Equations*, A. Haraux, Ellipses
- *Advanced Mathematics Course*, Ramis, Deschamps, Odoux
- Lecture notes available at `http://mabouzai.perso.univ-pau.fr/`

Keywords: Differential systems, differential equations, phase portrait, Runge-Kutta

Institut Supérieur Aquitain
ÉCOLE D'INGÉNIEURS

ISA BTP
FORMATION INGÉNIEUR

BCR 7-1 – Soil Mechanics 1: Earth pressure, retaining structures

Timetable
Semester.....7
Term.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM	10.30 am
Tutorial	10.30
Total	**9.00 pm**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- Basic concepts of soil mechanics
- Basics of statics and structural equilibrium

Objectives

- To understand the mechanisms of earth pressure and earth resistance
- To be familiar with the main theories (Coulomb, Rankine, Caquot-Kérisel)
- Apply these concepts to the design of retaining structures

Syllabus

- States of rest, active earth pressure and passive earth pressure
- Rankine's and Coulomb's theories
- The Caquot and Kérisel approach
- Cohesive and non-cohesive soils
- Applications to retaining walls and walls

Key learning points

- Determining earth pressure and bearing forces
- Selecting the appropriate theory based on soil type and the structure
- Incorporating these forces into the design of retaining structures 289

Bibliography

- *Tables of Earth Pressure and Earth Retaining Forces*, A. Caquot, J. Kérisel, Eyrolles
- *Principles of Geotechnical Engineering*, B.M. Das, Cengage

Keywords: Earth pressure, earth retaining structures, Rankine, Coulomb, Caquot-Kérisel, retaining structures, soil mechanics

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ÉCOLE D'INGÉNIEURS

ISA BTP
FORMATION INGÉNIEUR

BCR 7-2 – Design of Structures 1: Reinforced Concrete

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM	15h
Tutorial	15 hours
Total	**30 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- Reinforced concrete: Resources BA1 (R4-12), BA2 (R5-10), BA3 (R6-11)
- Soil mechanics: design and stability of foundations and retaining walls

Objectives

- To be familiar with the vocabulary and technologies associated with the construction of common infrastructure structures (shallow foundations, deep foundations, raft foundations and caisson walls, retaining structures, buried walls)
- Understand how these structural elements function
- Be able to quickly produce calculation notes for these structures
- Analyse and interpret a calculation report and/or set of drawings provided by a design consultancy for this type of structure
- Verify that the design consultancy's proposals are consistent with the chosen construction methods
- Use structural analysis software

Programme

Dimensioning – Concrete and reinforcement – construction details:

- Reinforced concrete floor
- PàF balconies
- Short cantilevers
- Flag-shaped walls
- Shallow foundations 291

- Deep foundations
- BA underground walls
- Wall beams
- Retaining walls

Key learning points

- Mastering the design principles for the elements mentioned above

Bibliography

- Regulatory texts: Eurocodes
- *Handbook of Civil Engineering Structures*, Nataf, Pralat, Nathan Afnor
- *Reinforced Concrete Handbook*, Pierre Guillemont, Le Moniteur
- *Design and Calculation of Building Structures*, H. Thonier, Presses de l'ENPC
- *Treatise on Civil Engineering*, École Polytechnique Fédérale de Lausanne (24 volumes of the RDM series, covering structures and materials, etc.), Presses Polytechniques et Universitaires Romandes
- *Engineering Techniques*, electronic version provided by the University Library
- *The Encyclopaedia of Building*
- COBAZ: all regulations and standards available online via the UPPA
- Journals and technical documentation

Keywords: Reinforced concrete, design, Eurocode 2, calculation note

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ISA BTP
FORMATION INGÉNIEUR

BCR 7-3 – Technology of Historic Buildings 1

Timetable
Semester.....7
Term.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM	15h
Tutorial	15 hours
Total	**30 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 – Specify technical solutions for sustainable and more durable construction
C3 – Designing structures and systems
C4 - Manage a construction organisation

Prerequisites

- Previous chemistry modules
- Previous modules on materials, in particular Resource R6-14 'Materials 7: defects'
- Previous technology modules

Objectives

- To understand the main structural defects in buildings: deformations, cracking, etc.
- Propose appropriate repairs and reinforcement measures

Syllabus

- Analysis of defects in concrete, steel, timber and masonry structures
  - Observation of deformations and cracks
  - Analysis of observations and investigation of causes
- Proposals for structural repairs
- Fire damage
- Cases involving the presence of asbestos and lead

Key lessons learnt

- Recognising the main structural defects in buildings
- Knowing how to propose a structural repair solution 293

Bibliography

- *Structural Defects in Timber Structures*, Jean-Pierre Biger, Techniques de l'Ingénieur
- *Foundation Defects*, Jean Delefosse, Techniques de l'Ingénieur
- *Structural Defects and Maintenance in Buildings – Introduction and Developments*, Claude Saint Martin, Techniques de l'Ingénieur
- *Structural Defects, Diagnosis, Prevention and Maintenance*, Michel Lor, Techniques de l'Ingénieur
- *Pathologies of Reinforced Concrete – Design and Calculation Errors*, Jean Delefosse, Techniques de l'Ingénieur
- *Steel Structures – Defects in Steel Structures*, Jacques Mayère, Techniques de l'Ingénieur
- *Maintenance, Renovation and Refurbishment of Buildings*, Le Moniteur
- *Cut Stone*, Jean-Marc Laurent, Eyrolles
- *Restoration of Cut-Stone Façades*, Jean-Marc Laurent, Eyrolles

Keywords: Deterioration, concrete structures, steel structures, timber structures, masonry structures

BCR 7-4 – Assessment 1: structure

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial.....9 hours
Total.....**18h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- Previous technology modules
- Previous materials modules
- Previous structural analysis modules

Objectives

- To understand the main techniques used to carry out a structural assessment of building structures
- To establish a method for carrying out an assessment of common reinforced concrete, steel, timber and masonry structures
- To analyse a structural assessment
- Propose repairs and reinforcement measures in response to a structural assessment

Syllabus

- Detailed presentation of the main diagnostic methods for common structures: application to reinforced concrete, steel, timber and masonry structures
  - Non-destructive methods
  - Methods involving sampling and laboratory analysis
- Practical work on structural assessments
  - Critical analysis of the assessment
  - Possible proposals for additional work or modifications
  - Proposal of repair or reinforcement solutions in line with the findings of the assessment

Key lessons learnt

- Propose the analyses to be carried out to obtain an assessment of a structure exhibiting common defects
- Be able to analyse a diagnostic assessment of a simple building structure and propose repair and/or reinforcement solutions

Bibliography

- *The Rehabilitation of Structures in Historic Buildings: Materials, Calculations, Diagnosis and Rehabilitation*, Alain Popinet, Le Moniteur, 2023
- *Structural Defects, Diagnosis, Prevention and Maintenance*, Michel Lor, Techniques de l'Ingénieur
- *Diagnosis and Restoration of Stone Masonry*, Kévin Beck, Xavier Brunetaud, Sarah Janvier-Badosa, Olivier Rolland, Techniques de l'Ingénieur

Keywords: Diagnosis, structure, non-destructive testing

BCR 7-5 – Materials with low environmental impact

Timetable	
Semester	7
Period	Oct. – Jan.
Face-to-face	

Assessment
Continuous assessment

Duration	
CM	15h
Tutorial	15 hours
Total	**30 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- LCA (Life Cycle Assessment)
- Materials: eco-friendly building materials, in particular R6-15 'Eco-friendly and innovative materials'

Objectives

- To analyse and compare the environmental impact of construction solutions using a simplified LCA
- To evaluate and justify technological choices within a real-world project context
- Propose construction solutions with low environmental impact by applying one's knowledge critically

Syllabus

- Identification of various construction solutions using bio-based and geosourced materials
- Application to an existing building
- Implementing bio- and geosourced solutions as a replacement for a traditional masonry solution. Assessing the technological impact on the building. Specifying the chosen construction solutions and justifying them

Key learning points

- Comparing several construction solutions whilst taking environmental and technical criteria into account
- Justify a choice of materials in a real-world project based on the results of a simplified LCA
- Apply the knowledge gained on innovative bio- and geosourced materials to develop realistic construction solutions suited to the site context

Bibliography

- *Better Design and Construction with Raw Earth – Rammed Earth*, Vincent Venzal
- *Building with cut stone today*, Gilles Perraudin
- *Study on the sector and production chains for bio-based materials and products used in construction*, Nomadeis
- *Bio-based construction materials in public procurement*, Ministry for Ecological and Solidarity Transition
- *Bio-based and geosourced building materials*, Ministry for Ecological and Solidarity Transition

Keywords: LCA, materials, environmental impact

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ÉCOLE D'INGÉNIEURS

ISA BTP
FORMATION INGÉNIEUR

GCM 7-1 – Soil mechanics: earth pressure, retaining structures

Timetable	
Semester	7
Period	Oct. – Jan.
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	10.30 am
Tutorial	10.30
Total	**9.00 pm**

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

- Fundamentals of soil mechanics
- Fundamentals of statics and structural equilibrium

Objectives

- To understand the mechanisms of earth pressure and earth resistance
- To be familiar with the main theories (Coulomb, Rankine, Caquot-Kérisel)
- Apply these concepts to the design of retaining structures

Syllabus

- States of rest, active earth pressure and passive earth pressure
- Rankine's and Coulomb's theories
- The Caquot and Kérisel approach
- Cohesive and non-cohesive soils
- Applications to retaining walls and walls

Key learning points

- Determining earth pressure and bearing forces
- Selecting the appropriate theory based on soil type and the structure
- Incorporating these forces into the design of retaining structures 299

Bibliography

- *Tables of Earth Pressure and Earth Retaining Forces*, A. Caquot, J. Kérisel, Eyrolles
- *Principles of Geotechnical Engineering*, B.M. Das, Cengage

Keywords: Earth pressure, earth retaining structures, Rankine, Coulomb, Caquot-Kérisel, retaining structures, soil mechanics

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ISA BTP
FORMATION INGÉNIEUR

GCM 7-2 – Structural Design 1: Reinforced Concrete

Timetable
Semester.....7
Term.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM	10.30 am
Tutorial	10.30
Total	**9.00 pm**

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 – Designing structures and systems

Prerequisites

- Reinforced concrete: Resources BA1 (R4-12), BA2 (R5-10), BA3 (R6-11)
- Soil mechanics: design and stability of foundations and retaining walls

Objectives

- To be familiar with the terminology and technologies associated with the construction of common infrastructure structures (shallow foundations, deep foundations, raft foundations and caisson walls, retaining structures, buried walls)
- To understand how these structural elements function
- To be able to quickly produce calculation notes for these structures
- To analyse and interpret a calculation report and/or set of drawings provided by a design consultancy for this type of structure
- Verify that the design consultancy's proposals are consistent with the chosen construction methods
- Use structural analysis software

Programme

Dimensioning – Concrete and reinforcement – construction details:

- Reinforced concrete floor
- PàF balconies
- Short cantilevers
- Flag-shaped walls
- Shallow foundations
- Deep foundations 301

- BA underground walls
- Wall beams
- Retaining walls

Key learning points

- Master the principles of dimensioning the elements mentioned above

Bibliography

- Regulatory texts: Eurocodes
- *Handbook of Civil Engineering Structures*, Nataf, Pralat, Nathan Afnor
- *Reinforced Concrete Handbook*, Pierre Guillemont, Le Moniteur
- *Design and Calculation of Building Structures*, H. Thonier, Presses de l'ENPC
- *Treatise on Civil Engineering*, École Polytechnique Fédérale de Lausanne (24 volumes of the RDM series, covering structures and materials, etc.), Presses Polytechniques et Universitaires Romandes
- *Engineering Techniques*, electronic version provided by the University Library
- *The Encyclopaedia of Building*
- COBAZ: all regulations and standards available online via the UPPA
- Journals and technical documentation

Keywords: Reinforced concrete, design, Eurocode 2, calculation note

GCM 7-3 – Wave theory – Introduction to propagation

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM	12 hours
Tutorials	20.30
Total	**32h30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

- Physics: Mechanics of incompressible fluids
- Mathematics: limit expansions, vector operators

Objectives

- To acquire a basic understanding of linear wave theory
- To develop an understanding of the physical aspects of surface waves
- To be able to apply this knowledge to practical cases

Syllabus

This course focuses on the theory of gravity waves, which governs not only conventional swells but also long waves such as tides, seiches and tsunamis. The course programme includes:

- Linear wave theory
- Properties of waves
- Long waves
- Irregular swell: statistical and spectral theory
- Numerical simulation

Each chapter of the course is followed by a set of exercises enabling students to apply their new knowledge to practical cases in the field of coastal or maritime engineering. The module concludes with a supervised exam and a mini simulation project based on the TOMAWAC code.

Key learning outcomes

- Master the theory of linear waves and its applications
- Analysing the properties of waves and long waves
- Apply statistical and spectral theory to irregular waves
- Use numerical simulation tools to model wave propagation

Bibliography

- *Water Wave Mechanics for Engineers and Scientists. Advanced Series on Ocean Engineering – Volume 2*, Dean, R.G., Dalrymple, R.A., 1991
- *Coastal Engineering Manual*, 2008. Part II – Coastal Hydrodynamics – Chapters 1, 3, 5, 7

Keywords: Swell, gravity waves, wave propagation, numerical simulation, coastal engineering, TOMAWAC

GCM 7-4 – Marine and Port Structures 1

Timetable	
Semester	7
Period	Oct. – Jan.
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	6.5 hours
Tutorials	6 hours
Total	**12.30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 – Managing a construction organisation

Prerequisites

- R2-14: Technology 4: Engineering Structures – Civil Engineering
- Soil resources: S5 (R5-13 and R5-14)

Objectives

- To understand the main types of port structures
- To understand construction methods used on maritime and port sites

Syllabus

- General overview of ports and associated works
- Introduction to the design of port structures
- Site visits to port construction sites

Bibliography

ROSA 2000: Application of the Eurocodes to maritime and inland waterway structures, Press of the École Nationale des Ponts et Chaussées.

GCM 7-5 – Earthworks

Timetable
Semester.....7
Term.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM	1.30 pm
Tutorial	1.30 pm
Total	**27**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- Fundamentals of geology and the identification of natural materials
- Physical, chemical and mechanical properties of soils
- Topography: site surveys, levelling, contour lines, longitudinal profiles, cross-sections, volume calculations

Objectives

- Selecting equipment for earthworks
- To study the organisation of an earthworks site, taking safety parameters into account
- Calculate the costs of an earthworks project

Syllabus

- Different types of earthworks projects: earthworks for the construction of structures, construction of earthworks structures, road earthworks (excavation – backfilling)
- Criteria for selecting techniques and equipment
- Equipment and its performance
- Structuring earthworks stages
- Calculating productivity and costs
- Health and safety on earthworks sites

Key learning points

- Identifying the different types of earthworks sites
- Selecting the appropriate equipment based on technical and economic criteria
- Organise an earthworks site in accordance with safety regulations
- Calculate productivity and assess the costs of a project

Bibliography

- *Earthworks and Earthen Structures*, G. Philiponnat and B. Hubert, Eyrolles
- Online: Encyclopaedia *of Engineering Techniques*

Keywords: Earthworks, construction equipment, excavated material, backfill, productivity, costs, safety, site organisation

GCM 7-6 - Bridges 1

Timetable	
Semester	7
Period	Oct. – Jan.
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorials	7h30
Total	**15 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Technology resources:
  - R1-13: Technology 2: General Principles of Road and Drainage Works – Roads – Earthworks
  - R2-14: Technology 4: Engineering Structures – Civil Engineering
  - R5-17: Technology 6: Introduction to Planning and Urban Development
- RDM Resources: RdM1 to RdM7
- Soils Resources: Soils 1 to Soils 4
- Organisation Resources:
  - R4-17: Organisation 6: Shoring and Formwork
  - R4-18: Organisation 7: Civil Engineering Site Methods
- SAÉ 4-2 "End-of-Year Project: roads, engineering structures, developments, roads and utilities"

Objectives

- To understand the different types of crossing and retaining structures
- To carry out preliminary design of civil engineering structures

Syllabus

- Types and construction principles of common engineering structures
- Preliminary design of structures: longitudinal bending of deck slabs and stability of abutments
- Finite element modelling for common engineering structures
- Interfaces between civil engineering works and earthworks

Key learning outcomes

- Mastery of the terminology relating to common engineering structures and their construction methods.
- Mechanical modelling of structures using 1D beam-type elements

Bibliography

SETRA and CEREMA technical guides

Keywords: civil engineering structures, technology, modelling

H&E 7-1 – Secondary structures 1: facades and technology

Timetable	
Semester	7
Period	Oct. – Jan.
Face-to-face	

Assessment
Continuous assessment

Duration	
Total	**7.30 pm**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Basic knowledge of structures and materials (concrete, steel, timber)
- Reading and understanding technical drawings (PRO)

Objectives

- To understand the technical principles of façades and cladding systems
- Identify the different types of façades: metal cladding, timber cladding, glass façades, curtain walls, etc.
- Be familiar with the regulations and technical requirements applicable to façades
- To be familiar with fixing elements and their role in façade design

Programme

- Cladding fitted to a secondary metal and timber framework
- Glass façades and curtain wall systems
- Regulations and technical requirements for façades
- Fixing elements: anchors, brackets and accessories

Key learning points

- Knowing how to specify the appropriate technical solution for a given type of façade
- Identifying regulatory and standard-related constraints for design
- Understand the fasteners required depending on the framework and substrate
- Read and interpret the DTUs relating to façades and cladding
- Design a cladding fixing detail

Bibliography

- Eurocodes
- Engineering techniques
- DTU 41.2: External timber cladding
- DTU 33.1: Curtain walls
- NF DTU 32.1: Steel construction – Steel frames

Keywords: Facade, cladding, framework, fixing, regulations, glass, finishing works

H&E 7-2 – Thermodynamic systems

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face

Assessment
Continuous assessment

Duration
Total.....30 hours
Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

Thermodynamics, Thermal Engineering, Fluid Mechanics, Building Technology

Objectives

- Study of cooling requirements for a building (residential or commercial)
- Applying thermodynamics to real-world machines to assess their performance

Syllabus

Single-stage refrigeration machine:

- Principle, Installation examples, Enthalpy diagram, Basic refrigeration cycles, System characteristics, Refrigerants, Use of manufacturers' software

Refrigeration equipment:

- Refrigeration principles used in air conditioning, System technology, Equipment selection: liquid chillers, heat pumps, condensing units, use of equipment selection software (Bitzer, Frigabohn, Copeland)
- Controls and safety of refrigeration systems
- Calculation of air-conditioning loads

Key learning outcomes

- Understanding how a compression refrigeration machine works
- Plotting and analysing a refrigeration cycle on an enthalpy diagram
- Calculating the performance of a refrigeration system (COP, power)
- Understanding the techniques involved in installing refrigeration systems
- Sizing a refrigeration system
- Selecting the appropriate equipment using manufacturers' software

Bibliography

- *Mémotech Energy Engineering*
- Supplier documents (Bitzer, Copeland, Friga Bohn)
- *Industrial Refrigeration*, P. Rapin, P. Jacquard, Dunod
- Engineering Techniques

Keywords: Refrigeration, refrigeration cycle, enthalpy diagram, air conditioning, heat pump, refrigerants

H&E 7-3 – Heat exchangers

Timetable
Semester.....7
Term.....Oct. – Jan.
Face-to-face

Assessment
Continuous assessment

Duration
Total.....30 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 – Designing structures and systems

Prerequisites

Thermodynamics, Fluid Mechanics

Objectives

- To understand how a heat exchanger works
- Be able to determine the thermal performance of a heat exchanger
- Propose technical solutions to improve performance
- Explore ways of recovering heat from existing systems

Syllabus

Heat exchangers: technology and heat transfer mechanisms

- Theoretical study: calculation of the convection coefficient
- Efficiency of a heat exchanger
- Heat recovery: case studies

Key learning points

- Identify the different types of heat exchangers and their applications
- Calculate the overall heat transfer coefficient
- Determine the efficiency of a heat exchanger
- Size a heat exchanger according to requirements
- Analyse opportunities for heat recovery in a system
- Propose technical solutions to improve energy performance

Bibliography

- Engineering Techniques
- Technical documentation
- *Heat Transfer*, J.-L. Battaglia et al., Dunod
- *Heat Exchangers*, J. Padet, Masson

Keywords: Heat exchanger, thermal efficiency, heat recovery, convection, heat transfer

H&E 7-4 – Industrial equipment and installations

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face

Assessment
Continuous assessment

Duration
Total.....15 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- Physics
- Fluid Mechanics

Objectives

- To analyse the functionality of an existing energy system
- Commission installations, carry out checks and adjustments to optimise the installation

Syllabus

Functional and structural analysis:

- Schematic diagram
- Identification of the various components

Behavioural analysis:

- Operation and use of measuring instruments
- Commissioning procedure
- Adjustments and checks of nominal air flow rates and pressures
- Adjustment and checking of nominal hydraulic flow rates and pressures
- Performance checks

Practical training facilities (examples):

- KIMO air handling test bench
- AIC hybrid heat pump heating test rig (heat pump + gas boiler + storage tank)
- Salmson hydraulic test bench
- Domestic wiring

Key skills

- Knowing how to use measuring instruments
- Commissioning a system
- Checking a system
- Calculating the performance of a system

Keywords: Technical equipment, industrial installations, measurement, commissioning, inspection, performance, hydraulics, aerodynamics

H&E 7-5 – Dynamic thermal simulation 1

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face

Assessment
Continuous assessment

Duration
Total **13h30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

Calculation of heat loss, Thermal regulations, Materials and Construction Technology

Objectives

- To be able to adapt construction solutions to ensure different levels of comfort for users through dynamic thermal simulation
- To understand the requirements of thermal regulations and the environmental approach to a construction project through dynamic thermal simulation
- To predict the thermal behaviour of a building

Syllabus

Software overview: Comfie (calculation engine), Pleiades (data entry interface for building management, calculation and results analysis libraries, and data entry and display interface for the building)

Case study:

- Modelling a simple building
- Simulation of the current condition
- Analysis of results
- Simulation of different scenarios to improve thermal comfort
- Verification of requirements (regulatory, energy efficiency labels, etc.)

Key lessons learnt

- Formulating clear assumptions and implementing them in the software
- Modelling a building in dynamic thermal simulation software
- Analysing results and identifying possible sources of error
- Presenting the results in a study report in a clear and relevant manner

- Propose improvement measures in order to identify the optimal solution that meets a range of requirements (client, regulations, climate, location, project type, etc.)
- Be able to explain and justify these choices verbally

Bibliography

- Technical documentation from the software publisher, Izuba Energies
- Pleiades-Comfie user guide
- Current thermal regulations

Keywords: Dynamic thermal simulation, Pleiades, Comfie, thermal comfort, regulations, modelling

H&E 7-6 - GAO - Geometric models

Timetable
Semester.....7
Term.....Oct. – Jan.
Face-to-face

Assessment
Continuous assessment

Duration
Total.....**21 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

This module is the first of five modules focusing on 'Architecture and Urban Physics' within the Housing and Energy programme. It aims to provide an understanding of geometric concepts (projections of the sphere) that will be useful for the subsequent modules.

Prerequisites

Programming with Python

Objectives

- To master the concepts of three-dimensional geometry required for modelling
- Use numerical simulation to solve geometry problems
- Apply these concepts to architecture and urban physics

Syllabus

The course presents six illustrative examples of the possibilities offered by numerical simulation for solving geometry problems.

The examples are covered using the Python simulation tool to serve as a guide for programming in other equivalent environments.

- Chapter 1: Handling lines and planes. The concept of parametric vector shapes
- Chapter 2: Polynomial shapes (Coons tessellations) and structured meshes
- Chapter 3: The sphere, solid angles and spherical trigonometry
- Chapter 4: Ray-tracing techniques and Monte Carlo methods, spatial homogeneity
- Chapter 5: Modelling three-dimensional objects using the Delaunay mesh generation method (unstructured meshes)
- Chapter 6: Representations of spherical objects and trajectories defined on the sphere (solar paths)

Key learning outcomes

- Manipulating parametric vector forms to represent lines and planes
- Generate structured and unstructured meshes
- Apply spherical trigonometry
- Implement ray-tracing techniques
- Modelling solar trajectories
- Programming 3D geometry algorithms in Python

Bibliography

- Lecture notes (57 pages, in French) available at `www.heliodon.net`
- Python documentation for numerical simulation

Keywords: Numerical simulation, programming, geometry, 3D, Python, meshing, solar trajectories

RIS 7-1 – Road Infrastructure 1

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorials	7h30
Total	**15 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- Basic knowledge of roads
- General knowledge of construction materials

Objectives

- To design and dimension road pavement structures in accordance with technical and regulatory requirements
- Select and justify the appropriate materials for the various pavement layers (base courses, surface courses)
- Be able to design a road alignment that complies with safety and comfort standards
- Use software tools (e.g. MENSURA + AutoCAD) for modelling, calculating the volumes of soil and pavement structural materials, and quality control

Syllabus

- Pavement Engineering:
  - Road categories and traffic classes
  - Typical pavement structures (concrete, asphalt, etc.)
  - Surface layers and stress analysis (freeze-thaw, traffic)
- Road materials:
  - Hydrocarbon binders (bitumen, emulsions)
  - Treated and untreated base courses
  - Wearing courses (screeds, asphalt, concrete)

- Geometric design of roads:
  - Plan layout: straight alignments, circular curves and clothoids
  - Longitudinal profile: gradients, vertical transitions, sight lines
- Using the MENSURA software for road layout and analysis of quantities required

Key learning points

- Knowing how to select and justify materials in line with technical and economic constraints
- Designing drainage solutions suited to road projects
- Mastering quality control tools and current standards

Bibliography

- *Design and Dimensioning of Pavement Structures*, Technical Guide, SETRA, 1994
- *Catalogue of Standard Pavement Structures*, SETRA, 1998
- *Development of Main Roads (ARP) and Link Motorways*, ICTAAL, SETRA
- *Construction of Embankments and Sub-base*, Technical Guide, SETRA
- *Roads*, Volumes 1 and 2, by M. FAURE, published by ALEAS
- Engineering Techniques, electronic encyclopaedia

Keywords: Road infrastructure, pavements, design, road materials, road alignment, MENSURA

RIS 7-2 – Railway Infrastructure 1

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration	
Lectures	6 hours
Practical sessions	6 hours
Total	**12**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 – Managing a construction organisation

Prerequisites

- Basic knowledge of civil engineering and construction materials
- General knowledge of transport infrastructure

Objectives

- To understand the basic principles of railway infrastructure, its components and functions
- To identify the different types of railway track (ballast, slab track) and their applications
- Gain a thorough understanding of superstructure technologies (rails, sleepers, fastenings, vibration damping)
- Be familiar with the standards and regulations specific to railway infrastructure
- To analyse the technical constraints relating to track maintenance and durability

Programme

- Introduction to railway infrastructure:
  - The role and challenges of railway infrastructure
  - Terminology and current standards
- Railway superstructures:
  - Rails: types, materials, geometry and laying
  - Sleepers: timber, concrete, steel and innovative technologies
  - Fastening systems and vibration damping
- Types of railway tracks:

  - Ballasted track: composition, advantages and limitations
  - Slab track: technologies and applications
- Maintenance and durability:
  - Track inspection and maintenance methods
  - Management of mechanical and environmental stresses
- Case studies:
  - Analysis of recent railway projects
  - Virtual tour or review of technical documentation

Key learning points

- Ability to describe and compare different railway track technologies
- Understand the challenges of maintenance and sustainability in railway infrastructure
- Apply standards and regulations in the design of superstructures

Bibliography

- *La voie ferrée*, by J. POIRIER, published by Presses de l'École Nationale des Ponts et Chaussées
- **Railway Track Engineering**, by E. ESVELDT, 4th Edition
- NF EN 13230 and subsequent standards (railway tracks)
- Techniques de l'Ingénieur, online encyclopaedia

Keywords: Railway infrastructure, railway tracks, ballast, slab track, superstructure, rails, sleepers, maintenance

RIS 7-3 - Bridges 1

Timetable
Term 7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....7.5 hours
Tutorials 7h30
Total.....15 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Fundamentals of strength of materials
- Fundamentals of structural mechanics
- Topography and geometry of alignments

Objectives

- To understand the different types of bridges, viaducts and footbridges
- To understand their structural principles and operating conditions
- To study the design stages and construction constraints

Syllabus

- Types of bridges and viaducts (reinforced concrete, prestressed concrete, steel, composite)
- Pedestrian footbridges: specific features and innovations
- Design principles and dimensioning
- Construction methods (voussoirs, deck slabs, beams, cables)
- Defects and maintenance

Key lessons learnt

- Identify the different types of linear engineering structures
- Analyse the structural behaviour of a bridge or footbridge
- Understand construction and maintenance constraints
- Select the appropriate type of structure for a given situation
- Identify common defects in engineering structures

Bibliography

- *Bridges: History, Technology and Architecture*, C. Huet, Le Moniteur
- *Design and Dimensioning of Engineering Structures*, Sétra technical guides
- *Common Bridges in Seismic Zones*, Sétra
- Eurocodes 1 and 2 (loads and concrete)

Keywords: Engineering structures, bridges, viaducts, footbridges, design, dimensioning, construction methods

RIS 7-4 – Lecture Series 1

Timetable	
Semester	7
Period	Oct. – Jan.
Face-to-face in person	

Duration	
Lectures	5 hours
Total	**5 hours**

Assessment
Assessed as part of SAÉ

Prerequisites

None

Objectives

- To deepen knowledge of the field of networks, linear infrastructure and soils through lectures and site visits
- To discover innovative practices and capitalise on feedback
- To link theory with professional practice

Programme

- Talks by experts or industry representatives
- Site visits

Key lessons learnt

- Identifying best practice and innovations
- Developing critical thinking skills regarding technical or organisational choices

Bibliography

- Speakers' publications or presentations
- OPPBTP or CSTB guidelines on construction methods or operating procedures
- Articles and industrial case studies

Keywords: Conferences, innovative equipment, materials and management practices, lessons learnt, site visits

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RIS 7-5 - VRD 1

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorials	7h30
Total	**15 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Designing structures and systems
C4 - Manage a construction organisation

Prerequisites

- Basic concepts of geotechnics and earthworks
- Basics of surveying and road alignment
- Knowledge of construction materials

Objectives

- To identify and understand dry networks and their constraints
- Understand the structure and composition of road pavements
- To dimension and lay out kerbs and linear features
- Take into account cost, safety and compliance with environmental standards

Syllabus

- Types of underground utility networks (electricity, telecommunications, gas)
- Installation techniques and regulatory requirements
- Road pavement structure: sub-base, foundation, base course, wearing course
- Dimensioning and choice of materials
- Kerbs and road furniture: design, installation and inspections
- Health and safety and risk prevention during roadworks
- Cost estimation and environmental constraints (management of excavated material,

nuisance) 329

Key learning points

- Identifying technical constraints relating to utility networks
- Dimensioning road pavement structures
- Design linear infrastructure whilst taking into account costs, safety and the environment
- Produce layout plans for utility networks and roadworks
- Estimate the costs of a road and utilities project

Bibliography

- *Design and dimensioning of pavement structures*, LCPC-SETRA
- NF P 98-300, *Prefabricated concrete kerbs and gutters*
- *Development of main roads*, SETRA
- CEREMA Technical Guides

Keywords: road infrastructure, drainage systems, road network, kerbs, pavements, design, costs

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RIS 7-6 – Hydrogeology and hydraulic structures 1

Calendar
Semester.....7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM	7.30 am
Tutorial	7.30 am
Total	**15**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

Year 1: Introduction to geology and hydrogeology (R 3-12)

Objectives

- To understand the formation and structure of aquifers, taking into account weathering, erosion and the role of clays in porosity and permeability
- To analyse water-rock interactions and the factors influencing groundwater chemistry, including the effect of soils, surface formations and vegetation
- To describe groundwater dynamics and aquifer recharge, taking into account subsurface flow, interactions with surface watercourses, hydrological regimes, seasonal variability and the role of the catchment

Programme

- Structure of geological formations and location of aquifers
- Weathering and erosion of rocks in relation to aquifers
- Genesis and influence of clays on porosity and permeability
- Water-rock interactions and hydrogeochemical reactions
- Groundwater flow and interactions with surface watercourses
- Hydrological regimes and seasonal variability of groundwater tables
- The role of the catchment in aquifer recharge and water quality
- The influence of soils, surface formations and vegetation on infiltration and water chemistry 331

Key learning outcomes

- Be able to interpret a geological profile and a hydrogeological map
- Identify the hydrodynamic behaviour and recharge mechanisms of a groundwater body

Bibliography

- *Hydrogeology: Topics, Methods, Applications*, Gilli et al., 5th edition, Dunod, 2021, 366 pp.
- *Foundations and Earthworks*, Philipponat and Hubert, 2011, 548 pp.

Keywords: Aquifer, water-rock interaction, groundwater table, hydrological regime, catchment, hydrogeology

RIS 7-7 – Urban Planning

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration	
Lecture	3 hours
Tutorial	7.5 hours
Total	**10.30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

- Basic knowledge of spatial planning
- Basic understanding of road and utility networks, and engineering structures
- Fundamentals of construction and environmental law

Objectives

- To understand the institutional and regulatory framework of urban planning in France
- To identify the role of public works projects in urban and regional planning
- To integrate technical, economic, environmental and social constraints into planning
- Be able to analyse an urban planning document and deduce its implications for infrastructure projects

Programme

- Institutional framework: stakeholders in urban planning (central government, local authorities, developers, private operators)
- Urban planning documents: SCOT, PLU, municipal maps, permits and authorisations
- Operational urban planning: ZACs, housing developments, development concessions
- Integration of transport infrastructure, roads and utilities, networks and engineering structures within the city
- Environmental constraints and sustainability: Water Act, biodiversity, climate, land management
- Economic and financial analysis: development costs, infrastructure funding
- Public consultation and social acceptability of public transport projects
- Case studies: analysis of urban projects incorporating roads, bridges, networks and drainage

Key learning points

- Identify the main town planning documents and procedures
- Integrate an infrastructure project within its regulatory and territorial framework
- Assess the costs, environmental impacts and social constraints of a project

Bibliography

- *Dictionary of Town Planning and Development*, P. Merlin, F. Choay, PUF
- Planning Code, consolidated version
- *Operational Planning and Urban Development*, CERTU
- CEREMA Technical Guides

Keywords: Town planning, spatial planning, Local Urban Development Plan (PLU), Territorial Cohesion Scheme (SCOT), public works, infrastructure, regulations

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RIS 7-8 – Drinking water network: operation and schematic diagram

Calendar
Semester.....7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM	6 hours
Tutorials	7.5 hours
Total	**1.30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 – Managing a construction organisation

Prerequisites

- Fluid mechanics
- Hydraulics under load
- Basic concepts of infrastructure and networks

Objectives

- To understand the design principles of a drinking water supply network
- To identify and dimension the main components of a network
- To analyse the hydraulic operation of a network at a regional level
- Draw up and interpret schematic diagrams of drinking water networks

Syllabus

- Assessment of water requirements and determination of design flow rates
- Water resources, abstraction and regulatory constraints
- Design of storage structures: reservoirs, water towers and storage basins
- Sizing of transmission and distribution pipes
- Selection and layout of hydraulic equipment: valves, air vents, pressure reducers, stabilisers
- Pumping and booster stations
- Network structuring and

interconnection 335

- Sectorisation and security of the water supply
- Preparation of overview diagrams and functional diagrams
- Case studies on the design of drinking water networks

Key Learning Points

- Designing the overall architecture of a drinking water network to meet a specific need
- Selecting and positioning the network's main structures and equipment
- Verify the hydraulic consistency of a distribution scheme
- Illustrating the operation of a network using a flow chart that can be used by the various project stakeholders

Bibliography

- ASTEE, *Technical Handbook on Drinking Water*
- International Office for Water (OIEau), technical guides on drinking water services
- NF EN 805, *Water supply – Requirements for networks outside buildings and their components*
- Section 71 of the CCTG – Drinking water supply and distribution works

Keywords

Drinking water – Network design – Hydraulics under load – Reservoir – Pumping – Distribution – Schematic diagram – Sizing

RIS 7-9 – Geotechnical studies

Timetable
Term 7
Period.....Oct. – Jan.
Face-to-face

Assessment
Continuous assessment

Duration
CM .....6 hours
Total .....6 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

- Basic knowledge of geology and soil mechanics
- Knowledge of geotechnical engineering (laboratory and in situ tests)
- Familiarity with geotechnical standards and regulations (Eurocodes, NF P 94 standards)

Objectives

- To understand the different phases of a geotechnical project, from the preliminary study to the monitoring of works
- Be able to identify the geotechnical challenges of a project and propose appropriate solutions
- Master geotechnical investigation methods (borings, tests, instrumentation)
- To draft geotechnical reports in accordance with regulatory requirements
- To incorporate geotechnical constraints into the design and construction of structures

Programme

- Introduction to geotechnical projects:
  - Regulatory and standards framework (NF P 94-500 standards, Eurocode 7)
  - Roles and responsibilities of the parties involved (client, geotechnical engineer, engineering consultancy)
- Phases of a geotechnical project:
  - Preliminary study (G1): identification of geotechnical risks
  - Design study (G2): investigations and dimensioning
  - Detailed design (G3): monitoring of works and adaptation of solutions
  - Geotechnical supervision (G4): monitoring and instrumentation
- Investigation methods:
  - Boring and sampling (core sampling, penetrometers)
  - In-situ tests (pressure meter, dynamic penetrometer, permeability tests)

  - Instrumentation and monitoring (piezometers, inclinometers)
- Preparation of geotechnical reports:
  - Structure and content of a report (summary of investigations, recommendations)
  - Analysis of geotechnical risks and proposed solutions
- Case studies:
  - Analysis of real-world projects (foundations, retaining structures, earthworks)
  - Use of geotechnical modelling software (e.g. PLAXIS, GTS NX)

Key learning points

- The ability to plan and organise a geotechnical survey in line with the phases of a project
- Mastering soil investigation and analysis techniques
- Drafting clear and precise reports that comply with regulatory requirements
- Proposing technical solutions tailored to the identified geotechnical constraints
- Collaborating with the various stakeholders in a project (engineers, architects, contractors)

Bibliography

- NF P 94-500 standards: Geotechnical engineering assignments
- Eurocode 7: Geotechnical design
- *Practical Geotechnics*, by P. MESTAT, published by Presses des Ponts
- *Guide to Earthworks*, IDRRIM, Cerema
- Engineering Techniques, online encyclopaedia

Keywords: Geotechnical projects, investigations, G1, G2, G3, G4, boreholes, reports, Eurocode 7

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ÉCOLE D'INGÉNIEURS

ISA BTP
FORMATION INGÉNIEUR

RIS 7-10 – GTR Classification of Materials

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration
CM 4h30
Tutorial.....9 hours
Total .....1.30 pm

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- Soils 1: Introduction to geology and hydrogeology (R 3-12)
- Soils 2: Soil Mechanics 1 (R4-15)
- Soils 3: Soil Mechanics 2 (R5-13)
- Soils 4: Laboratory Tests (R5-14)

Objectives

- To master the main soil characterisation tests
- To be able to classify soils according to their physical and geotechnical properties
- Be able to use the GTR to assess, design and monitor road earthworks, drawing on soil characterisation and consultation with other project stakeholders

Syllabus

- Presentation of the framework and objectives of the GTR in road geotechnics
- Identification and classification of soils according to GTR classes
- Determination of construction conditions and bearing capacity
- Selection and design of any necessary soil treatments
- Monitoring and validation of works' compliance with GTR criteria

Key learning points

- Reading and interpreting the GTR (tables, classes, criteria)
- Deciding on and justifying technical choices based on soil data 339

Bibliography

- *Guide to Earthworks: Embankments and Sub-base Layers. Volume 1 – General Principles*, IDRRIM, Cerema, 2024. ISBN: 978-2-37180-678-8 / 978-2-37180-609-2
- *Guide to Earthworks: Embankments and Sub-base Layers – Volume 2 – Technical Appendices*, IDRRIM, Cerema, 2024. ISBN: 978-2-37180-679-5 / 978-2-37180-613-9
- AFNOR NF EN 16907 *Earthworks*

Keywords: GTR, soil classification, laboratory tests

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ÉCOLE D'INGÉNIEURS

ISA BTP
FORMATION INGÉNIEUR

RIS 7-11 – Earthworks 1

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorials	7h30
Total	**15 hours**

Target skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Fundamentals of geology and identification of natural materials
- Physical, chemical and mechanical properties of soils
- Topography: site surveys, levelling, contour lines, longitudinal and cross-sections, volume calculations

Objectives

- To identify the different types of earthworks sites
- Understand earthworks techniques and equipment
- Assess the performance and limitations of equipment

Syllabus

- Different types of projects: earthworks, road construction, embankments and cuttings
- Criteria for selecting techniques and equipment
- Earthworks machinery: characteristics, performance and limitations
- Structure and organisation of earthworks teams
- Methods for surveying and topographical control of earthworks

Key lessons learnt

- Selecting the appropriate equipment for an earthworks site
- Applying the basic principles of earthworks according to the type of project
- Carrying out the topographical surveys required for site preparation 341

Bibliography

- *Foundations and Earthworks*, G. Philipponnat, B. Hubert, Eyrolles
- *Guide to Earthworks*, IDRRIM, Cerema
- Engineering Techniques

Keywords: Earthworks, equipment, fill, excavated material, volumes, topography, site organisation

MHS 7-1 - Design of Assembled Structures 1: Timber 1

Timetable	
Semester	7
Period	Oct. – Jan.
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorials	7h30
Total	**15 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- Calculation of basic structures (beams, columns, simple frames)
- Knowledge of the mechanical properties of timber
- General understanding of the behaviour of joints

Objectives

- To understand the role and importance of joints in the overall behaviour of timber structures
- To identify the different types of timber-to-timber and timber-to-metal joints
- To design and verify simple joints in accordance with Eurocode 5

Syllabus

- A review of the properties of timber as they apply to connections
- Overview of standards and design rules (Eurocode 5, DTU)
- Types of connections: nails, screws, bolts, pins, metal connectors
- Methods for calculating simple joints (tension, shear, bending)
- Guided exercises: checking common joints

Key learning points

- Selecting a suitable connection based on the load
- Dimensioning a timber-to-timber or timber-to-metal joint in accordance with best practice
- Identifying the limitations of different types of joints

Bibliography

- Eurocode 5: Design of timber structures
- *Design and Calculation of Timber Structures*, P. Freyburger, Éditions du Moniteur
- *Timber Structures: Design and Calculation*, J.-L. Boucher, Éditions Eyrolles
- *DTU – Timber Structures and Associated Technical Documents*, CSTB

Keywords: Joints, timber, Eurocode 5, dimensioning, nails, screws, bolts

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ISA BTP
FORMATION INGÉNIEUR

MHS 7-2 – Design of Assembled Structures 2: Steel 1

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....7.5 hours
Tutorials 7h30
Total.....15 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 – Specify technical solutions for sustainable and more durable construction
C3 - Designing structures and systems

Prerequisites

- Introductory course on structural connections
- Calculation of basic structures (beams, frames, simple trusses)
- Basic concepts of strength of materials and general metallurgy

Objectives

- To understand the metallurgical and mechanical fundamentals of structural steels
- To understand the general principles of welding and their effects on the material
- To introduce students to the design and analysis of simple metal assemblies

Syllabus

- Steels in construction: production, metallurgical and mechanical properties
- General introduction to welding
- Welding metallurgy: thermal cycles, phase changes
- Introduction to the design and calculation of steel structures

Key learning outcomes

- Identify the metallurgical properties of steels and their impact on joints
- Understand the basics of welding metallurgy
- Designing a simple metal joint 345

Bibliography

- Eurocode 3: Design of steel structures
- NF EN 1090: Execution of steel and aluminium structures
- CTICM technical documents

Keywords: Joints, steel, welding, metallurgy, Eurocode 3, steel structures

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MHS 7-3 – Structural analysis: prefabricated elements

Calendar	
Semester	7
Period	Oct. – Jan.
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorial	7.30 am
Total	**3.00**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- Calculation of statically determinate and indeterminate structures
- Reinforced concrete: fundamentals of design
- Concepts in precast concrete design

Objectives

- To understand the behaviour of precast structures
- To analyse connection systems and their role in overall stability
- To assess the stability of structures comprising prefabricated elements

Syllabus

- Overview of prefabrication and its structural implications
- Types of prefabricated elements (slabs, beams, columns, walls, etc.)
- Analysis of connections: stiffness, force transmission, design
- Overall stability of structures comprising prefabricated elements
- Modelling and analysis methods
- Practical case studies in building construction

Key learning points

- Identifying the structural characteristics of prefabricated elements
- Modelling a structure incorporating prefabricated elements and connections
- Verifying the stability of a prefabricated structure, taking connections

into account 347

Bibliography

- Eurocode 2: Design of concrete structures
- *PCI Design Handbook*, Precast/Prestressed Concrete Institute
- International Concrete Federation (fib), Technical Bulletins
- CSTB publications on prefabrication

Keywords: Prefabrication, connections, stability, prefabricated elements, concrete, structural analysis

MHS 7-4 – Lecture series 1

Calendar	
Semester	7
Period	Oct. – Jan.
Face-to-face in person	

Duration	
Lectures	5 hours
Total	**5 hours**

Assessment
Assessed as part of SAÉ

Prerequisites

- General knowledge of construction and off-site methods
- Previous modules on prefabrication and on-site methods

Objectives

- To explore different perspectives and lessons learnt regarding off-site construction
- To deepen understanding of the industrial, technical and organisational challenges
- To observe and analyse real-world projects through site visits and presentations by experts
- Link the theory covered in class to professional practice

Programme

- Lectures by guest experts in off-site construction
- Presentations on modular and prefabricated projects
- Site visits and tours of prefabrication facilities
- Discussions on practices, innovations and challenges encountered
- Critical analysis of the solutions observed and lessons learnt

Key takeaways

- Identifying best practices and innovations in off-site construction
- Linking theoretical concepts to real-world examples
- Develop a critical approach to technical and organisational choices
- Understand the impact of off-site solutions on scheduling, safety and quality

Keywords: Conferences, off-site construction, case studies, site visits, innovation, prefabrication

MHS 7-5 - Methods 1: project context, construction methods, work rates, lifting, PIC

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....7.5 hours
Tutorials 7h30
Total.....15 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Designing structures and systems
C4 - Manage a construction organisation

Prerequisites

- Resources "Site Organisation 1 to 8",
- Resources "RdM" and R3-10 "Column-and-beam structures"
- Resources "Technologies" and "Materials"
- Basics of project management and construction supervision

Objectives

- List the constraints associated with the project: environment, schedule, budget, quality
- Identify alternative construction methods suitable for prefabrication
- Define construction methods for prefabrication and off-site construction, including transport, lifting and assembly of components
- Assess the required off-site production rates and their impact on schedules (site, suppliers)
- Draw up a Site Installation Plan (SIP) taking into account the specific requirements of prefabrication

Programme

- The benefits of construction methods in building projects
- Construction methods suited to prefabrication for various materials (concrete, metal, timber)
- Production rates and industrial logistics
- Lifting, handling, installation and assembly of prefabricated components

- Specific resources: choice of equipment, procurement
- Developing a site organisation suited to prefabrication: logistics, storage areas, safety and sequencing, PIC
- Case studies and practical exercises on modular projects

Key learning points

- Analysing a project and specifying construction methods that favour prefabrication
- Assessing the feasibility of prefabrication: storage, lifting, assembly, cost
- Determine installation and production rates, as well as the site's lifting equipment
- Design a Construction Implementation Plan (CIP) tailored to the specific requirements of prefabrication

Keywords: Methods, prefabrication, construction methods, rates, lifting, PIC, off-site construction

MHS 7-6 – Formwork tools: design, sizing

Timetable	
Semester	7
Period	Oct. – Jan.
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorials	7h30
Total	**15 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Reinforced concrete: basic knowledge and previous modules
- RDM and the design of simple structures
- Basic understanding of site operations and concrete placement

Objectives

- To understand the different types of formwork and their functions
- To design and check formwork for concrete structures
- To understand the technical and safety requirements associated with formwork
- To develop a critical approach to formwork solutions

Syllabus

- Types of formwork: timber, metal, modular, sliding
- Dimensioning formwork in accordance with applicable standards and loads
- Assembly and dismantling techniques
- Safety and stability of formwork on site
- Case studies and practical examples

Key learning points

- Selecting formwork suitable for a given structure
- Identifying safety and stability requirements
- Selecting the type of formwork according to the structure and the site
- Apply the relevant standards and regulations

Bibliography

- Eurocode 2: Design of concrete structures
- *Formwork and Scaffolding – Technical Guide*, CSTB
- *Formwork and Shoring*, A. Bérenger, Éditions du Moniteur

Keywords: Formwork, design, concrete, safety, erection, standards

MHS 7-7 – Temporary Stability and Shoring 1: Common Elements

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM hours	7.5
Tutorials	7.30
Total pm	**3.00**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- RDM and R 3-10 resources: 'Column-beam structures'
- Structural analysis resources: concrete, steel, timber
- Organisational resources, in particular R3-15, R4-17, R4-18

Objectives

- To identify the different types of temporary shoring components
- Understand the role of each element in the temporary stability of structures
- To design and verify common shoring components
- Apply safety rules and best practice on site

Programme

- Classification of shoring components: props, towers, arches, beams, formwork platforms and temporary supports
- Loads and stresses on temporary elements
- Design of temporary structures
- Detailed operating procedures: safe erection, adjustment and dismantling
- Case studies on common structures (buildings and engineering structures)

Key learning points

- Selecting the appropriate type of shoring for the structure and the situation
- Dimensioning temporary components according to loads and standards
- Ensuring the safety of workers and the structure during the temporary phase

Keywords: Shoring, stability, temporary, design, safety, temporary supports

MHS 7-8 - Numerical modelling and BIM 1

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM	4h30
Tutorial	9 hours
Total	**1.30 pm**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- Basic knowledge of structural design and dimensioning
- Introduction to computer-aided design and modelling tools
- Basic understanding of prefabrication and off-site construction

Objectives

- To understand the principles of digital modelling as applied to construction
- To explore the concept and applications of BIM (Building Information Modelling) in prefabrication
- Be able to create and manipulate a digital model of an off-site project
- Integrate digital modelling into the planning and coordination of works

Programme

- Introduction to digital modelling tools for off-site construction
- BIM concepts and principles: data structuring and interdisciplinary collaboration
- Creating a digital model of a prefabricated project
- Information management and technical documentation via BIM
- Case studies: integrating BIM into off-site design and production

Key Learning Points

- Creating a coherent digital model for a prefabrication project
- Using BIM to improve coordination between design offices and the construction site
- Identify the benefits of BIM for the monitoring and management of prefabricated components
- Leveraging digital information to optimise production and assembly

Bibliography

- CSTB publications and professional guides on BIM and prefabrication
- Scientific articles and case studies on the integration of BIM in off-site construction

MHS 7-9 – Coordination of Design and Works 1: technical aspects, planning

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration	
Lectures	6 hours
Tutorials	7.5 hours
Total	**1.30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- Knowledge of site organisation and planning
- Basic understanding of project management and monitoring of works
- Basic knowledge of structures and construction methods

Objectives

- To understand the challenges of coordination between design and construction
- To identify the technical interfaces between the various project stakeholders
- Master planning and monitoring tools in the context of off-site construction
- Develop skills to anticipate and resolve conflicts between design and construction

Programme

- The role of design-construction coordination in a construction project
- Identification of technical interfaces and critical points
- Planning methods and associated tools (Gantt charts, flowcharts, monitoring software)
- Change management and schedule adjustments
- Case studies: coordination in a project involving prefabricated or modular components

Key learning points

- Identify technical constraints and interfaces in an off-site project
- Establish a coherent schedule linking design and construction
- Anticipate and resolve conflicts between design and execution
- Communicate effectively with all stakeholders to ensure the continuity of the project

Bibliography

- *Coordination of Design and Construction*, J. Deltombe, Éditions du Moniteur
- *Construction Site Planning and Monitoring*, P. Cailly, Éditions Eyrolles
- OPPBTP professional guides and recommendations
- Project management software and planning tools: MS Project, Primavera

Keywords: Coordination, design and construction, planning, technical interfaces, off-site construction

MHS 7-10 – Organisation and management of prefabrication 1

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Continuous assessment

Duration
Lectures.....6 hours
Tutorials .....7.5 hours
Total **1.30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Knowledge of site management and planning
- Basic understanding of construction project organisation
- Understanding of off-site production methods and rates

Objectives

- To understand the principles of organising a prefabrication unit
- To master the planning and management of off-site production flows
- Optimise production rates and logistics processes for prefabrication
- Develop a comprehensive understanding of coordination between the factory and the construction site

Programme

- Organisation of a prefabrication production unit
- Stock management and raw materials procurement
- Planning production rates and optimising resources
- Coordination between factory production and on-site assembly
- Tools for monitoring and managing prefabrication
- Case studies: analysis of modular and prefabricated projects

Key takeaways

- Implementing an effective production schedule for a prefabricated project
- Identify bottlenecks and propose solutions
- Coordinate logistics flows between the factory and the construction site
- Justify organisational and production rate decisions based on project constraints

Bibliography

- *Methods of Prefabricated Construction*, B. Cazet, Éditions Eyrolles
- *Organisation and Methods for Off-Site Construction Sites*, J.-P. Regnier, Éditions du Moniteur
- OPPBTP professional guides and recommendations
- Publications on industrial and logistics management in off-site construction

Keywords: Prefabrication, organisation, management, production rates, logistics, factory-site coordination

SAÉ 7-1 – Case study: the engineer's approach and ethics

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face in person

Assessment
Defences and Portfolio

Duration	1 week
Supervised hours	14 hours
Self-study	14 hours
Targeted skill(s)	
C1 – Analysing a construction project within its context	
C4 - Manage a construction organisation	

Prerequisites

Fundamentals of sustainable development

Objectives

To raise the ethical awareness of future engineers and develop their capacity for multidimensional analysis (technical, human, regulatory, managerial, etc.).

- To identify and analyse the specific ethical and social responsibility issues faced by civil engineers
- To propose tools and develop a framework for individual and collective ethical commitment
- To identify good governance practices and practical tools for integrating ethics into decision-making and professional conduct
- To analyse a situation in light of social responsibility issues
- Develop a responsible and socially conscious professional approach; promote civic engagement and responsibility within the engineering profession

Programme

Half-day #1: Fundamentals of ethics and CSR in the construction industry

- Presentation of objectives
- Group work to explore the topic
- A refresher on sustainable development
- Introduction to CSR and the ISO 26000 standard
- The fundamentals of engineering ethics and values

Half-day #2: Role-play

- Testimonial from a professional

- Case study and role-play: identifying ethical and CSR issues, key indicators, defining strategy, identifying best practices, challenges encountered (technical constraints, environmental, economic, social, safety, compliance and societal issues, etc.), ways to engage stakeholders
- Role-play: project owner, project manager, employee, elected representative, local resident, NGO, subcontractor, etc.

Half-day session #3: The engineer as a driver of societal transformation

- Presentation of each group's role-play scenarios: challenges, best practices, difficulties encountered
- What role and approach should the engineer adopt?
- What commitments should an ethical, responsible engineer make?
- Some methodological tools (checklists, responsibility matrix, etc.)
- Negotiation and the search for ethical compromise
- Engineers: Facing contemporary challenges, driving social change

Key learning points

- Acquiring a theoretical understanding of ethics and CSR
- Ability to analyse an ethical and CSR dilemma within the construction industry
- Development of a responsible professional approach
- Collective formulation of commitments, a tangible outcome of the training

Keywords: Ethics, social responsibility, analytical skills, values, transformation

SAÉ 7-2 – Assistant Engineer Placement: areas related to the course

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face

Assessment
Report and oral defence

Duration	8 weeks

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

This course description is currently being drafted.

A dedicated working group has been set up to define and formalise the details relating to this learning and assessment scenario.

The final version of the description is scheduled to be completed by 15 July 2026 at the latest.

SAÉ 7-3 – Work Placement

Timetable
Semester.....7
Period.....Oct. – Jan.
Face-to-face

Assessment
Report and oral defence

Duration	18 weeks

Targeted skills
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Designing structures and systems
C4 - Manage a construction organisation

This course description is currently being drafted.

A dedicated working group has been set up to define and formalise the details relating to this learning and assessment scenario.

The final version of the description is scheduled to be completed by 15 July 2026 at the latest.

Semester 8 – BCR pathway

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
FISE 8-2	Management 7: Business Start-ups and Takeovers – Entrepreneurship	4.35%
FISE 8-4	English S8	10.88%
FISE 8-5	Spanish S8	14.5%
R 8-9	Risk management	4.83%
FISE 8–10	Organisation 10: Public and private works contracts	7.25%
FISE 8-11	Organisation 11: Contractual management of contracts during the execution phase	3.38%
R 8–12	An Introduction to Issues in Environmental Law	4.35%
FISE 8–13	Digital Models and the BIM Approach	3.38%
BCR 8-1	Soil Mechanics 2: effects of water, underpinning. . .	4.83
BCR 8-2	Structural Dynamics 1	6.77
BCR 8-3	Fire resistance design	5.8%
BCR 8-4	Structural design 2: prestressed concrete	4.83
BCR 8-5	Assessment 2: building envelope and services	5.8%
BCR 8-6	Durability and defects	5.8
BCR 8-7	Organisation of works 1 (TCE)	5.8%
BCR 8-8	Energy analysis (STD)	7.41%
SAÉ for competence C1		**%**
SAÉ 8-1	R&D project (or competition/challenge)	17.65%
SAÉ 8-2	Management project: serious game	4.71%
SAÉ 8-3	BIM and digital tools project	7.06%
SAÉ 8-4	End-of-Year Project related to the course pathway	14.12%
SAÉ 8-5	Engineering Assistant Placement: fields related to the course of study	56.47%

Competence C2 – Proposing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
FISE 8-4	English S8	13.17%
FISE 8-5	Spanish S8	17.56%
R 8-9	Risk management	5.85%
FISE 8–11	Organisation 11: Contract management for projects in the EXE phase	4.1%
R 8-12	Introduction to environmental law issues	5.27%
FISE 8–13	Digital Models and the BIM Approach	4.1%
BCR 8-1	Soil Mechanics 2: effects of water, underpinning. . .	5.85
BCR 8-2	Structural Dynamics 1	8.2
BCR 8-3	Fire resistance design	7.02%
BCR 8-4	Structural design 2: prestressed concrete	5.85
BCR 8-5	Assessment 2: Building envelope and services	7.02
BCR 8-6	Durability and defects	7.02%
BCR 8-7	Organisation of works 1 (TCE)	0
BCR 8-8	Energy analysis (STD)	8.98%

SAÉ for competence C2		%
SAÉ 8-1	R&D project (or competition/challenge)	17.65%
SAÉ 8-2	Management project: serious game	4.71%
SAÉ 8-3	BIM and digital tools project	7.06%
SAÉ 8-4	End-of-Year Project related to the course pathway	14.12%
SAÉ 8-5	Engineering Assistant Placement: fields related to the course of study	56.47%

Competency C3 – Designing structures and systems

Resources for Competency C3		%
FISE 8-6	Numerical optimisation	13.02%
FISE 8-7	Numerical methods – Partial differential equations	20.84%
FISE 8-8	Introduction to finite element analysis: linear problems	19.54 %
R 8-9	Risk management	4.34%
BCR 8-1	Soil Mechanics 2: effects of water, underpinning. . .	4.34%
BCR 8-2	Structural Dynamics 1	6.08
BCR 8-3	Fire resistance design	5.21%
BCR 8-4	Structural design 2: prestressed concrete	4.34
BCR 8-5	Assessment 2: building envelope and services	5.21%
BCR 8-6	Durability and defects	5.21
BCR 8-7	Organisation of works 1 (TCE)	5.21%
BCR 8-8	Energy analysis (STD)	6.66 %

SAÉ for competence C3		%
SAÉ 8-1	R&D project (or competition/challenge)	18.52%
SAÉ 8-3	BIM and digital tools project	7.41%
SAÉ 8-4	End-of-Year Project related to the course pathway	14.81%
SAÉ 8-5	Engineering Assistant Placement: fields related to the course of study	59.26%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
FISE 8-2	Management 7: Business start-ups and takeovers – Entrepreneurship	9.47%
FISE 8-3	Management 4: Innovation and Development – Engineering Agility	34.74%
FISE 8-10	Organisation 10: Public and private works contracts	15.79%
FISE 8–11	Organisation 11: Contract management of projects in the execution phase	7.37%
FISE 8-13	Digital models and the BIM approach	7.37
BCR 8-6	Durability and structural defects	12.63%
BCR 8-7	Organisation of works 1 (TCE)	12.63
SAÉ for competence C4		**%**
SAÉ 8-1	R&D project (or competition/challenge)	17.65%
SAÉ 8-2	Management project: serious game	4.71%
SAÉ 8-3	BIM and digital tools project	7.06%
SAÉ 8-4	End-of-Year Project related to the course pathway	14.12%
SAÉ 8-5	Engineering Assistant Placement: fields related to the course of study	56.47%

Semester 8 – GCM Programme

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
FISE 8-2	Management 7: Business Start-ups and Takeovers – Entrepreneurship	3.95 %
FISE 8-4	English S8	9.87%
FISE 8-5	Spanish S8	13.16%
R 8-9	Risk management	4.39%
FISE 8–10	Organisation 10: Public and private works contracts	6.58%
FISE 8-11	Organisation 11: Contractual management of contracts during the execution phase	3.07%
R 8-12	Introduction to environmental law issues	3.95%
FISE 8–13	Digital Models and the BIM Approach	3.07
GCM 8-1	Structural Dynamics 1	9.21%
GCM 8-2	Structural Design 2: Prestressed Concrete	6.58%
GCM 8-3	Foundations applied to civil engineering	6.14%
GCM 8-4	Breakwater design	9.21%
GCM 8-5	Coastal processes and coastal defence	9.21%
GCM 8-6	Bridges 2	2.63%
GCM 8-7	Road alignment and design	5.26%
GCM 8-8	Retaining Structures – Tunnels	3.73%
SAÉ for competence level C1		**%**
SAÉ 8-1	R&D project (or competition / challenge)	17.65%
SAÉ 8-2	Management project: serious game	4.71%
SAÉ 8-3	BIM and digital tools project	7.06%
SAÉ 8-4	End-of-Year Project linked to the course	14.12%
SAÉ 8-5	Engineering Assistant Placement: fields related to the course	56.47%

Competence C2 – Proposing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
FISE 8-4	English S8	17.86 %
FISE 8-5	Spanish S8	23.81%
R 8-9	Risk management	7.94%
FISE 8–11	Organisation 11: Contract management for projects in the execution phase	5.56%
R 8-12	Introduction to environmental law issues	7.14
FISE 8-13	Digital Models and the BIM Approach	5.56%
GCM 8-3	Foundations Applied to Civil Engineering	11.11%
GCM 8-6	Bridges 2	4.76%
GCM 8-7	Road alignment and design	9.52%
GCM 8-8	Retaining structures – Tunnels	6.75 %
SAÉ at C2 level		**%**
SAÉ 8-1	R&D project (or competition / challenge)	17.65%
SAÉ 8-2	Management project: serious game	4.71%
SAÉ 8-3	BIM and digital tools project	7.06%
SAÉ 8-4	End-of-Year Project related to the course pathway	14.12%
SAÉ 8-5	Engineering Assistant Placement: fields related to the course of study	56.47%

Competency C3 – Designing structures and systems

Resources for Competency C3		%
FISE 8-6	Numerical optimisation	11.93 %
FISE 8-7	Numerical Methods – Partial Differential Equations	19.09%
FISE 8-8	Introduction to finite element analysis: linear problems	17.89%
R 8-9	Risk management	3.98%
GCM 8-1	Structural Dynamics 1	8.35%
GCM 8-2	Structural Design 2: Prestressed Concrete	5.96%
GCM 8-3	Foundations applied to civil engineering	5.57%
GCM 8-4	Breakwater design	8.35%
GCM 8-5	Coastal processes and coastal defence	8.35%
GCM 8-6	Bridges 2	2.39%
GCM 8-7	Road alignment and design	4.77%
GCM 8-8	Retaining Structures – Tunnels	3.38%
SAÉ for competence level C3		**%**
SAÉ 8-1	R&D project (or competition / challenge)	18.52%
SAÉ 8-3	BIM and digital tools project	7.41%
SAÉ 8-4	End-of-Year Project linked to the course	14.81%
SAÉ 8-5	Engineering Assistant Placement: fields related to the course	59.26%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
FISE 8-2	Management 7: Business start-ups and takeovers – Entrepreneurship	9.23%
FISE 8-3	Management 4: Innovation and Development – Engineering Agility	33.85%
FISE 8-10	Organisation 10: Public and private construction contracts	15.38%
FISE 8–11	Organisation 11: Contractual management of contracts during the execution phase	7.18
FISE 8-13	Digital models and the BIM approach	7.18
GCM 8-6	Bridges 2	6.15%
GCM 8-7	Road alignment and design	12.31%
GCM 8-8	Retaining Structures – Tunnels	8.72%
SAÉ for competence level C4		**%**
SAÉ 8-1	R&D project (or competition / challenge)	17.65%
SAÉ 8-2	Management project: serious game	4.71%
SAÉ 8-3	BIM and digital tools project	7.06%
SAÉ 8-4	End-of-Year Project related to the course pathway	14.12%
SAÉ 8-5	Engineering Assistant Placement: fields related to the course of study	56.47%

Semester 8 – H&E programme

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
FISE 8-2	Management 7: Business Start-ups and Takeovers – Entrepreneurship	4.27 %
FISE 8-4	English S8	10.67%
FISE 8-5	Spanish S8	14.23%
R 8-9	Risk management	4.74%
FISE 8–10	Organisation 10: Public and private works contracts	7.11%
FISE 8-11	Organisation 11: Contractual management of contracts during the execution phase	3.32%
R 8-12	Introduction to environmental law issues	4.27
FISE 8–13	Digital Models and the BIM Approach	3.32%
H&E 8-1	Ventilation and Air Handling	9.49%
H&E 8-2	Secondary structural frames 2: design and dimensioning	9.49
H&E 8-3	Dynamic thermal simulations 2	5.85%
H&E 8-4	Urban Systems Engineering	10.43%
H&E 8-5	Urban Physics	12.81%
SAÉ for competence C1		**%**
SAÉ 8-1	R&D project (or competition/challenge)	17.65%
SAÉ 8-2	Management project: serious game	4.71%
SAÉ 8-3	BIM and digital tools project	7.06%
SAÉ 8-4	End-of-Year Project related to the course pathway	14.12%
SAÉ 8-5	Engineering Assistant Placement: fields related to the course of study	56.47%

Competence C2 – Proposing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
FISE 8-4	English S8	12.04%
FISE 8-5	Spanish S8	16.06%
R 8-9	Risk management	5.35%
FISE 8–11	Organisation 11: Contract management for projects in the EXE phase	3.75%
R 8-12	Introduction to environmental law issues	4.82%
FISE 8–13	Digital Models and the BIM Approach	3.75%
H&E 8-1	Ventilation and Air Handling	10.7%
H&E 8-2	Secondary structural frames 2: design and dimensioning	10.7
H&E 8-3	Dynamic thermal simulations 2	6.6%
H&E 8-4	Urban Systems Engineering	11.78%
H&E 8-5	Urban Physics	14.45%
SAÉ for competence C2		**%**
SAÉ 8-1	R&D project (or competition/challenge)	17.65%
SAÉ 8-2	Management project: serious game	4.71%
SAÉ 8-3	BIM Project and Digital Tools	7.06%
SAÉ 8-4	End-of-Year Project related to the course	14.12%
SAÉ 8-5	Engineering Assistant Placement: fields related to the course of study	56.47%

Competency C3 – Designing structures and systems

Resources for Competency C3		%
FISE 8-6	Numerical optimisation	12.8 %
FISE 8-7	Numerical methods – Partial differential equations	20.48%
FISE 8-8	Introduction to finite element analysis: linear problems	19.2%
R 8-9	Risk management	4.27%
H&E 8-1	Ventilation and air treatment	8.53%
H&E 8-2	Secondary structural frames 2: design and dimensioning	8.53
H&E 8-3	Dynamic thermal simulations 2	5.26%
H&E 8-4	Urban Systems Engineering	9.39%
H&E 8-5	Urban Physics	11.52%
SAÉ for competence C3		**%**
SAÉ 8-1	R&D project (or competition/challenge)	18.52%
SAÉ 8-3	BIM and digital tools project	7.41%
SAÉ 8-4	End-of-Year Project related to the course pathway	14.81%
SAÉ 8-5	Engineering Assistant Placement: fields related to the course of study	59.26%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
FISE 8-2	Management 7: Business start-ups and takeovers – Entrepreneurship	12.68%
FISE 8-3	Management 4: Innovation and Development – Engineering Agility	46.48%
FISE 8-10	Organisation 10: Public and private works contracts	21.13%
FISE 8–11	Organisation 11: Contract management of contracts in the EXE phase	9.86%
FISE 8–13	Digital models and the BIM approach	9.86%
SAÉ for competence area C4		**%**
SAÉ 8-1	R&D project (or competition/challenge)	17.65%
SAÉ 8-2	Management project: serious game	4.71%
SAÉ 8-3	BIM and digital tools project	7.06%
SAÉ 8-4	End-of-Year Project related to the course pathway	14.12%
SAÉ 8-5	Engineering Assistant Placement: fields related to the course of study	56.47%

Semester 8 – RIS programme

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
FISEA 8-4	English S8	17.31%
FISEA 8-5	Spanish S8	23.08%
R 8-9	Risk Management	7.69%
R 8–12	Introduction to environmental law issues	6.92%
RIS 8-1	Road Infrastructure 2: Geometric Design of Alignments	4.62%
RIS 8-2	Railway infrastructure 2: track beds	3.46%
RIS 8-3	Engineering Structures 1: retaining structures, dams, dykes	5.77%
RIS 8-4	Hydrogeology and hydraulic structures 2	7.69%
RIS 8-5	Settlement and consolidation	10
RIS 8-6	Earth pressure, earth pressure resistance	7.69%
RIS 8-7	Earthworks 2	5.77%
SAÉ for competence C1		**%**
SAÉ 8-6	Work placement period	100%

Competency C2 – Prescribing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
FISEA 8-4	English S8	17.31%
FISEA 8-5	Spanish S8	23.08%
R 8-9	Risk Management	7.69%
R 8–12	Introduction to environmental law issues	6.92%
RIS 8-1	Road Infrastructure 2: Geometric Design of Alignments	4.62%
RIS 8-2	Railway infrastructure 2: track beds	3.46%
RIS 8-3	Engineering Structures 1: retaining structures, dams, dykes	5.77%
RIS 8-4	Hydrogeology and hydraulic structures 2	7.69%
RIS 8-5	Settlement and consolidation	10%
RIS 8-6	Thrust, earth retaining wall	7.69%
RIS 8-7	Earthworks 2	5.77%
SAÉ for competence C2		**%**
SAÉ 8-6	Work placement period	100%

Competence C3 – Dimensioning structures and systems

Resources for Competency C3		%
FISEA 8-8	Introduction to finite element analysis: linear problems	36.28%
R 8-9	Risk management	9.3%
RIS 8-1	Road Infrastructure 2: Geometric Design of Alignments	5.58%
RIS 8-2	Railway infrastructure 2: track beds	4.19%
RIS 8-3	Engineering Structures 1: retaining structures, dams, dykes	6.98%
RIS 8-4	Hydrogeology and hydraulic structures 2	9.3%
RIS 8-5	Settlement and consolidation	12.09%
RIS 8-6	Earth pressure, earth abutment	9.3%
RIS 8-7	Earthworks 2	6.98%
SAÉ for competence C3		**%**
SAÉ 8-6	Work placement period	100%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
RIS 8-1	Road infrastructure 2: geometric design of alignments	23.53%
RIS 8-2	Railway infrastructure 2: track beds	17.65%
RIS 8-3	Engineering Structures 1: retaining structures, dams, dykes	29.41%
RIS 8-7	Earthworks 2	29.41%
SAÉ under competence C4		**%**
SAÉ 8-6	Work placement period	100%

Semester 8 – MHS pathway

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
FISEA 8-4	English S8	15.79%
FISEA 8-5	Spanish S8	21.05%
R 8-9	Risk Management	7.02%
R 8–12	Introduction to environmental law issues	6.32%
MHS 8-1	Structural Design of Assembled Structures 3: Timber 2	7.02%
MHS 8-2	Design of assembled structures 4: steel 2	7.02%
MHS 8-3	Design of assembled structures 5: BA and BP frames	8.42%
MHS 8-4	Methods 2: risks, safety, alternatives, phasing / cycling	7.02
MHS 8-5	Coordination of Design and Works 2: cost estimation, subcontracting	6.32%
MHS 8-6	Organisation and management of prefabrication 2: lean management	8.42%
MHS 8-7	Production, processes, robotisation 1	5.61%
SAÉ for competence C1		**%**
SAÉ 8-6	Work placement period	100%

Competency C2 – Prescribing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
FISEA 8-4	English S8	17.24%
FISEA 8-5	Spanish S8	22.99%
R 8-9	Risk Management	7.66%
R 8–12	Introduction to environmental law issues	6.9%
MHS 8-1	Structural Design of Assembled Structures 3: Timber 2	7.66%
MHS 8-2	Design of assembled structures 4: steel 2	7.66%
MHS 8-3	Design of assembled structures 5: BA and BP frames	9.2 %
MHS 8-4	Methods 2: risks, safety, alternatives, phasing / cycling	7.66%
MHS 8-5	Coordination of Design and Works 2: cost estimation, subcontracting	6.9%
MHS 8-7	Production, processes, automation 1	6.13%
SAÉ for competence C2		**%**
SAÉ 8-6	Work placement period	100%

Competency C3 – Dimensioning structures and systems

Resources for Competency C3		%
FISEA 8-8	Introduction to finite element analysis: linear problems	48.15%
R 8-9	Risk Management	12.35%
MHS 8-1	Design of assembled structures 3: timber 2	12.35%
MHS 8-2	Design of Assembled Structures 4: Metal 2	12.35%
MHS 8-3	Design of Assembled Structures 5: BA and BP Frameworks	14.81%
SAÉ for competence C3		**%**
SAÉ 8-6	Work placement period	100%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
MHS 8-4	Methods 2: risks, safety, alternatives, phasing / scheduling	25.64 %
MHS 8-5	Coordination of Design and Works 2: cost estimation, subcontracting	23.08%
MHS 8-6	Organisation and management of prefabrication 2: lean management	30.77
MHS 8-7	Production, processes, robotisation 1	20.51%
SAÉ for competence C4		**%**
SAÉ 8-6	Work placement period	100%

R 8-1 – Communication 4: Professional Communication – Networking

Timetable
Semester.....8
Period.....Feb. – June
Face-to-face in person

Duration
CM .....3 hours
Tutorial .....4 hours 30 minutes
Total **7h30**

Assessment
Assessed as SAÉ

Prerequisites

- R 2-1: Communication 2: Written and Oral Expression 2
- R 4-1: Management 1: Sociology of Work and Stakeholder Dynamics
- R 6-1: Management 2: HRM, recruitment and induction of employees

Objectives

To understand and be familiar with:

- The importance of a professional network
- How to build, maintain and expand it
- How to communicate on these networks?
  - Risks and benefits
  - Practical tips and tricks

Programme

- The basics of communication: How to spark interest without coming across as 'pushy'
- Digital and physical networks: it's all the same. You're talking to real people
  - Be sincere, natural, clear and confident
  - Talk about your convictions to resonate with others'
  - Talk about their needs, whilst explaining our solutions
- Specific features of social media (digital networks)
  - Which platform to use for which purpose
  - How to make people want to engage
  - Tips and tricks
- Key features of in-person networking (also very important)
  - How to be effective at professional networking events
    - Preparation (beforehand)
    - Attitudes and interpersonal skills (during)
    - Follow-up (after)
  - How to approach people (targets), make an impression on them and maintain the connection?

Key takeaways

- In-person networking event: scenario-based exercises, role-plays
- The basics of using LinkedIn
- Creating your LinkedIn profile

Bibliography

- The Ultimate Social Media Toolkit, C. Pellerin, Dunod
- HubSpot Academy

Keywords: mission and vision, trust and recommendations, word of mouth, clarity, consistency, reliability, honesty

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R 8-9 – Risk management

Timetable
Semester.....8
Period.....Feb – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....6 hours
Tutorials .....4½ hours
Tutorial 4h30
Total 15

Targeted skill(s)
C1 - Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- MHS 7-1 Design of assembled structures 1: timber 1
- Calculation of basic structures (beams, columns, simple frames)

Objectives

- To develop a deeper understanding of the design of timber joints in complex situations
- To master the design and verification of joints subjected to combined loads
- To develop a critical approach to technological and construction choices

Syllabus

- Complex timber-to-timber and timber-to-metal joints
- Connections subjected to combined loads (tension, shear, bending, torsion)
- Design and verification of portal frame and truss joints
- Analysis of deformations and stiffness of connections
- Case studies: design of connections for real-world timber structures

Key learning points

- Sizing a joint subjected to multiple loads
- Verifying that joints comply with current standards
- Assessing the impact of joints on the overall behaviour of the structure
- Proposing and justifying connection solutions in a timber structure project 381

Bibliography

- Eurocode 5: Design of timber structures
- *Design and Analysis of Timber Structures*, P. Freyburger, Éditions du Moniteur
- *Timber Structures: Design and Calculation*, J.-L. Boucher, Éditions Eyrolles
- *DTU – Timber Structures and Associated Technical Documents*, CSTB

Keywords: Timber joints, Eurocode 5, combined loads, joints, dimensioning

R 8-12 – An Introduction to Issues in Environmental Law

Timetable
Semester.....8
Period.....Feb. – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....9 hours
Total.....9 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

- R1-15 – Introduction to environmental issues
- R5-17: Technology 6: Introduction to Planning and Urban Development

Objectives

To understand the main environmental constraints that must be taken into account prior to construction

Syllabus

- Geographical constraints: the case of construction in coastal municipalities
- Procedural constraints: impact assessments and public consultations
- Material constraints: environmental permits

Key learning points

Identifying environmental regulatory obligations

Bibliography

- *Environmental Law*, Marianne Moliner-Dubost, Lefebvre Dalloz, 3rd ed. 2024
- *General Environmental Law*, Eric Naim-Gesbert, LexisNexis, 4th ed. 2024

Keywords: Coastal Act, ICPE, IOTA, impact assessment, public participation, public inquiry

FISE 8-2 - Management 7: Business Start-ups and Takeovers - Entrepreneurship

Timetable
Semester.....8
Period.....Feb – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....9 hours
Total.....9 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

- Previous management modules

Objectives

- To understand the concept of a business beyond theoretical knowledge
- To explore a new path to personal fulfilment and value creation in one's future professional life: setting up or taking over a business in the construction industry
- Develop your own approach to setting up or taking over a business
- To be an entrepreneur, and therefore to commit
- To be independent, responsible, a team player and tenacious

Programme

- Raising students' awareness of how to develop and present a business model. Basic concepts relating to business plans will be covered
- Training-focused awareness-raising covering aspects of valuation, innovation, industrial property rights, market identification, and accounting and legal-financial matters
- Students will have covered the essential elements needed to understand what a business plan is
- The basic mechanisms of strategy, management and steering a business
- The path of the business buyer: business analysis, takeover plan, negotiation, financing, change management
- Innovation in the broadest sense of the term

Method:

- Half-day seminars
- Initiatives by ISA BTP alumni will be highlighted during these seminars
- The construction sector will be emphasised as soon as possible to maintain a link with their core training

Key learning points

- Developing a business model
- Drawing up a business plan
- Understanding the mechanisms of business strategy, management and governance
- Analysing the legal, financial and accounting aspects of setting up or taking over a business
- Identifying market and innovation opportunities

Keywords: Business start-up, business takeover, entrepreneurship, business model, business plan, innovation, construction

Note: Students planning to start or take over a business may apply for National Student Entrepreneur Status to benefit from personalised support. In particular, they may use the 'Conducting an R&D project' module in Semester 8 and the 'Synthesis project' module in Semester 10 (begun in Semester 9) to work on their entrepreneurial project, or even undertake a work placement.

FISE 8-3 - Management 4: Innovation and Development – Engineering Agility

Timetable	
Semester	8
Period	Feb – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
Lecture	4h30
Tutorial hours	6
Tutorial hours	6
Total	**16.5**

Targeted skill(s)
C4 – Managing a construction organisation

Prerequisites

- R6-1 - Management 2: HRM
- R4-1 - Management 1

Objectives

- To understand the challenges and dynamics of innovation in the construction industry and other sectors
- Master agile methods and their application
- Develop the mindset of an innovative and adaptable engineer
- To understand the barriers and drivers associated with an innovative mindset

Programme

- Innovation in the construction industry: types, processes, barriers
- Innovation management: creativity, R&D, open innovation
- Agile methods: Scrum, Kanban, Lean and others
- Organisational agility and agile project management
- Design thinking and a user-centred approach
- Digital transformation and new ways of working
- Change management and managing uncertainty

Key learnings

- Managing a project using agile methods
- Facilitating creativity and innovation sessions
- Adapting your management style to changing contexts
- Integrating innovation into professional practices

Bibliography

- *Innovation Management*, F. Le Roy, Dunod
- *Scrum*, J. Sutherland, Dunod
- *Design Thinking*, T. Brown, Eyrolles

Keywords: Innovation, agility, agile methods, design thinking, digital transformation, creativity

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FISE 8-4 - English S8

Timetable
Semester.....8
Period.....Feb – June
Face-to-face in person

Duration	
Tutorials	22.30
Total	**22h30**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Recommend technical solutions for sustainable and more durable construction

Prerequisites

ISA 3 S6 passed – Level B2 in English

Programme

Speaking

Tutorials:

- **IELTS Oral Tasks Preparation**
- **Oral presentation**
- **Oral**:
  - Communicate fluently and coherently, maintaining a natural flow of speech and a logical sequence of ideas
  - Use a wide range of vocabulary to discuss abstract, academic and familiar topics
  - Apply accurate and varied grammatical structures to express complex ideas
  - Pronounce words clearly and use intonation patterns effectively to enhance meaning

Key learning outcomes

By the end of this course, you will be able to:

- Achieve a level 7 in the IELTS Professional speaking tasks
- Demonstrate an ability to speak at length on a given topic
- Demonstrate confidence and composure in academic speaking
- Show a willingness to self-correct and improve your pronunciation and grammar
- Engage politely and appropriately with the examiner
- Display a positive attitude towards communicating ideas clearly and accurately

Bibliography

- Barron's Writing for the IELTS
- Get the IELTS Band 9 Speaking PDF book by Cambridge IELTS Consultants
- IELTS Official Website

Keywords: Professional vocabulary, grammar, fluency, coherence, business English

FISE 8-5 - Spanish S8

Timetable
Semester.....8
Term.....Feb. – June
Face-to-face in person

Assessment
Continuous assessment

Duration
Practical sessions.....30 hours
Total.....30 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

Spanish ISA 1, 2 and 3

Objectives

In Semester 8, students continue to consolidate their B2 level with a view to certification.

Level B2 certifies that the learner can understand the main points of concrete or abstract topics in a complex text, including a technical discussion within their field of specialisation. They can communicate with such spontaneity and fluency that interaction with a native speaker is natural and effortless for both parties. They can express themselves clearly and in detail on a wide range of topics, put forward a reasoned opinion, and outline the advantages and disadvantages of different options.

The course focuses on preparing students for official Spanish language qualifications (DELE, SIELE). The aim is to consolidate and expand B2-level skills, enabling students to:

- To sit international exams in the best possible conditions
- To ensure sufficient linguistic fluency to thrive in a Spanish-speaking academic or professional environment

The B2 level is the target: in-depth comprehension, fluent and nuanced oral and written expression, and the ability to interact without difficulty with native speakers and to defend a well-reasoned point of view.

Syllabus

- Familiarisation with the DELE and SIELE exams: structure, duration, assessment criteria
- Systematic practice in the four assessed skills: listening comprehension, reading comprehension, written expression, and oral expression and interaction
- Grammar and vocabulary consolidation to achieve the accuracy and correctness expected at B2 level
- Development of specific strategies for time management, understanding lengthy texts and producing coherent and well-argued written work
- Mock exams under real exam conditions

Key learning outcomes

- Understanding complex texts, identifying main ideas and relevant details
- Producing clear, structured and well-argued written work on a variety of topics (society, culture, the world of work, current affairs)
- Interacting spontaneously and confidently in spoken English, expressing and defending one's opinions with nuance
- Use an appropriate register (formal/informal) depending on the situation
- Develop strategies for self-correction and managing exam-related stress

Bibliography

- https://eduscol.education.fr/1971/cadre-europeen-commun-de-reference-pour-les-langues-cecrl
- https://leblogdespagnol.com/
- Official DELE and SIELE resources: guides, sample exams, past papers
- Preparation books for B2-level certification exams (DELE/SIELE)

Keywords: CEFR, B2, DELE, SIELE, argumentation, opinion, comprehension, expression, exam, mock exam

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FISE 8-6 – Numerical Optimisation

Timetable	
Semester	8
Period	Feb – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
Lecture	4h30
Tutorial	4h30
Tutorial hours	6
Total hours	**15**

Targeted skill(s)
C3 – Designing structures and systems

Prerequisites

- Concepts relating to numerical sequences
- Basics of computer programming
- Python

Objectives

- To be able to programme and evaluate the main methods of numerical optimisation

Syllabus

- Generalised Newton's method
- Gradient descent methods

Key learning outcomes

- Master the programming of the main numerical optimisation methods
- To evaluate and compare the performance of different methods

Bibliography

- To be completed

Keywords: Numerical optimisation, Newton's method, gradient descent methods, Python

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FORMATION INGÉNIEUR

FISE 8-7 – Numerical methods – Partial differential equations

Timetable	
Semester	8
Term	Feb – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	12 hours
Tutorial	12 hours
Total	**24**

Targeted skill(s)
C3 – Designing structures and systems

Prerequisites

- Basic knowledge of computer programming
- Python

Objectives

- To understand the transition from a physical problem to a partial differential equation and the physical meaning of this equation
- To be familiar with the different types of partial differential equations (PDEs) and be able to solve a simple problem numerically using the finite difference method
- To be aware of numerical issues (stability, consistency, etc.) associated with PDEs
- To be familiar with certain methods for the exact solution of simple PDEs

Syllabus

- Basics of the Python language
- Partial differential equations – classification
- Relationship with physics
- Numerical solution methods and associated problems
- Exact solution methods
- Project

Key learning outcomes

- Solve a simple PDE problem numerically using finite differences
- Analysing numerical problems relating to stability and consistency
- Apply exact solution methods to simple PDEs 393

Bibliography

- *Numerical Methods for Engineers and Scientists*, J. D. Hoffman, CRC Press, 2001

Keywords: PDEs, partial differential equations, finite differences, numerical methods, Python

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FISE 8-8 – Introduction to finite element analysis: linear problems

Timetable
Semester.....8
Period.....Feb – June
Face-to-face in person

Assessment
Continuous assessment

Duration
Lecture.....6 hours
Tutorial.....9 hours
Tutorial 7.30
Total **10.30**
Targeted skill(s)
C3 – Designing structures and systems

Prerequisites

- RDM
- Continuum mechanics
- Thermodynamics

Objectives

- To understand the finite element method, introduced through a one-dimensional heuristic approach
- To understand that the method provides an approximate solution to the actual problem
- Be able to use finite element analysis software to solve a simple problem in mechanics or thermodynamics

Syllabus

- Solving a problem: a kinematically admissible field of unknowns, a statically admissible field of dual variables, and the behaviour relationship
- Discretisation and shape functions
- Weak formulation of the problem

Key learning outcomes

- Understanding the fundamentals of the finite element method
- Applying discretisation and shape functions to a simple problem
- Using finite element analysis software for mechanical or thermal problems 395

Bibliography

- *Numerical Methods in Finite Element Analysis*, K.J. Bathe and E.L. Wilson, Prentice-Hall
- *Finite Element Modelling of Structures*, J.L. Batoz and G. Dhatt, Volumes 1, 2 and 3, Hermès
- *An Introduction to the Finite Element Method*, G. Dhatt and G. Touzot, Les presses de l'université Laval, Québec, 1981
- *An Introduction to the Finite Element Method*, J. Garrigues: `http://jgarrigues.perso.egim-mrs.fr/ef`
- *Introduction to the Finite Element Method*, C. La Borderie: `http://clb.perso.univ-pau.fr/rdm/isa5/coursef.pdf`

Keywords: Finite elements, discretisation, weak formulation, linear problems, mechanics, thermal

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FISE 8-10 – Organisation 10: Public and private works contracts

Timetable
Semester.....8
Period.....Feb. – June
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorial	7h30
Total	**15 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

- R6-2 - Management 5: Construction and insurance law
- R4-3 - Organisation 4: Organisational context of the construction industry

Objectives

- To gain a thorough understanding of the different types of construction contracts
- To understand the specific features of public and private contracts
- Be able to analyse a tender dossier

Syllabus

- Public procurement: legal framework, Public Procurement Code
- Procurement procedures: calls for tenders, negotiated procedures
- Private contracts: CCMI, works contracts
- Contract documents: CCAP, CCTP, DPGF, plans
- General Administrative Terms and Conditions (CCAG)
- Analysis of tender documents and consultation dossier
- Preparation of a tender and response to a call for tenders
- Award criteria and analysis of tenders

Key learning points

- Analysing a tender documentation pack (DCE)
- Identifying contractual obligations
- Drafting a response to a call for tenders
- Distinguishing between public and

private procurement 397

Bibliography

- *Public Procurement Code*, Dalloz
- *Works Contracts*, J.-P. Monceau, Le Moniteur
- *Practical Guide to Public Procurement*, CCAG Travaux

Keywords: Works contracts, public procurement, calls for tenders, CCAG, Public Procurement Code

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FISE 8-11 – Organisation 11: Contractual management of contracts during the EXE phase

Timetable	
Semester	8
Period	Feb – June
Face-to-face in person	

Duration	
CM	6 hours
Tutorials	4½ hours
Total	**10.5 hours**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

Resource R 8-10 'Organisation 10: public and private construction contracts'

Objectives

- Carry out contractual management of the contract: stakeholders, technical execution, financial execution, possible penalties, contract closure
- Identify the company's commitments: services, price, deadlines, guarantees

Syllabus

- **Course**:
  - Launching a project: stages, administrative and technical arrangements
  - Identification and roles of the various parties involved in a contract
  - Monitoring the construction site with the project manager: site orders, technical specifications, progress reports, technical specifications, amendments, price variations, environmental and social clauses
  - Dispute resolution, imposition of penalties
  - Contract closure: handover, guarantees, final accounts, dispute resolution
- **Examples of practical exercises**:
  - Group presentations on a topic relating to site supervision / Case studies
  - Price updates and revisions
  - Written correspondence in the context of a contract
  - Identifying key concepts relating to contract management in the tender documents

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Key learning points

- Understanding the various parties involved in a contract
- Understanding and being able to manage the technical, financial and administrative aspects of a construction project from start to finish

Keywords: Management, construction site, responsibilities

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FORMATION INGÉNIEUR

FISE 8-13 – Digital Models and the BIM Approach

Timetable
Semester.....8
Period.....Feb – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....6 hours
Tutorials .....4½ hours
Total **10.5**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- digital design tools
- site preparation and management (previous modules on safety and works organisation)
- management of a construction project
- end-of-year project

Syllabus

- Optimised project management: PMBOK, IPD, TVD, SBD methodologies, etc. (lecture-based teaching approach)
- Digital BIM tools: 4D and 5D software, project management, augmented reality, etc. (through case studies)

This module is delivered in partnership with the DomoLandes platform in Saint-Geours-de-Maremne, whose facilities may be used

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FISEA 8-4 – English S8

Timetable
Semester.....8
Period.....Feb – June
Face-to-face in person

Duration	
Tutorials	22.30
Total	**22h30**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Recommend technical solutions for sustainable and more durable construction

Prerequisites

ISA 3 S6 passed – Level B2 in English

Programme

Speaking

Tutorials:

- **IELTS Oral Tasks Preparation**
- **Oral presentation**
- **Oral**:
  - Communicate fluently and coherently, maintaining a natural flow of speech and a logical sequence of ideas
  - Use a wide range of vocabulary to discuss abstract, academic and familiar topics
  - Apply accurate and varied grammatical structures to express complex ideas
  - Pronounce words clearly and use intonation patterns effectively to enhance meaning

Key learning outcomes

By the end of this course, you will be able to:

- Achieve a level 7 in the IELTS Professional speaking tasks
- Demonstrate the ability to speak at length on a given topic
- Demonstrate confidence and composure in academic speaking
- Show a willingness to self-correct and improve your pronunciation and grammar
- Engage politely and appropriately with the examiner
- Display a positive attitude towards communicating ideas clearly and accurately

Bibliography

- Barron's Writing for the IELTS
- Get the 'IELTS Band 9 Speaking' PDF book by Cambridge IELTS Consultants
- IELTS Official Website

Keywords: Professional vocabulary, grammar, fluency, coherence, business English

FISEA 8-5 - Spanish S8

Timetable
Semester.....8
Term.....Feb. – June
Face-to-face in person

Assessment
Continuous assessment

Duration
Practical sessions.....30 hours
Total.....30 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

Spanish ISA 1, 2 and 3

Objectives

In Semester 8, students continue to consolidate their B2 level with a view to certification.

Level B2 certifies that the learner can understand the main points of concrete or abstract topics in a complex text, including a technical discussion within their field of specialisation. They can communicate with such spontaneity and fluency that interaction with a native speaker is natural and effortless for both parties. They can express themselves clearly and in detail on a wide range of topics, put forward a reasoned opinion, and outline the advantages and disadvantages of different options.

The course focuses on preparing students for official Spanish language qualifications (DELE, SIELE). The aim is to consolidate and expand B2-level skills, enabling students to:

- To sit international exams in the best possible conditions
- To ensure sufficient linguistic fluency to thrive in a Spanish-speaking academic or professional environment

The B2 level is the target: in-depth comprehension, fluent and nuanced oral and written expression, and the ability to interact without difficulty with native speakers and to defend a well-reasoned point of view.

Syllabus

- Familiarisation with the DELE and SIELE exams: structure, duration, assessment criteria
- Systematic practice in the four assessed skills: listening comprehension, reading comprehension, written expression, and oral expression and interaction
- Grammar and vocabulary consolidation to achieve the accuracy and correctness expected at B2 level
- Development of specific strategies for time management, understanding lengthy texts and producing coherent and well-argued written work
- Mock exams under real exam conditions

Key learning outcomes

- Understanding complex texts, identifying main ideas and relevant details
- Producing clear, structured and well-argued written work on a variety of topics (society, culture, the world of work, current affairs)
- Interacting spontaneously and confidently in spoken English, expressing and defending one's opinions with nuance
- Use an appropriate register (formal/informal) depending on the situation
- Develop strategies for self-correction and managing exam-related stress

Bibliography

- https://eduscol.education.fr/1971/cadre-europeen-commun-de-reference-pour-les-langues-cecrl
- https://leblogdespagnol.com/
- Official DELE and SIELE resources: guides, sample exams, past papers
- Preparation books for B2-level certification exams (DELE/SIELE)

Keywords: CEFR, B2, DELE, SIELE, argumentation, opinion, comprehension, expression, exam, mock exam

FISEA 8-8 – Introduction to finite element analysis: linear problems

Timetable	
Semester	8
Period	Feb – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
Lecture	6 hours
Tutorial	6 hours
Tutorial	7.30
Total	**7.30**

Targeted skill(s)
C3 – Designing structures and systems

Prerequisites

- RDM
- Continuum mechanics
- Thermodynamics

Objectives

- To understand the finite element method, introduced through a one-dimensional heuristic approach
- To understand that the method provides an approximate solution to the actual problem
- Be able to use finite element analysis software to solve a simple problem in mechanics or thermodynamics

Syllabus

- Solving a problem: a kinematically admissible field of unknowns, a statically admissible field of dual variables, and the behaviour relationship
- Discretisation and shape functions
- A broad formulation of the problem

Key learning points

- Understanding the fundamentals of the finite element method
- Applying discretisation and shape functions to a simple problem
- Using finite element analysis software for mechanical or thermal problems

Bibliography

- *Numerical Methods in Finite Element Analysis*, K.J. Bathe and E.L. Wilson, Prentice-Hall
- *Finite Element Modelling of Structures*, J.L. Batoz and G. Dhatt, Volumes 1, 2 and 3, Hermès
- *An Introduction to the Finite Element Method*, G. Dhatt and G. Touzot, Les presses de l'université Laval, Québec, 1981
- *An Introduction to the Finite Element Method*, J. Garrigues: `http://jgarrigues.perso.egim-mrs.fr/ef`
- *Introduction to the Finite Element Method*, C. La Borderie: `http://clb.perso.univ-pau.fr/rdm/isa5/coursef.pdf`

Keywords: Finite elements, discretisation, weak formulation, linear problems, mechanics, thermal

BCR 8-1 – Soil Mechanics 2: effect of water, underpinning.

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Timetable	
Semester	8
Term	Feb. – June
Face-to-face in person	

Duration	
CM	7.5 hours
Tutorial	7h30
Total	**15 hours**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- Soils 1: Introduction to geology and hydrogeology (R 3-12)
- Soils 2: Soil Mechanics 1 (R4-15)
- Soils 3: Soil Mechanics 2 (R5-13)
- Soils 4: Laboratory Tests (R5-14)
- Strength of Materials
- Structural Analysis

Objectives

The module aims to train students in the design, diagnosis and rehabilitation of foundations, taking into account complex geotechnical conditions, in particular clay swelling, variations in the water table and soil pathologies, whilst incorporating the latest regulatory approaches and underpinning techniques.

- Design of foundations under drained and undrained conditions
- Understanding the tip, shaft and lateral resistances of piles and pile groups
- Analysing the influence of geotechnical conditions on the behaviour of structures.
- Assessing the effects of groundwater level fluctuations on the bearing capacity and settlement of foundations
- Soil-structure interaction
- Understanding the causes of defects and failures affecting foundations
- Identifying techniques for investigating and diagnosing soils and structures

- Mastering the methods and conditions for underpinning, in accordance with the current regulatory framework
- Exploring and comparing traditional and innovative techniques for soil reinforcement and consolidation
- Design and justification of a technical choice for underpinning based on soil type, foundation type and structure type

Syllabus

- Limit analysis for the design of shallow foundations:
  - Study of ultimate and serviceability limit states
  - Soil-structure interaction
- Prediction of the bearing capacity and settlements of shallow foundations, taking into account:
  - Hydrogeological conditions
  - Delayed behaviour of soils
- Effects of clay swelling and shrinkage on foundations:
  - Identification of swelling soils
  - Assessment of the risks of uplift and cracking
  - Prevention and remediation methods
- Influence of groundwater level fluctuations on foundation behaviour
  - Consequences of groundwater level fluctuations on bearing capacity, settlement and overall stability
  - Drainage and protection measures
- Design of pile foundations subjected to vertical and horizontal loads
  - Bearing capacity calculations
  - Group effects
  - Pile-soil-structure interaction
- Investigation and diagnosis of foundation defects through in situ and laboratory tests:
  - Geotechnical investigation
  - Identification of the causes of defects
- Underpinning requirements and regulatory framework
- Underpinning methods using traditional and innovative consolidation techniques

Key learning points

- Mastering the fundamental principles of soil mechanics as applied to foundation design
- Correctly assessing the bearing capacity and settlement of shallow and deep foundations
- Recognise the phenomena of clay swelling and shrinkage and their effects on structures
- Understand the causes and effects of groundwater level fluctuations on the stability and performance of foundations
- Carry out a comprehensive geotechnical assessment based on in situ and laboratory tests
- Select and apply underpinning techniques to real-world case studies

Bibliography

- *Calculation of Shallow and Deep Foundations*, Sébastien Burlon, Fahd Cuira, Roger Frank, Presses des Ponts, 2019
- *Soil Improvement and Reinforcement – Volumes 1–2*, Claude Plumelle, Technical Expertise Series, 2018

Keywords: Foundations, bearing capacity, settlement, soil-structure interaction, consolidation, underpinning, swelling/shrinkage of clays, changes in the water table

BCR 8-2 – Structural Dynamics 1

Timetable
Semester.....8
Period.....Feb – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM.....10.30 am
Tutorial.....10.30
Total.....9.00 pm

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- Solid mechanics (statics, kinematics)
- Basics of calculating element stiffness (bars, beams)
- Concepts of differential calculus and differential equations

Objectives

- To model a simple vibrating system with 1 degree of freedom (1 DDL / SDOF – Single Degree of Freedom)
- To write and solve the equation of motion for different cases (free undamped, free damped, forced)
- Determine the stiffness of an elementary structure and deduce its natural frequency
- To understand the phenomena of resonance and damping

Syllabus

- Mass–spring–damper model: deriving the equation of motion
- Free vibrations: undamped, damped
- Response to harmonic excitation
- Calculation of the stiffness of simple elements (rods, beams) and relationship to natural frequency
- Applications to practical cases

Key learning outcomes

- Be able to formulate the equation of motion for a system with one degree of freedom
- Be able to analytically solve a second-order differential equation in mechanics
- Be able to calculate and interpret a natural frequency
- Understand the impact of damping on the vibrational response

Bibliography

- *Mechanics of Rigid Bodies – Volume 5: Solid Dynamics*, Rachid Mesrar, Brahim Amghar, EDP Sciences, 2024
- *Mechanics 3 – Mechanics of Rigid Bodies: Kinetics, Dynamics: Lectures and Solved Exercises*, Yves Brémont, Paul Réocreux, Ellipses, 1998

Keywords: Dynamics, earthquake, design, multiple degrees of freedom, natural modes

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BCR 8-3 – Fire resistance calculation

Timetable	
Semester	8
Period	Feb – June
Face-to-face in person	

Duration	
CM	9 hours
Tutorial	9 hours
Total	**18h**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 – Designing structures and systems

Prerequisites

- Materials: steel, concrete, timber
- Structural analysis: Steel Construction Resources 1 to 3, Reinforced Concrete 1 to 3, Timber 1 and 2

Objectives

- To be able to calculate or verify the fire resistance of concrete, steel or timber structures

Syllabus

- Regulatory framework for fire resistance design of structures: concept of accidental load, general design principles...
- Behaviour of materials under high temperature conditions
- General construction rules: expansion joints, geometric arrangements, reinforcement layouts, the effect of secondary protection, etc.
- Standard rules and calculation methods by structural element type (tension members, columns, walls, beams and floors)

Key learning outcomes

- Be able to calculate or verify a structure made of concrete, steel or simple timber, and understand the various stages of design to be carried out for reinforced concrete structures subjected to fire

Bibliography

- Part 2.1 of Eurocodes 2, 3 and 5
- *A Guide to Reinforced Concrete Structures*, Pierre Guillemont, Dunod, 2013

Keywords: Structure, fire, structural analysis, building, Eurocode 2 413

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BCR 8-4 – Structural Design 2: Prestressed Concrete

Timetable	
Semester	8
Period	Feb. – June
Face-to-face in person	

Duration	
CM	7.5 hours
Tutorial	7h30
Total	**15 hours**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

The course handout for this resource is in English, but the course is largely bilingual (French-English) in order to acquire technical vocabulary related to prestressing in both languages.
The course handout for this resource is in English, but the course is largely bilingual (French-English) in order to acquire technical vocabulary related to prestressing in both languages.

Prerequisites

Strength of materials, theory of beams: isostatic structures, concepts of strains and stresses

Learning Outcomes

- Describe the principles of prestressing: the effect of applying compressive force to connected elements; how a compressive force eliminates tension in a beam; advantages compared with reinforced concrete
- Distinguish between the different types of rules in Eurocode 2
- Calculate the loss of stress
- Design and troubleshoot a section of prestressed concrete with regard to normal stresses at the Service Limit State (SLS)
- Describe the principles of design and troubleshoot a section of prestressed concrete with regard to normal stresses under the Ultimate Limit State (ULS)

Programme

- General overview, operating principles, methods of application, examples of prestressing
- Technological aspects of prestressing (pre-tensioning – precast concrete structural systems – post-tensioning prestressing)
- Regulatory aspects (Eurocode 2): safety principle, material properties (concrete and steel)
- Determination of the probable tension in the prestressing cables: evaluation of stress losses
- Bending of isostatic beams: design at the Serviceability Limit State (SLS) under normal stresses
- Bending of isostatic beams: design justifications at the Ultimate Limit State (ULS) under normal stresses
- Resistance of prestressed concrete to shear force: justifications and design under tangential loads

BCR 8-4 – Structural Design 2: Prestressed Concrete

Critical learning outcomes

- Determine the critical phases in the life of a prestressed isostatic structure and specify the associated SLS combinations
- Verify a prestressed isostatic structure against normal stresses using the SLS

Bibliography

- NF EN 1992: Eurocode 2
- *Prestressed Concrete under Limit States*, H. THONIER, 2nd edition, ENPC Press
- *Prestressing*, R. CHAUSSIN, A. FUENTES, R. LACROIX, J. PERCHAT, ENPC Press
- *Properties of Reinforced and Prestressed Concrete*, edited by R. LACROIX and JL. CEMENT, published by Lavoisier Hermès, 2002
- *Applications of Eurocode 2: Design of Concrete Structures*, edited by J.A. GALGARO and J. CORTADE, 2nd edition, ENPC Press, 2008
- *Design of prestressed concrete members using bonded wires*, P. PASSEMAN, C. VINOT, published by CSTB, 2010
- *Prestressed Concrete under the Eurocodes*, P. Le Delliou, published by ENTPE, 2003
- *Eurocode 2: Application to Concrete Road Bridges – Methodological Guide*, Bui, Ngoc-Vu, published by SETRA, 2008
- Online: www.ba-cortex.com

Keywords:

- Prestressing, prestressed concrete, ULS calculation, Eurocode 2,
- Eurocode 2, prestressed concrete, prestressing, ULS calculation

BCR 8-5 - Assessment 2: building envelope and services

Timetable
Semester.....8
Period.....Feb – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial.....9 hours
Total.....**18h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 – Designing structures and systems

Prerequisites

- Previous technology modules
- Previous modules on materials

Objectives

- To understand the main techniques used to carry out a diagnostic assessment of a building's envelope and technical systems
- To establish a method for carrying out an assessment of a building's envelope and technical systems
- To analyse an assessment of a building's envelope and technical systems
- Propose improvement solutions in response to a structural assessment, including an analysis of the overall environmental impact and optimising expenditure

Syllabus

- Key techniques for assessing a building's envelope
  - Analysis of as-built drawings and other available documentation
  - Thermography: comprehensive analysis and identification of thermal bridges
  - Air infiltration test: analysis of airtightness and thermal bridges
  - Analysis of watertightness
- Summary of analyses of a building's technical systems
- Overall energy analysis
  - Metering plan
  - PIMVP (International Protocol for Measurement and Verification of Performance)

- Analysing an assessment of the building envelope and technical systems
- Proposing solutions based on the findings of the assessment
  - For the building envelope and technical systems
  - Comprehensive environmental analysis
  - Financial optimisation

Key lessons learnt

- Understanding the main diagnostic techniques for the building envelope and technical systems
- Be able to analyse a diagnostic assessment of the building envelope and technical systems and propose a number of significant improvements

Bibliography

- *Sustainable Energy Renovation of Detached Houses: Architectural Quality, Summer Comfort and Performance*, Catherine Charlot-Valdieu, Philippe Outrequin, Le Moniteur, 2024
- *Moisture-related defects. Clad walls in buildings – Analysis of the phenomenon*, Paul Dahan, Techniques de l'Ingénieur
- *Moisture-related defects. Single-skin walls – Condensation phenomena*, Paul Dahan, Techniques de l'Ingénieur
- *Thermal insulation of single-family and multi-family buildings*, André Bergner, Techniques de l'Ingénieur
- *Energy Performance of Existing Buildings – Characterisation*, Richard Cantin, Techniques de l'Ingénieur

Keywords: Diagnosis, building envelope, airtightness, watertightness, insulation, thermal equipment, energy consumption assessment

BCR 8-6 – Durability and defects

Timetable	
Term	8
Period	Feb – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	12 hours
Tutorial	12 hours
Total	**24**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Technology: knowledge of structural work and finishing work in the field of new-build construction
- Course on Strength of Materials

Objectives

- To recognise and select a type of stone using the knowledge acquired on the main categories of stone used in construction and their properties
- To understand the composition of a stone structure and the construction techniques used
- Understand some of the principles of dimensioning stone masonry
- Propose repair solutions for the main defects affecting a stone structure

Syllabus

- Introduction to building stones, their characteristics and uses
- Overview of construction techniques for foundations, walls, floors, roof structures, etc., found in stone buildings
- Methods for dimensioning the basic elements of a stone structure
- Problems affecting stone buildings
- Repair techniques for stone structures

Key learning outcomes

- Understand the basic terminology associated with stone structures
- Recognise the main defects in a stone structure
- Propose a number of repair solutions for a stone structure

Bibliography

- Collection of fact sheets on building defects, Agence Qualité Construction
- *Knowledge of Stone*, M. Mamillan, Memento, CATED
- *Quarry Stones*, Catalogue of Building Products, CATED
- *Stone Buildings*, Techniques for Improving Existing Homes, EDF Habitat
- *The Old House: Construction, Assessment and Interventions*, Jean Coignet and Laurent Coignet, Eyrolles
- *Maintenance, Renovation and Refurbishment of Buildings*, Le Moniteur
- *Cut Stone*, Jean-Marc Laurent, Eyrolles
- *Restoration of Cut Stone Facades*, Jean-Marc Laurent, Eyrolles
- *Cracking*, Building Techniques Guides, CATED
- *Facade Refurbishment: A Practical Guide*, Gilbert Vallière, Eyrolles

Keywords: Stone masonry, defects, dimensioning, repair

BCR 8-7 – Organisation of Works 1 (TCE)

Timetable	
Semester	8
Period	Feb. – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	9 hours
Tutorial	9 hours
Total	**18h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- Technology resources: structural works and finishing works
- Materials resources: basic knowledge of the main construction materials
- Environmental approach and compliance with health and safety regulations
- Site organisation resources, in particular R2-12 'Task scheduling'

Objectives

- To identify the constraints involved in carrying out the work and the interfaces between trade areas
- Understand techniques for repairing and reinforcing structures, and temporary shoring
- Understand the techniques and procedures for demolition, reconstruction and underpinning
- Recommend finishing works and systems appropriate to the building type
- Draw up a works schedule specific to refurbishment works (occupied site, phasing of demolition, temporary structures, etc.)
- Recommend techniques and systems that comply with current regulations, and which improve comfort, reduce running costs (energy consumption, service charges, maintenance) and contribute to the objectives of safeguarding occupants' health (indoor air quality, etc.)

Programme

- Types of building
- Structural and finishing works technologies specific to renovation and refurbishment (all technical trades and systems)

- Specific technical aspects relating to the management of interfaces between trades: waterproofing, mechanical performance, expansion joints, installation systems, etc.
- Concepts of concurrent engineering and interoperability
- Overall organisation and business interfaces: planning, partial handover, phasing, finishing touches

Key lessons learnt

- List the specific construction constraints associated with refurbishment
- Propose building refurbishment works that improve the building's lifespan, sustainability and occupants' comfort
- Propose an organisation of building works (structural, mechanical and electrical): planning, phasing, critical path

Bibliography

- Collection of fact sheets on building pathology, Agence Qualité Construction
- Technology handbooks, Memento, CATED
- Trade journals and publications

Keywords: Construction site, organisation, all-trade refurbishment

BCR 8-8 – Energy analysis (STD)

Calendar	
Semester	8
Period	Feb – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorial	15h30
Total	**23h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- Calculation of heat loss
- Thermal regulations
- Building Materials and Technology

Objectives

- To adapt construction solutions to ensure thermal comfort for occupants through dynamic thermal simulation
- Understand the requirements of thermal regulations and the environmental approach to a construction project through dynamic thermal simulation
- To predict the thermal behaviour of a building

Syllabus

- Software presentation:
  - Comfie (calculation engine)
  - Pleiades (input interface for building management libraries, calculation and results analysis, and building input and display interface)
- Practical example:
  - Modelling a simple building
  - Simulation of the current condition
  - Analysis of results
  - Simulation of different scenarios to improve thermal comfort
  - Verification of requirements (regulatory, energy efficiency labels, etc.)

Key learnings

- Formulating clear assumptions and implementing them in the software
- Analysing results and identifying possible sources of error
- Presenting results in a study report in a clear and relevant manner
- Propose improvement measures to find the optimal solution that meets a range of requirements (client, regulations, climate, location, project type, etc.)
- Be able to explain and justify these choices verbally

Bibliography

- Technical documentation from the software publisher, Izuba Energies

Keywords: Dynamic thermal simulation, comfort, improvement solutions

GCM 8-1 - Structural Dynamics 1

Timetable	
Semester	8
Period	Feb – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	10.30 am
Tutorial	10.30
Total	**9.00 pm**

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

- 1D Solid Dynamics (previous course)
- Knowledge of linear algebra (eigenvalues and eigenvectors, matrices)
- Basics of matrix calculations applied to mechanics
- Basic understanding of seismic regulations (Eurocodes)

Objectives

- To model a vibrating system with n degrees of freedom (n DDL / MDOF – Multi Degrees of Freedom)
- Construct the mass and stiffness matrices of a mechanical or structural system
- Determine the natural modes and natural frequencies of a system
- Analyse the dynamic response using modal superposition
- Apply these methods to calculate seismic effects on simple structures

Syllabus

- Matrix formulation of the equation of motion with n DDLs
- Natural modes and natural frequencies (orthogonality, normalisation)
- Free and forced response with proportional damping
- Modal superposition and the principle of decomposition
- Application to seismic dynamics: simplified calculation of seismic forces

Key learning outcomes

- Ability to formulate and solve a dynamic system with multiple DDLs
- To interpret the natural modes and their influence on the response in physical terms
- Be able to apply modal analysis to estimate seismic forces
- Linking mathematical concepts (eigenvalues, eigenvectors) to a mechanical interpretation

Bibliography

- *Dynamics of Structures*, A. K. Chopra, Prentice Hall
- *Structural Dynamics*, M. Paz, Springer
- Eurocode 8: Design of structures for resistance to earthquakes

Keywords: Structural dynamics, MDOF, eigenmodes, modal superposition, seismic, modal analysis

GCM 8-2 – Structural Design 2: Prestressed Concrete

Timetable
Semester.....8
Period.....Feb – June
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorial	7h30
Total	**15 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

The handout for this resource is in English, but the course is largely bilingual (French and English) to help students acquire the technical vocabulary of prestressing in both French and English.

Prerequisites

Strength of materials, theory of beams: isostatic structures, concepts of strains and stresses

Learning outcomes

- Describe the principles of prestressing: the effect of applying a compressive force to connected elements; how a compressive force eliminates tension in a beam; advantages compared with reinforced concrete
- Distinguish between the different types of rules in Eurocode 2
- Calculate the loss of stress
- Design and troubleshoot a section of prestressed concrete with regard to normal stresses at the Serviceability Limit State (SLS)
- Describe the principles of design and troubleshoot a section of prestressed concrete with regard to normal stresses under the Ultimate Limit State (ULS)

Programme

- General overview, operating principles, methods of application, examples of prestressing
- Technological aspects of prestressing (pre-tensioning – precast concrete structural systems – post-tensioning prestressing)
- Regulatory aspects (Eurocode 2): safety principle, material properties (concrete and steel)
- Determination of the probable tension in the prestressing cables: evaluation of stress losses
- Bending of isostatic beams: design at the Serviceability Limit State (SLS) under normal stresses
- Bending of isostatic beams: design justifications at the Ultimate Limit State (ULS) under normal stresses
- Resistance of prestressed concrete to shear force: justifications and design under tangential loads

Key learning points

- Determine the critical phases in the life of a prestressed isostatic structure and specify the associated ELS combinations
- Verify a prestressed isostatic structure against normal stresses under ELS conditions

Bibliography

- NF EN 1992: Eurocode 2
- *Prestressed Concrete at Limit States*, H. THONIER, 2nd edition, ENPC Press
- *Prestressing*, R. CHAUSSIN, A. FUENTES, R. LACROIX, J. PERCHAT, ENPC Press
- *Properties of Reinforced and Prestressed Concrete*, edited by R. LACROIX and JL. CEMENT, Lavoisier Hermès, 2002
- *Applications of Eurocode 2: Design of Concrete Buildings*, edited by J.A. GALGARO and J. CORTADE, 2nd edition, ENPC Press, 2008
- *Design of prestressed concrete members using bonded wires*, P. PASSEMAN, C. VINOT, published by CSTB, 2010
- *Prestressed Concrete under the Eurocodes*, P. Le Delliou, published by ENTPE, 2003
- *Eurocode 2: Application to Concrete Road Bridges – Methodological Guide*, Bui, Ngoc-Vu, published by SETRA, 2008
- Online: www.ba-cortex.com

Keywords: Prestressing, prestressed concrete, ELS analysis, Eurocode 2, prestressed concrete

GCM 8-3 – Foundations for Structural Engineering

Timetable	
Semester	8
Term	Feb – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	10.30 am
Tutorial	10.30
Total	**9.00 pm**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- GCM7-1 – Soil mechanics: earth pressure, retaining structures
- R6-9 - Geotechnics 2: Foundations

Objectives

The aim of the course is to provide the fundamentals of the geotechnical design of shallow and deep foundations, with a particular focus on engineering structures and foundations in marine environments:

- To master the design of shallow and deep foundations
- Select the appropriate type of foundation for the context
- Interpret the results of in situ and laboratory tests for bearing capacity and settlement calculations.
- Understand the tip, shaft and lateral resistances of piles and pile groups

Syllabus

- Introduction to foundations: role and classification
- Shallow foundations: footings, isolated piles, continuous piles, raft foundations and caissons
- Calculation of bearing capacity and settlement of shallow foundations based on in-situ and laboratory tests.
- Deep foundations: piles and micropiles
- Classifications by type; construction methods.
- Axial and lateral bearing capacity of a pile
- Behaviour of pile groups
- Marine foundations: raft foundations, caissons, offshore piles

- Specific aspects of geotechnical design in marine environments (geotechnical conditions, dynamic loads, stability and durability of foundations)
- Design in accordance with Eurocode 7

Key learning points

- Designing shallow and deep foundations
- Calculating bearing capacity and settlements
- Interpreting the results of geotechnical tests
- Selecting a suitable foundation solution

Bibliography

- *Foundations and Earthworks*, R. Frank, Presses de l'ENPC
- *Eurocode 7: Geotechnical Design*, NF EN 1997
- *Deep Foundations*, F. Schlosser, Techniques de l'Ingénieur

Keywords: foundations, bearing capacity, settlement, Eurocode 7

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GCM 8-4 - Breakwater design

Timetable	
Term	8
Period	Feb. – June
Face-to-face in person	

Duration	
CM	10.30 am
Tutorial	10.30
Total	**9.00 pm**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisite

- Fluid Mechanics (ISA2)

Course objectives

- By the end of this course, students should be able to design rubble mound or vertical wall breakwaters

Syllabus

- Different types of coastal structures
- Hydraulic behaviour of breakwaters: wave run-up, overtopping discharges, wave transmission and reflection
- Rubble mound breakwater: stability of the armour layer, design rules for the breakwater section
- Vertical wall: stability analysis

Key learning outcomes

- Identify different types of coastal structures and their applications
- Analyse the hydraulic behaviour of breakwaters
- Design rubble mound breakwaters in accordance with stability rules
- Calculate the stability of vertical walls

Bibliography

- *Coastal Engineering Manual*, Part VI, Chapter 5, 'Fundamentals of Design', 353 pp., Coastal and Hydraulics Laboratory – Engineer Research and Development Centre
- *Rock Manual: The Use of Rock in Hydraulic Engineering*, Chapters 4 and 5, ISBN 978-0-86017-683-1
- *Design of Vertical Breakwaters*, Shigeo Takahashi, 2002, Port and Airport Research Institute, Japan, 105 pp.

Keywords: Breakwaters, coastal structures, stability, hydraulic design, maritime engineering

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GCM 8-5 – Coastal processes and coastal defence

Timetable	
Semester	8
Period	Feb – June
Face-to-face in person	

Duration	
CM	10.30 am
Tutorial	10.30
Total	**9.00 pm**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisite

- Fluid mechanics
- Marine hydraulics

Course objectives

- By the end of this class, students should be able to identify the causes of beach erosion and develop strategies to deal effectively with shoreline erosion

Programme

- Coastal processes (waves, currents, storm surges, sediment transport)
- Beach morphology (beach profiles, beach plan shape)
- Design of coastal defences (groynes, seawalls, beach nourishment, etc.)

Key learning outcomes

- Analyse coastal processes and their interactions
- Identify the causes of coastal erosion
- Design appropriate coastal defence strategies
- Assess the effectiveness of different types of coastal protection structures

Bibliography

- *Coastal Engineering Manual*
- *Beach Processes and Sedimentation*, P. Komar, Prentice Hall
- *Coastal Processes with Engineering Applications*, R. Dean and R. Dalrymple, Cambridge University Press

Keywords: Coastal processes, erosion, coastal defence, beach morphology, sediment transport

GCM 8-6 – Bridges 2

Timetable
Semester.....8
Period.....Feb. – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....6 hours
Practical sessions.....6 hours
Total.....**12**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Prerequisites for Resource GCM 7-6 Bridges 1
- GCM Resource 7-6 Bridges 1
- Organisation Course:
  - R2-12: Organisation 2: Task Scheduling
  - R5-15: Health and Safety 4: Safety Integration and Site Preparation
  - R5-16: Organisation 8: Construction Economics – Costing a Simple Structure

Objectives

- To design and describe a construction method for a standard engineering structure
- Draw up a site budget and site schedule for the construction of a standard engineering structure
- Draft a construction procedure for the construction of a standard engineering structure, taking into account quality, safety and environmental requirements

Syllabus

- Drawing up a method statement, a cost estimate and a schedule (review, applied to a civil engineering structure project)
- Construction procedures: purpose, content and contractual requirements
- Drafting safety risk assessments, environmental risk assessments and monitoring plans

Key learning points

- Drawing up a construction budget
- Drafting an implementation procedure

Bibliography

- SETRA and CEREMA technical guides
- CCTG booklets

Keywords: Engineering structures, technology, construction procedures

GCM 8-7 – Alignment and design of road pavements

Schedule	
Semester	8
Period	Feb – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	10.30 am
Tutorial	1.30 pm
Total	**24**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Designing structures and systems
C4 - Manage a construction organisation

Prerequisites

- Basic knowledge of roads

Objectives

- To design the geometric characteristics of a road project
- Design the road drainage system
- Justify technological choices and materials

Syllabus

- Roads: general characteristics, design and geometry
  - Selecting the type of road
  - Selecting the road category
  - Definitions of plan layout and longitudinal profile
  - Definition of cross-sections
- Roundabouts
  - General provisions
  - Geometry of roundabout components
- Road drainage: general design
  - Introduction
  - Water collection
  - Treatment systems

- Road pavements: selection and design of structures
  - Road category
  - Determining the traffic class
  - Subgrade class
  - Selection of one or more structures
  - Surface course
  - Freeze-thaw verification
  - Cross-section
  - Estimation and comparison of the overall cost of a structure
- Road pavements: analysis and selection of different materials
  - Functional analysis
  - Hydrocarbon binders: pure bitumen, fluidised bitumen, fluxed bitumen, emulsions
  - Materials used in road sub-bases: untreated sub-bases, treated sub-bases
  - Materials used in the wearing courses: specific grades, surface treatments, hydrocarbon-based mixes (hot and cold), concrete pavements
- Pavements: quality control
  - Inspection of sub-bases and surface treatment layers
  - Inspection of wearing courses
- Use of the MENSURA software, road module

Key learning points

- Defining the geometric characteristics of a road project
- Designing pavement structures in accordance with current standards
- Selecting suitable materials for sub-bases and surface courses
- Design a road drainage system
- Using software tools for road design

Bibliography

- *Design and Dimensioning of Pavement Structures*, Technical Guide, SETRA, 1994
- *Catalogue of Standard Pavement Structures*, SETRA, 1998
- *Development of Main Roads (ARP) and Link Motorways*, ICTAAL, SETRA
- *Construction of Embankments and Sub-base*, Technical Guide, SETRA
- *Roads*, Volumes 1 and 2, M. Faure, Aleas
- Engineering Techniques, electronic encyclopaedia

Keywords: Roads, pavements, design, road alignment, drainage, roundabouts, road materials

GCM 8-8 – Retaining Structures – Tunnels

Calendar	
Half-year	8
Period	Feb. – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	10.30 am
Tutorial	6.5 hours
Total	**17h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- Advanced geotechnics and soil mechanics
- Solid mechanics
- Structural analysis
- Fundamentals of Materials and Structural Strength

Objectives

- To understand the principles of design and dimensioning for tunnels and covered trenches
- To identify and analyse the factors influencing the stability of excavations (geology, hydrogeology, stresses, etc.)
- To master methods of site investigation (geological, hydrogeological and geotechnical)
- Identify excavation and support methods suited to geological conditions
- To integrate safety, cost and environmental constraints into underground projects

Syllabus

- Types of tunnels (road, rail, hydraulic, urban)
- Challenges posed by the excavation of underground structures (stability of the excavation walls, influence of hydrogeological conditions, interactions between the rock mass and the support system)
- Excavation methods: conventional (NATM), tunnel boring machines, covered trenches
- Geotechnical investigations and soil/rock assessment
- Design of linings and support structures

- Fire safety, ventilation, evacuation and operation
- Economic analysis: construction and maintenance costs
- Environmental constraints and impacts, and urban impacts

Key lessons learnt

- Identify and characterise the geotechnical risks associated with tunnelling.
- Analyse the influence of hydrogeological conditions on tunnel stability.
- Apply the convergence-confinement method to analyse soil-retaining structure interaction.
- Compare tunnelling techniques and justify the choice of a method or tunnel boring machine depending on the context.
- Designing tunnel support structures and linings
- Integrate safety, costs and environmental considerations into an underground project

Bibliography

- *Tunnel Design Using the Convergence-Confinement Method*, Marc Panet, Jean Sulem (eds.), Presses des Ponts, 2021
- *Design and Construction of Tunnels*, Pietro Lunardi, Springer
- *Guidelines for Tunnel Design*, ITA-AITES, https://tunnel.ita-aites.org/media/k2/attachments/public/Tust_Vol_3_3_237-249.pdf

Keywords: underground excavation, soil-retaining structure interaction, conventional tunnelling, mechanised excavation, tunnel boring machine / segments

H&E 8-1 – Ventilation and air treatment

Timetable
Semester.....8
Period.....Feb. – June
Face-to-face

Assessment
Continuous assessment

Duration
Total.....**30 hours**
Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

Thermodynamics 1, 2 and 3, Thermal Engineering (heat transfer, heat loss, thermal regulation), Fluid Mechanics 1 and 2, Building Technology

Objectives

- To understand the various air renewal solutions (ventilation and air treatment)
- To select and size a ventilation system for residential buildings, blocks of flats and/or commercial premises
- Be able to read and draw up a system layout plan

Syllabus

The need for and requirement to provide ventilation:

- Types of systems and applications
- Design and sizing of air ducts and extraction units
- Analysis and interpretation of plans and supplier documentation
- Cost-benefit analysis of ventilation, payback period
- Analysis of air handling units (AHUs) The

focus is consistently on:

- Knowledge of the systems
- Project sizing
- The layout of the systems on the various plans
- Design and implementation
- Coordination with structural drawings

Key learning points

- Understanding the various ventilation and air-handling systems
- Be able to read ductwork plans
- Dimensioning an air distribution system (extraction unit, distribution, system components)
- Understand how an Air Handling Unit (AHU) works

Bibliography

- *Memotech Energy Engineering*, P. Dal Zotto, J-M. Larre, A. Merlet, L. Picau
- Supplier documentation
- Ventilation regulations (current decrees)

Keywords: Ventilation, air handling, AHU, network, sizing

H&E 8-2 – Secondary structures 2: design and dimensioning

Timetable
Semester.....8
Term.....Feb – June
Face-to-face

Assessment
Continuous assessment

Duration
Total.....**30 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 – Designing structures and systems

Prerequisites

Finishing works, façades 1 or equivalent knowledge of façade systems

Objectives

- To dimension secondary facade frameworks in accordance with standards and Eurocodes
- Draw up the corresponding calculation notes for façade structures
- To dimension fixing elements and draw up the associated calculation notes
- Integrate the design and dimensioning into a complete façade project

Syllabus

- Sizing of secondary steel and timber frameworks
- Sizing of fixings connecting the framework to the load-bearing structure
- Application of Eurocodes and other relevant regulations
- Practical case studies: calculation notes and detailed working drawings

Key learning points

- Be able to carry out a complete design of a cladding façade
- Be able to draft and justify a calculation note
- Be able to apply standards and regulations in design and dimensioning

Bibliography

- Eurocodes 1, 3 and 5
- Engineering Techniques
- DTU 33.1: Curtain walls
- DTU 41.2: External timber cladding

Keywords: Secondary frameworks, façades, design, fixings, calculation notes, Eurocodes

H&E 8-3 – Dynamic thermal simulation 2

Timetable	
Semester	8
Period	Feb – June
Face-to-face	

Assessment
Continuous assessment

Duration	
Total	**18h30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

Dynamic thermal simulations 1

Objectives

- To be able to adapt building solutions to ensure different levels of comfort for users through dynamic thermal simulation
- To understand the requirements of thermal regulations and the environmental approach to a construction project through dynamic thermal simulation
- To predict the thermal behaviour of a building

Syllabus

Use of the Pléiade software, as covered in
STD1 Practical exercise:

- Modelling a more complex building, chosen by the student
- Simulation of the existing conditions
- Analysis of the results
- Simulations of different options to improve thermal comfort
- Verification of requirements (regulatory, energy efficiency labels, etc.)

Key learning points

- Formulating clear assumptions and implementing them in the software
- Analysing results and identifying possible sources of error
- Presenting the results in a study report in a clear and relevant manner
- Proposing improvement measures to identify the optimal solution that meets a range of requirements (client, regulations, climate, location, project type, etc.)
- Be able to explain and justify these choices verbally

Bibliography

- Technical documentation from the software publisher, Izuba Energies
- Pleiades-Comfie user guide
- Current thermal regulations

Keywords: Dynamic thermal simulation, Pleiades, complex project, thermal comfort, regulations

H&E 8-4 – Urban Systems Engineering

Timetable	
Semester	8
Term	Feb – June
Face-to-face	

Assessment
Continuous assessment

Duration	
Total hours	**33**

Targeted skill(s)
C1 – Analysing a construction project within its environment
C2 - Recommend technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

This module is the second of five modules focusing on 'Architecture and Urban Physics' within the Housing and Energy programme. It aims to provide a multifaceted perspective on cities.

Prerequisites

None

Objectives

- To understand the historical development of cities from antiquity to the present day
- To analyse urban planning responses to the challenges of industrialisation and urbanisation
- To understand the current and future challenges facing cities (demographics, climate, energy, urban sprawl)

Syllabus

The course begins by examining the effects of the Industrial Revolution on cities from the early 19th century onwards, and the responses provided by the emerging field of urban planning, with a detailed analysis of Haussmann's Paris and the example of Barcelona. The ever-increasing difficulties posed by 20th-century urbanisation, particularly in the 'new towns' of France, India (Chandigarh) and Brazil (Brasília), are largely explained by the impossibility of modelling increasingly complex situations. The text then traces the history back to the earliest antiquity to explain what a city is and how it is perceived, from Sumer and Egypt, through the leading cities of the Greco-Roman Mediterranean (Athens, Alexandria, Rome, Constantinople) and the Middle Ages (Córdoba), emphasising the decisive contribution of new representational tools (perspective projection) to Renaissance, Baroque and pre-industrial urban designs. Finally, the book addresses current and future challenges, particularly those linked to demographic change, urban sprawl, the interactions between cities and the climate, and the availability and integration of renewable energy. Chapters are devoted to the five continents: railways in the Americas, the electrification of Africa, the European dream of an ideal city, the urban coastlines of Asian cities, and the future of islands and peripheral regions.

Key lessons

- Identify the key stages of urban development
- Analysing historical and contemporary urban planning models
- Understand the urban challenges of the 21st century

Bibliography

- Book in preparation (scheduled for 2025)

Keywords: Urban planning, cities, urban sprawl, urban history, urban systems engineering

H&E 8-5 – Urban Physics

Timetable	
Semester	8
Period	Feb. – June
Face-to-face	

Assessment
Continuous assessment

Duration	
Total	**40h30**

Targeted skill(s)
C1 – Analyse a construction project within its environment
C2 - Recommend technical solutions for sustainable and more durable construction
C3 – Dimension structures and systems

This module is the third of five modules focusing on 'Architecture and Urban Physics' within the Housing and Energy programme. It aims to provide an understanding of the physical concepts (solar paths, radiation) upon which Urban Physics is based.

Prerequisites

The first two modules of the 'Architecture and Urban Physics' stream within the Housing and Energy programme (RHEE 7-6, RHEE 8-4)

Objectives

- To master the fundamental concepts of thermal radiation (black body, grey body)
- Understand radiative exchanges within the Sun–Earth–Atmosphere system
- Apply these concepts to building thermal performance and urban physics

Syllabus

The course begins with the fundamental concepts relating to black bodies and grey bodies (emissivity). It then moves on to the concepts of radiative exchange and the coupling of conduction, convection and radiation. The framework within which these phenomena occur consists of three essential elements: the Sun, the Earth and the atmosphere. Their roles are examined in detail. This leads to a discussion of climate (distribution of solar radiation, advection, trade winds, major ocean currents, etc.). Returning to a local perspective, we examine building thermal performance across each major climate zone, and introduce some basic concepts of energy to better understand the technological and geopolitical challenges associated with fossil and renewable energies, in relation to the development of major urban centres around the world.

Key learning outcomes

- Understanding the mechanisms of thermal radiation
- Analysing radiative exchanges within the Sun–Earth–Atmosphere system
- Apply the principles of radiation physics to building thermal performance
- Identify the energy challenges associated with major urban centres

Bibliography

- Lecture notes: various documents at `www.heliodon.net` + reference book (2012)

Keywords: Urban physics, radiation, radiative exchange, climate, building thermal performance, energy

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RIS 8-1 – Road Infrastructure 2: Geometric Design of Alignments

Timetable	
Semester	8
Period	Feb. – June
Face-to-face in person	

Duration	
CM	6 hours
Practical sessions	6 hours
Total	**12 hours**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 – Managing a construction organisation

Prerequisites

- Basic knowledge of geometry and surveying
- General knowledge of road infrastructure (course 'Road Infrastructure 1: Technology ")

Objectives

- To design the plan layout and longitudinal profile of a road in accordance with geometric standards and site constraints, ensuring comfortable traffic flow and effective water management
- Master road drainage techniques and water treatment systems: Water flow paths (unpolluted surface runoff, groundwater and polluted road surface water) to the outlet
- Analyse and monitor the quality of road materials and structures
- Master earthworks and planning techniques
- Integrate environmental and landscape constraints into route design

Programme

- Road drainage:
  - Rainwater collection and treatment
  - Drainage systems and water management
- Quality control:
  - Methods for testing sub-bases and surface courses

  - Applicable standards and regulations
- Earthworks:
  - Lalanne's diagram
  - Earthworks
- Works planning:
  - Standard schedule for earthworks, drainage and roadworks
- Integration of constraints:
  - Environmental (landscape impact, biodiversity)
  - Regulatory (SETRA and ICTAAL standards)
- Modelling tools:
  - Geometric design software (e.g. MENSURA, AutoCAD)
  - Route simulation and optimisation

Key lessons learnt

- Integrating environmental and technical constraints into the design
- Using software tools to model and optimise routes

Bibliography

- *Geometric Design of Roads*, Technical Guide, SETRA
- *Design of Main Roads (ARP) and Link Motorways*, ICTAAL, SETRA
- *Topography and Road Alignment*, by J. LABORDE, published by Eyrolles
- Engineering Techniques, electronic encyclopaedia

Keywords: Geometric design, road alignment, road drainage, earthworks, planning, quality control

RIS 8-2 – Railway Infrastructure 2: Platforms

Timetable
Semester.....8
Period.....Feb. – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....3 hours
Practical .....6 hours
Total.....**9**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Railway Infrastructure 1: Technology
- Basic concepts in geotechnics and soil mechanics

Objectives

- To design and dimension railway platforms in accordance with geotechnical and environmental constraints
- Master techniques for stabilising and draining railway platforms
- To incorporate bearing capacity and settlement requirements into infrastructure design
- To analyse the interactions between the platform and the railway superstructure
- Apply quality control and monitoring methods for railway subgrades

Programme

- Design of railway platforms:
  - Preliminary geotechnical investigations
  - Dimensioning of embankments and cuttings
- Stabilisation and drainage:
  - Soil compaction and reinforcement techniques
  - Drainage systems (longitudinal, transverse)
- Bearing capacity and settlement:
  - Bearing capacity calculations and prevention of differential settlement

  - Use of geosynthetics and other technical solutions
- Platform–superstructure interactions:
  - Influence of the platform on track stability
  - Adapting solutions to local constraints
- Quality control and monitoring:
  - Methods for inspecting and monitoring platforms
  - Applicable standards and regulations
- Case studies:
  - Analysis of complex railway platform projects
  - Use of modelling software (e.g. PLAXIS, GTS NX)

Key learning points

- Knowing how to design a railway platform suited to geotechnical and environmental constraints
- Mastering stabilisation and drainage techniques to ensure the durability of infrastructure
- Incorporating bearing capacity and settlement requirements into platform design
- Apply quality control and monitoring methods for railway platforms

Bibliography

- *Railway Geotechnics*, by P. BREUL, published by Presses des Ponts
- *Design and Construction of Railway Track Foundations*, by B. INDRARATNA and W. SALIM
- NF P 11-300 and subsequent standards (railway geotechnics)
- Engineering Techniques, online encyclopaedia

Keywords: Railway subgrades, geotechnics, stabilisation, drainage, bearing capacity, settlement, quality control

RIS 8-3 – Engineering Structures 1: Retaining Structures, Dams, Dykes

Timetable
Semester.....8
Period.....Feb. – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....7.5 hours
Tutorial 7.30
Total.....**3.00 pm**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Geotechnics: mechanical properties of soils
- Basic hydraulics
- Fundamentals of slope stability

Objectives

- To understand the different types of retaining structures, dams and dykes
- To understand the principles of stability and design
- To identify associated risks and defects

Syllabus

- Retaining structures: gravity walls, T-shaped walls, nailed walls, screens
- Dams: types (embankment, arch, gravity), design and safety
- Dykes: design, seepage, hydraulic stability
- Risks of failure and monitoring systems

Key lessons learnt

- Recognising the different types of retaining and hydraulic structures
- Apply appropriate stability and design principles
- Identify major risks and incorporate safety into projects

Bibliography

- *Geotechnical Engineering of Dams*, R. Fell et al., CRC Press
- *Retaining Structures*, J.-P. Magnan, Presses de l'ENPC

Keywords: Retaining structures, dams, dykes, stability, hydraulic structures, design

RIS 8-4 – Hydrogeology and Hydraulic Structures 2

Timetable
Semester.....8
Period.....Feb – June
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorial	7h30
Total	**15 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

Hydrogeology and Hydraulic Structures 1 (RIS 7-6)

Learning Outcomes

- To understand the functioning and use of hydraulic structures and their impact on groundwater
- To analyse the effect of human activities on the quantity and quality of groundwater and on pollution processes
- Apply modelling and management tools to plan, protect and assess risks to aquifers

Syllabus

- Hydraulic structures: wells, boreholes, pumps, drains, geothermal energy
- Pumping techniques and quantitative groundwater management
- Impacts of human activities: agriculture, industry and urbanisation on groundwater pollution
- Contaminant transport processes in aquifers
- Measures to protect and safeguard groundwater quality
- Hydrogeological modelling applied to groundwater planning and management
- Risk assessment related to overexploitation and contamination

Key lessons learnt

- Assessing and understanding groundwater extraction and the role of hydraulic structures
- Identifying and analysing the impacts of human activities on groundwater quality
- Implement protective measures and know how to select the appropriate modelling tools for sustainable aquifer management

Bibliography

- *Hydrogeology: Subjects, Methods, Applications*, Gilli et al., 5th edition, Dunod, 2021, 366 pp.
- *Foundations and Earthworks*, Philipponat and Hubert, 2011, 548 pp.

Keywords: Pumping tests, groundwater management, water pollution, vulnerability and protection of resources

RIS 8-5 – Settlement and Consolidation

Timetable
Semester.....8
Term.....Feb. – June
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM	9 hours
Tutorial	10.30
Total	**7.30 pm**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

Soil Mechanics course (ISA 2 and 3)

Objectives

- To understand the phenomena of settlement and consolidation in soils subjected to loads
- Be able to assess soil deformations based on its mechanical and hydraulic properties
- Apply calculation models to predict the short- and long-term behaviour of foundations

Syllabus

- Lectures:
  - a review of soil compressibility and permeability
  - immediate and delayed settlement: causes and mechanisms
  - Terzaghi's theory of one-dimensional consolidation
  - compressibility and consolidation parameters
  - Estimation of settlement according to soil type and loading
  - Secondary consolidation and overload effects

- Tutorials:
  - calculations of primary and secondary settlements for real-world cases
  - analysis of oedometer test results and determination of the parameters Cc, Cv, Cr
  - application to shallow foundations and embankments
  - Comparison between theoretical approaches and experimental observations

Key learning outcomes

- distinguishing between different types of settlement
- master the steps involved in consolidation analysis according to Terzaghi
- interpret the results of an oedometer test
- Estimate the deformations of a soil under a given load

Keywords: Settlement, consolidation, compressibility, permeability, oedometer test, foundation, Terzaghi

RIS 8-6 – Earth pressure, earth retaining structures

Timetable
Term 8
Period.....Feb – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....7.5 hours
Tutorial 7h30
Total.....**15 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- Basic concepts of soil mechanics
- Basics of statics and structural equilibrium

Objectives

- To understand the mechanisms of earth pressure and earth resistance
- To be familiar with the main theories (Coulomb, Rankine, Caquot-Kérisel)
- Apply these concepts to the design of retaining structures

Syllabus

- States of rest, active earth pressure and passive earth pressure
- Rankine's and Coulomb's theories
- The Caquot and Kérisel approach
- Cohesive and non-cohesive soils
- Applications to retaining walls and partitions

Key lessons learnt

- Determining earth pressure and bearing forces
- Selecting the appropriate theory based on soil type and the structure
- Incorporating these forces into the design of retaining structures

Bibliography

- *Tables of earth pressure and earth resistance*, A. Caquot, J. Kérisel, Eyrolles
- *Principles of Geotechnical Engineering*, B.M. Das, Cengage

Keywords: Earth pressure, earth retaining structures, Rankine, Coulomb, Caquot-Kérisel, retaining structures, soil mechanics

RIS 8-7 - Earthworks 2

Timetable	
Semester	8
Period	Feb. – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorial	7h30
Total	**15 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Knowledge acquired in the Earthworks 1 course
- Basics of site management and works planning

Objectives

- To organise an earthworks site, taking into account both technical and safety aspects
- To calculate productivity and estimate the costs of a site
- Identify regulatory and environmental constraints

Syllabus

- General organisation of earthworks projects
- Methods for calculating productivity and optimising work sequences
- Cost estimation: equipment, labour, operations
- Health and safety and risk prevention on construction sites
- Waste and spoil management: environmental aspects
- Planning and phasing of works

Key learning points

- Planning and organising an earthworks site
- Assessing productivity and costs
- Integrating health and safety, regulations and environmental constraints into the organisation

Bibliography

- *Foundations and Earthworks*, G. Philipponnat, B. Hubert, Eyrolles
- *Guide to Earthworks*, IDRRIM, Cerema

Keywords: Earthworks, organisation, costs, productivity, planning, safety, site management

MHS 8-1 – Design of Assembled Structures 3: Timber 2

Timetable	
Semester	8
Period	Feb. – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorial	7h30
Total	**15 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- MHS 7-1 Design of assembled structures 1: timber 1
- Calculation of basic structures (beams, columns, simple frames)

Objectives

- To develop a deeper understanding of the design of timber joints in complex situations
- To master the design and verification of joints subjected to combined loads
- To develop a critical approach to technological and construction choices

Syllabus

- Complex timber-to-timber and timber-to-metal joints
- Connections subjected to combined loads (tension, shear, bending, torsion)
- Design and verification of portal frame and truss joints
- Analysis of deformations and stiffness of joints
- Case studies: design of connections for real-world timber structures

Key learning points

- Sizing a joint subjected to multiple loads
- Verifying that joints comply with current standards
- Assessing the impact of joints on the overall behaviour of the structure
- Proposing and justifying joint solutions in a timber structure project

Bibliography

- Eurocode 5: Design of timber structures
- *Design and Analysis of Timber Structures*, P. Freyburger, Éditions du Moniteur
- *Timber Structures: Design and Calculation*, J.-L. Boucher, Éditions Eyrolles
- *DTU – Timber Structures and Associated Technical Documents*, CSTB

Keywords: Timber joints, Eurocode 5, combined loads, joints, design

MHS 8-2 – Design of assembled structures 4: steel 2

Timetable	
Semester	8
Period	Feb – June
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorial	7h30
Total	**15 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

Design of Assembled Structures 1: Steel 1

Objectives

- To develop a deeper understanding of the design and calculation of complex steel assemblies
- To master the issues relating to fatigue in welded assemblies
- To situate the design and production of components within their regulatory and industrial context

Syllabus

- Design and calculation of steel structures: flexed frames and truss structures
- Fatigue in welded joints
- Production of structural steel components
- Regulatory context: NF EN 1090

Key learning points

- Designing joints subjected to complex loads
- Analysing and verifying the fatigue strength of a welded joint
- Incorporating production and standardisation constraints into the design process

Bibliography

- Eurocode 3: Design of steel structures
- NF EN 1090: Execution of steel and aluminium structures
- *Design of Steel Structures*, D. Dubina, V. Ungureanu, ECCS
- *Design of Steel Structures*, G. Sedlacek et al., Éditions Eyrolles

Keywords: Metal joints, Eurocode 3, fatigue, welding, NF EN 1090

MHS 8-3 – Design of Assembled Structures 5: BA and BP Frameworks

Timetable
Semester.....8
Period.....Feb. – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial.....9 hours
Total.....**18h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 – Designing structures and systems

Prerequisites

- MHS 7-1 to 7-2: Design of timber and steel composite structures
- MHS 7-3: Structural analysis of prefabricated elements
- Reinforced concrete (RC) and prestressed concrete (PC) foundations

Objectives

- To understand the design of reinforced and prestressed concrete frameworks in a prefabricated context
- To master the calculation of assembled components to ensure stability, strength and durability
- To take into account the constraints associated with prefabrication and on-site assembly
- Develop a critical approach to optimising RC and PC structural frames in modular projects

Syllabus

- Reinforced concrete (RC) structures: prefabricated elements, assemblies and connections
- Prestressed concrete (PC) structures: principles, design and assemblies
- Design in accordance with Eurocode 2 and rules specific to prefabrication
- Analysis of stresses and deformations during on-site assembly
- Case studies: modular frames for buildings and infrastructure

Key learning points

- Correctly dimensioning BA and BP frameworks for prefabricated elements
- Verifying the compliance of joints and connections
- Incorporating transport and assembly constraints into the design
- Propose optimised solutions for modular or prefabricated structures

Bibliography

- Eurocode 2: Design of concrete structures
- *Reinforced Concrete Handbook*, P. Guillemont, Éditions du Moniteur
- *Design and Analysis of Building Structures*, H. Thonier, Presses de l'ENPC
- Guides and technical documents on precast concrete, CSTB

Keywords: Reinforced concrete, prestressed concrete, prefabrication, structural frames, connections, Eurocode 2

MHS 8-4 – Methods 2: risks, safety, variants, phasing / cycling

Timetable
Semester.....8
Period.....Feb – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM 6am
Tutorial 9.00

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- MHS 7-4 Methods 1: project context, construction methods, work rates, lifting
- Basic knowledge of site organisation and planning
- Basics of prefabricated structures and assemblies

Objectives

- To identify and manage risks specific to prefabrication and off-site construction projects
- Master the safety aspects relating to the assembly and hoisting of prefabricated elements
- Analyse and propose construction alternatives suited to site constraints
- Organise the phasing and sequencing of works to optimise production and assembly

Programme

- Identifying risks associated with prefabricated components and off-site assembly
- Safety and risk prevention on site: lifting, handling and assembly
- Analysis and implementation of construction alternatives
- Phasing and sequencing of works for prefabrication and assembly
- Case studies: optimisation of construction sequences and risk management

Key lessons learnt

- Anticipating and managing risks associated with prefabricated elements
- Proposing and justifying construction alternatives tailored to the project
- Organising the phasing of works to maximise safety and efficiency
- Linking off-site production constraints to on-site assembly constraints

Bibliography

- *Prefabricated Construction Methods*, B. Cazet, Éditions Eyrolles
- *Organisation and Methods for Off-Site Construction Sites*, J.-P. Regnier, Éditions du Moniteur
- OPPBTP professional guides and recommendations on safety and lifting
- Eurocodes and technical documents relating to prefabricated elements

Keywords: Methods, risks, safety, variants, phasing, cycling, prefabrication

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MHS 8-5 – Coordination of Design and Works 2: cost estimation, subcontracting

Timetable
Semester.....8
Period.....Feb. – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....6 hours
Tutorial .....7.5 hours
Total **1.30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- Basic knowledge of structural design and dimensioning
- Introduction to computer-aided design and modelling tools
- Basic concepts of prefabrication and off-site construction

Objectives

- To understand the principles of digital modelling as applied to construction
- To explore the concept and applications of BIM (Building Information Modelling) in prefabrication
- Be able to create and manipulate a digital model of an off-site project
- Integrate digital modelling into the planning and coordination of works

Programme

- Introduction to digital modelling tools for off-site construction
- BIM concepts and principles: data structuring and interdisciplinary collaboration
- Creating a digital model of a prefabricated project
- Information management and technical documentation via BIM
- Case studies: integrating BIM into off-site design and production

Key takeaways

- Creating a coherent digital model for a prefabrication project
- Using BIM to improve coordination between design offices and the construction site
- Identify the benefits of BIM for the monitoring and management of prefabricated components
- Leveraging digital information to optimise production and assembly

Bibliography

- Autodesk Revit modelling manuals and guides
- *BIM standards and protocols*, BuildingSMART
- CSTB publications and professional guides on BIM and prefabrication
- Scientific articles and case studies on the integration of BIM in off-site construction

Keywords: BIM, digital modelling, prefabrication, Revit, coordination, information management

MHS 8-6 – Organisation and management of prefabrication 2: lean management

Timetable
Semester.....8
Period.....Feb – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....6 hours
Practical sessions.....6 hours
Total.....**12**

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 – Managing a construction organisation

Prerequisites

- MHS 7-6: Temporary stability and shoring 1 – common elements
- Basic knowledge of structural design and structural dimensioning
- Basic understanding of formwork and temporary supports

Objectives

- To understand the design and installation of complex shoring elements
- Manage the temporary stability of prefabricated or modular structures
- Apply best practice and safety standards for complex off-site structures
- Develop a critical approach to designing solutions tailored to site constraints

Programme

- Types of complex shoring elements: beams, trusses, cantilevers, articulated props
- Design and verification based on specific loads and configurations
- Safe erection and dismantling techniques for complex structures
- Coordination with prefabrication and the phasing of the construction site
- Case studies: modular structures, multi-storey structures or structures with unusual shapes

Key learning points

- Designing and verifying complex shoring systems for prefabricated structures
- Ensuring the safety of workers and the stability of structures
- Adapting shoring solutions to the constraints of off-site assembly
- Analysing and resolving specific problems relating to modular and complex structures

Bibliography

- *Props and Shoring – Practical Guide*, CSTB
- NF EN 12812: Temporary formwork and shoring equipment
- *Formwork and Shoring*, A. Bérenger, Éditions du Moniteur
- Technical publications on the assembly of complex prefabricated elements

Keywords: Stability, shoring, complex structures, prefabrication, safety, assembly

MHS 8-7 – Production, processes, robotisation 1

Timetable
Semester.....8
Period.....Feb – June
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....6 hours
Practical sessions.....6 hours
Total.....**12**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- General knowledge of construction and off-site methods
- Previous modules on prefabrication and on-site construction methods

Objectives

- To explore different perspectives and learn from experience regarding off-site construction
- To deepen understanding of the industrial, technical and organisational challenges
- To observe and analyse real-world projects through site visits and presentations by experts
- Link the theory covered in class to professional practice

Programme

- Lectures by guest experts in off-site construction
- Presentations on modular and prefabricated projects
- Site visits and tours of prefabrication facilities
- Discussions on practices, innovations and challenges encountered
- Critical analysis of the solutions observed and lessons learnt

Key takeaways

- Identifying best practices and innovations in off-site construction
- Linking theoretical concepts to real-world examples
- Develop a critical approach to technical and organisational choices
- Understand the impact of off-site solutions on scheduling, safety and quality

Bibliography

- Documents and materials provided by the speakers
- Feedback from prefabricated projects
- Professional publications on innovation in off-site construction

Keywords: Conferences, case studies, off-site construction, site visits, innovation, professional practice

SAÉ 8-1 – R&D project (or competition / challenge)

Timetable
Semester.....8
Period.....Feb. – June
Face-to-face in person

Assessment
Defences and Portfolio

Duration	2.5 weeks
Supervised hours	35 hours
Self-study	35 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- Materials Resources 1 to 8
- R 5-1 – Introduction to research

Objectives

- Develop a research and development approach
- To work as part of a team on an innovative project
- Apply a project management methodology
- Meet a client's specifications (company, laboratory, start-up)

Programme

- 2.5-week team-based R&D project
- Themes: technical innovation, new materials, processes
- Alternative: taking part in a student competition or challenge
- Literature review and state of the art
- Experimentation and prototyping
- Analysis of results and validation with the client
- Drafting of a technical report
- Oral defence

Key learning outcomes

- Leading an R&D project
- Working in a project-based environment
- Researching and utilising technical sources
- Presenting research findings

Bibliography

- *Research Methodology*, M. Beaud, PUF
- *Project Management*, J.-C. Corbel, Eyrolles
- Scientific and technical literature in the field

Keywords: R&D, innovation, project, research, experimentation, competition, teamwork

SAÉ 8-2 – Management Project: Serious Game

Timetable
Semester.....8
Period.....Feb. – June
Face-to-face in person

Assessment
Defences and Portfolio

Duration	0.5 weeks
Supervised hours	7 hours
Self-study	7 hours
Targeted skill(s)	
C1 – Analysing a construction project within its context	
C2 - Specify technical solutions for sustainable and more durable construction	
C4 - Manage a construction organisation	

Prerequisites

- R 7-1 'Management 6: Project Management'
- R 7-2 'Management 3: HRM, behavioural psychology and conflict management'
- R 8-1 'Communication 4: Professional Communication – Networking'
- R 8-10 'Organisation 10: Public and Private Construction Contracts'
- R 8-11 'Organisation 11: Contractual Management of Contracts during the Execution Phase'

Objectives

- To quickly grasp the parameters and progress of a project currently under construction
- To gain a clear understanding of the roles, responsibilities and scope of work of the various stakeholders in a construction project
- Propose solutions to address unforeseen issues in a project
- Adopt a professional approach to dealing with unforeseen events: both verbally and in writing

Programme

Concept of the serious game: A junior engineer is 'dropped in' onto a building site to fill a management gap. They must quickly understand the purpose and organisation of the site, its current stage of completion (TCE), and liaise with the various project stakeholders. His mission is to manage project incidents as effectively as possible (whether relating to design, on-site construction, administrative or regulatory issues), whilst adhering to the project's various constraints (regulatory, financial, deadlines, quality of working life, quality, safety, etc.).

The SAÉ course runs over 5½ days with frequent oral presentations.

Key learning points

- Understanding a project currently under construction
- Scope of work for the various project stakeholders
- Written and oral communication
- Collaborative working

Keywords: Project management, incidents, responsibilities, communication, conflicts, hierarchy, behaviours, collaborative work

SAÉ 8-3 – BIM project and digital tools

Timetable
Semester.....8
Period.....Feb – June
Face-to-face in person

Assessment
Defences and Portfolio

Duration	1 week
Supervised hours	14 hours
Self-study	14 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- R 3-18 'Drawing 3: Digital Models – Revit'
- R 7-1 "Management 6: Project Management"
- R 8-13 'Digital Models and the BIM Approach'
- SAÉ 3-3 "Building Design Project: Digital Model, Tender Documents, Planning Permission"

Objectives

- To analyse a construction project (buildings, development, infrastructure, roads and utilities) based on a set of construction documents, a specification or technical documents
- Use collaborative tools associated with the BIM process (collaborative platform, digital model, viewer, etc.) to build a working ecosystem (BIM charter, BIM agreement, chat, etc.)
- Partially create, utilise or enhance a digital model in a native format such as Revit: 3D object modelling, databases, views, bills of materials, etc.
- Export a digital model to calculation or simulation software (structural analysis, comfort analysis, LCA, etc.)
- Produce construction documents: construction drawings (GO, CES, CET), phasing plans, services diagrams, bills of quantities and cost estimates, schedules, etc.

Programme

SAÉ 8-3 can be undertaken independently of any other project, in order to produce and utilise one or more digital models. It can be usefully linked to SAÉ 8-4 'End-of-Year Project related to the course', to develop a BIM design approach. In this case, different models or parts of models may be designed within each of the five specialisations, then assembled and utilised (for example, to detect clashes).

Key learning outcomes

- Use of collaborative tools
- Advanced modelling in Revit
- Written and oral communication
- Collaborative working

Keywords: Project management, digital model, collaborative platform, BIM approach

SAÉ 8-4 – End-of-Year Project linked to the course

Timetable
Semester.....8
Period.....Feb. – June
Face-to-face in person

Assessment
Defences and Portfolio

Duration	2 weeks
Supervised hours	28 hours
Self-study	28 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- ISA4 Core Curriculum resources in the fields of humanities, languages, sciences and civil engineering techniques
- Specifically, Resource R 7-1 'Management 6: Project Management'
- Resources specific to the programme

Objectives

- To enable engineering students to integrate the four core competencies of the ISA Civil Engineering programme: Analyse, Specify, Design and Manage; whilst emphasising the link with their chosen specialisation
- To study complex projects or project sub-sections as a junior engineer within a client management team, a project management team or a construction company
- Adopt a professional approach and develop independence

Programme

The End-of-Year Project is carried out in groups, with certain activities undertaken individually:

- Study and analysis of the project context and documentation
- Preliminary design, detailed design or optimisation of structural elements and/or systems
- Detailed specification of technical solutions tailored to the terms of reference or recommendations for alternative options
- Organisation of the project according to the phase under consideration: during design, site preparation, construction or operation of the structure

The SAÉ can be usefully combined with SAÉ 8-3 'BIM Projects and Digital Tools' to continue or develop a BIM approach.

Key learning points

- Interactions with construction industry professionals
- Justification and relevance of the proposed solutions
- Written and oral communication
- Collaborative working

Keywords: Project management, complex activities, proactive approach, attention to detail, collaborative work

SAÉ 8-5 – Assistant Engineer Placement: areas related to the specialisation

Timetable
Semester.....8
Period.....Feb. – June
Face-to-face in person

Assessment
Report and oral defence

Duration	8 weeks

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

This course description is currently being drafted.

A dedicated working group has been set up to define and formalise the details relating to this learning and assessment scenario.

The final version of the description is scheduled to be completed by 15 July 2026 at the latest.

SAÉ 8-6 – Work Placement

Timetable
Semester.....8
Period.....Feb – June
Face-to-face in person

Assessment
Report and oral defence

Duration	20 weeks

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Designing structures and systems
C4 - Manage a construction organisation

This course description is currently being drafted.

A dedicated working group has been set up to define and formalise the details relating to this learning and assessment scenario.

The final version of the description is scheduled to be completed by 15 July 2026 at the latest.

Fifth year

•Aquitaine Higher Institute

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Semester 9 – BCR Programme

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
R 9-2	Management 8: Marketing and business development strategy	3.19 %
R 9-3	Management 9: Employment Law – Employees' Status	3.19%
R 9-4	Management 6: Risk Management and Psychosocial Benefits	1.59%
FISE 9-5	English S9	10.2%
FISE 9-6	Spanish S9	8.93%
R 9-7	Impact of Environmental Regulations on Design	2.98%
R 9-8	Natural Resource Management – Energy Management	3.83%
R 9-9	Technology 7: Seismic Design and Regulations	3.83%
FISE 9-10	Organisation 12: Quality management, application to the construction site	2.87%
R 9-11	Organisation 13: Financial management of the construction site	2.55
R 9–12	Digital environment: data, connected devices, smart cities, smart grids	5.1
R 9-13	ERP Regulations – Fire Safety	5.1%
BCR 9-1	Structural Dynamics 2	3.19%
BCR 9-2	Structural Design 3: Masonry	2.55%
BCR 9-3	Structural Design 4: Composite Structures	4.25
BCR 9-4	Structural Design 5: Complex Frameworks	5.1
BCR 9-5	Technology of historic buildings 2 (timber, brick, steel)	2.55%
BCR 9-6	Organisation of works 2 (occupied sites, constrained sites, etc.)	3.19%
BCR 9-7	Building services and equipment	4.57
BCR 9-8	Comfort assessment: acoustics, lighting design, thermal and hydraulic analysis	11.05%
BCR 9-9	Environmental analysis (LCA, HQE, etc.)	5.1%
BCR 9-10	Assessment 3: building management and maintenance	5.1%
SAÉ for competence C1		**%**
SAÉ 9-1	Specialist workshops and design offices	23.81%
SAÉ 9-2	Individual synthesis project	38.1
SAÉ 9-3	Group project on solidarity-based development: design/preparation phase	38.1%

Competence C2 – Prescribing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
R 9-4	Management 6: Risk management and psychosocial benefits	1.7%
FISE 9-5	English S9	10.9%
FISE 9-6	Spanish S9	9.53%
R 9-7	Impacts of Environmental Regulations on Design	3.18%
R 9-8	Natural Resource Management – Energy Management	4.09%
R 9-9	Technology 7: Seismic Design and Regulations	4.09%
FISE 9-10	Organisation 12: Quality management, application to the construction site	3.06%
R 9-11	Organisation 13: Financial management of the construction site	2.72%
R 9-12	Digital environment: data, connected devices, smart cities, smart grids	5.45
R 9-13	Public Building Regulations – Fire Safety	5.45%
BCR 9-1	Structural Dynamics 2	3.41%
BCR 9-2	Structural Design 3: Masonry	2.72%
BCR 9-3	Structural Design 4: Composite Structures	4.54%
BCR 9-4	Structural Design 5: Complex Frameworks	5.45
BCR 9-5	Technology of historic buildings 2 (timber, brick, steel)	2.72
BCR 9-6	Organisation of works 2 (occupied sites, constrained sites, etc.)	3.41%
BCR 9-7	Building services and equipment	4.88
BCR 9-8	Comfort assessment: acoustics, lighting design, thermal and hydraulic analysis	11.8%
BCR 9-9	Environmental analysis (LCA, HQE, etc.)	5.45%
BCR 9-10	Assessment 3: building management and maintenance	5.45%

SAÉ for competence C2		%
SAÉ 9-1	Specialist workshops and design offices	23.81%
SAÉ 9-2	Individual synthesis project	38.1
SAÉ 9-3	Group project on solidarity-based development: design/preparation phase	38.1%

Competence C3 – Dimensioning structures and systems

Resources for Competency C3		%
R 9-4	Management 6: Risk management and psychosocial benefits	3.09 %
R 9-7	Impacts of Environmental Regulations on Design	5.77%
FISE 9-10	Organisation 12: Quality management, application to the construction site	5.57
R 9-11	Organisation 13: Financial management of the construction site	4.95%
BCR 9-1	Structural Dynamics 2	6.19%
BCR 9-2	Structural Design 3: Masonry	4.95%
BCR 9-3	Structural Design 4: Composite Structures	8.25%
BCR 9-4	Structural Design 5: Complex Frameworks	9.9%
BCR 9-5	Traditional Building Technology 2 (timber, brick, steel)	4.95%
BCR 9-6	Organisation of works 2 (occupied sites, constrained sites, etc.)	6.19%
BCR 9-7	Building services and equipment	8.87%
BCR 9-8	Comfort assessment: acoustics, lighting design, thermal and hydraulic analysis	21.44%
BCR 9-9	Environmental analysis (LCA, HQE, etc.)	9.9%
SAÉ for competence level C3		**%**
SAÉ 9-1	Specialist workshops and design offices	23.81%
SAÉ 9-2	Individual synthesis project	38.1
SAÉ 9-3	Collective solidarity-based development project: design/preparation phase	38.1%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
R 9-2	Management 8: Marketing and business development strategy	9.23%
R 9-3	Management 9: Employment Law – Employees' Status	9.23%
R 9-4	Management 6: Risk Management and Psychosocial Benefits	4.62%
FISE 9-10	Organisation 12: Quality management, application to the construction site	8.31%
R 9-11	Organisation 13: Financial management of the construction site	7.38%
BCR 9-1	Structural Dynamics 2	9.23%
BCR 9-2	Structural Design 3: Masonry	7.38%
BCR 9-5	Technology of historic buildings 2 (timber, brick, steel)	7.38
BCR 9-6	Organisation of works 2 (occupied site, constrained site, etc.)	9.23%
BCR 9-7	Building services and equipment	13.23%
BCR 9-10	Diagnosis 3: building management and maintenance	14.77%
SAÉ for competence area C4		**%**
SAÉ 9-1	Specialist workshops and design offices	23.81%
SAÉ 9-2	Individual synthesis project	38.1
SAÉ 9-3	Collective solidarity-based development project: design/preparation phase	38.1%

Semester 9 – BCR Programme – *Professional Contracts*

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
R 9-2	Management 8: Marketing and Business Development Strategy	3.83 %
R 9-3	Management 9: Employment Law – Employees' Status	3.83%
R 9-5	English S9	9.19%
R 9-6	Spanish S9	6.89%
R 9-7	Impacts of Environmental Regulation on Design	3.57%
R 9-8	Natural Resource Management – Energy Management	4.6%
R 9-9	Technology 7: Seismic design and regulations	4.6 %
R 9–12	Digital environment: data, connected devices, smart cities, smart grids	6.13%
R 9-13	ERP regulations – Fire safety	6.13%
BCR 9-2	Structural Design 3: Masonry	4.09%
BCR 9-3	Structural Design 4: Composite Structures	5.11%
BCR 9-4	Structural Design 5: Complex Frameworks	6.13%
BCR 9-5	Technology of historic buildings 2 (timber, brick, steel)	3.06%
BCR 9-7	Building Services and Equipment	7.32%
BCR 9-8	Comfort assessment: acoustics, lighting, thermal and hydraulic analysis	13.28%
BCR 9-9	Environmental analysis (LCA, HQE, etc.)	6.13%
BCR 9-10	Assessment 3: building management and maintenance	6.13%
SAÉ for competence C1		**%**
SAÉ 9-3	Group solidarity development project: design/preparation phase	10.64%
SAÉ 9-4	Work placement period	89.36%

Competency C2 – Proposing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
R 9-5	English S9	8.17 %
R 9-6	Spanish S9	6.13%
R 9-7	Impacts of Environmental Regulation on Design	3.18%
R 9-8	Natural Resource Management – Energy Management	4.09%
R 9-9	Technology 7: Earthquake-resistant design and regulations	4.09%
R 9-12	Digital environment: data, connected devices, smart cities, smart grids	5.45%
R 9-13	ERP regulations – Fire safety	5.45%
BCR 9-2	Structural Design 3: Masonry	3.63
BCR 9-3	Structural Design 4: Composite Structures	4.54%
BCR 9-4	Structural Design 5: Complex Frameworks	5.45
BCR 9-5	Technology of historic buildings 2 (timber, brick, steel)	2.72%
BCR 9-7	Building networks and equipment	6.51%
BCR 9-8	Comfort assessment: acoustics, lighting design, thermal and hydraulic analysis	11.8%
BCR 9-9	Environmental analysis (LCA, HQE, etc.)	5.45%
BCR 9-10	Assessment 3: building management and maintenance	5.45%
SAÉ for competence C2		**%**
SAÉ 9-3	Group solidarity development project: design/preparation phase	10.64%
SAÉ 9-4	Work placement period	89.36%

Competency C3 – Dimensioning structures and systems

Resources for Competency C3		%
R 9-7	Impacts of Environmental Regulations on Design	7.34 %
BCR 9-2	Structural Design 3: Masonry	8.39%
BCR 9-3	Structural Design 4: Composite Structures	10.49%
BCR 9-4	Structural Design 5: Complex Frameworks	12.59%
BCR 9-5	Historic Building Technology 2 (timber, brick, steel)	6.29
BCR 9-7	Building Services and Equipment	15.03%
BCR 9-8	Comfort assessment: acoustics, lighting design, thermal and hydraulic analysis	27.27%
BCR 9-9	Environmental analysis (LCA, HQE, etc.)	12.59%
SAÉ for competence C3		**%**
SAÉ 9-3	Collective solidarity-based development project: design/preparation phase	10.64%
SAÉ 9-4	Work placement period	89.36%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
R 9-2	Management 8: Marketing and business development strategy	22.73 %
R 9-3	Management 9: Employment Law – Employees' Status	22.73%
BCR 9-5	Technology of Historic Buildings 2 (wood, brick, steel)	18.18%
BCR 9-10	Module 3: Building Management and Maintenance	36.36%
SAÉ for competence C4		**%**
SAÉ 9-3	Collective solidarity-based development project: design/preparation phase	10.64%
SAÉ 9-4	Work placement period	89.36%

Semester 9 – GCM pathway

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
R 9-2	Management 8: Marketing and business development strategy	2.61 %
R 9-3	Management 9: Employment Law – Employees' Status	2.61%
R 9-4	Management 6: Risk Management and Psychosocial Benefits	2.61%
FISE 9-5	English S9	8.34%
FISE 9-6	Spanish S9	7.3%
R 9-7	The Impact of Environmental Regulations on Design	2.43 %
R 9-8	Natural Resource Management – Energy Management	3.13%
R 9-9	Technology 7: Seismic design and regulations	3.13%
FISE 9-10	Organisation 12: Quality management, application to the construction site	3.13%
R 9-11	Organisation 13: Financial management of the construction site	4.17%
R 9-12	Digital environment: data, connected devices, smart cities, smart grids	4.17
R 9-13	ERP regulations – Fire safety	4.17%
GCM 9-1	Structural Dynamics 2	5.21%
GCM 9-2	Structural Design 3: Prestressed Concrete 2	6.78%
GCM 9-3	Structural Design 4: Composite Structures	10.43%
GCM 9-4	Advanced Geotechnics	5.21%
GCM 9-5	Fire safety analysis	3.13%
GCM 9-6	Modelling and simulation in coastal engineering	5.21%
GCM 9-7	Maritime and Port Structures 2	4.87%
GCM 9-8	Dams, reservoirs and hillside reservoirs	4.17%
GCM 9-9	Environmental policy – Contaminated land	4.52
GCM 9-10	Inspection, maintenance and repair of structures	2.69%
SAÉ under competence C1		**%**
SAÉ 9-1	Specialist workshops and design offices	23.81%
SAÉ 9-2	Individual synthesis project	38.1
SAÉ 9-3	Collective solidarity-based development project: design/preparation phase	38.1%

Competency C2 – Proposing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
FISE 9-5	English S9	17.68 %
FISE 9-6	Spanish S9	15.47%
R 9-7	Impact of Environmental Regulations on Design	5.16%
R 9-8	Natural Resource Management – Energy Management	6.63%
R 9-9	Technology 7: Seismic Design and Regulations	6.63%
FISE 9-10	Organisation 12: Quality management, application to the construction site	6.63%
R 9-12	Digital environment: data, connected devices, smart cities, smart grids	8.84%
R 9-13	ERP regulations – Fire safety	8.84%
GCM 9-8	Dams, reservoirs, hillside reservoirs	8.84%
GCM 9-9	Environmental policy – Contaminated land	9.58
GCM 9-10	Inspection, maintenance and repair of structures	5.71%
SAÉ under C2 remit		**%**
SAÉ 9-1	Specialist workshops and design offices	23.81%
SAÉ 9-2	Individual synthesis project	38.1
SAÉ 9-3	Group project on solidarity-based development: design/preparation phase	38.1

Competence C3 – Dimensioning structures and systems

Resources for Competency C3		%
R 9-7	The Impact of Environmental Regulations on Design	4.85%
GCM 9-1	Structural Dynamics 2	10.4%
GCM 9-2	Structural Design 3: Prestressed Concrete 2	13.52%
GCM 9-3	Structural Design 4: Composite Structures	20.8%
GCM 9-4	Advanced Geotechnics	10.4%
GCM 9-5	Fire safety analysis	6.24%
GCM 9-6	Modelling and simulation in coastal engineering	10.4
GCM 9-7	Maritime and Port Structures 2	9.71%
GCM 9-8	Dams, reservoirs and hillside reservoirs	8.32%
GCM 9-10	Inspection, maintenance and repair of structures	5.37%
SAÉ under competence C3		**%**
SAÉ 9-1	Specialist workshops and design offices	23.81%
SAÉ 9-2	Individual synthesis project	38.1%
SAÉ 9-3	Group project on solidarity-based development: design/preparation phase	38.1%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
R 9-2	Management 8: Marketing and business development strategy	8.31%
R 9-3	Management 9: Employment Law – Employees' Status	8.31%
R 9-4	Management 6: Risk Management and Psychosocial Benefits	8.31%
FISE 9-10	Organisation 12: Quality management, application to the construction site	9.97%
R 9-11	Organisation 13: Financial management of the construction site	13.3%
GCM 9-7	Maritime and Port Structures 2	15.51%
GCM 9-8	Dams, reservoirs, hillside reservoirs	13.3
GCM 9-9	Environmental policy – Contaminated land	14.4%
GCM 9-10	Inspection, maintenance and repair of structures	8.59%
SAÉ under C4 remit		**%**
SAÉ 9-1	Specialist workshops and design offices	23.81%
SAÉ 9-2	Individual synthesis project	38.1
SAÉ 9-3	Group project on solidarity-based development: design/preparation phase	38.1

Semester 9 – GCM Programme – *Professional Contracts*

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
R 9-2	Management 8: Marketing and Business Development Strategy	3.48%
R 9-3	Management 9: Employment Law – Employees' Status	3.48%
R 9-5	English S9	8.34%
R 9-6	Spanish S9	6.26%
R 9-7	Impacts of Environmental Regulation on Design	3.24%
R 9-8	Natural Resource Management – Energy Management	4.17%
R 9-9	Technology 7: Seismic design and regulations	4.17%
R 9-12	Digital environment: data, connected devices, smart cities, smart grids	5.56%
R 9-13	Public Building Regulations – Fire Safety	5.56%
GCM 9-2	Structural Design 3: Prestressed Concrete 2	9.04%
GCM 9-3	Structural Design 4: Composite Structures	13.9%
GCM 9-4	Advanced Geotechnics	6.95%
GCM 9-5	Fire safety analysis	4.17%
GCM 9-7	Maritime and port structures 2	6.49%
GCM 9-8	Dams, reservoirs and hillside reservoirs	5.56%
GCM 9-9	Environmental policy – Contaminated land	6.03
GCM 9-10	Inspection, maintenance and repair of structures	3.59%
SAÉ under competence C1		**%**
SAÉ 9-3	Collective solidarity development project: design/preparation phase	10.64%
SAÉ 9-4	Work placement	89.36%

Competence C2 – Prescribing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
R 9-5	English S9	15.89 %
R 9-6	Spanish S9	11.92%
R 9-7	Impacts of Environmental Regulation on Design	6.18%
R 9-8	Natural Resource Management – Energy Management	7.95%
R 9-9	Technology 7: Seismic Design and Regulations	7.95%
R 9-12	Digital environment: data, connected devices, smart cities, smart grids	10.6%
R 9-13	ERP regulations – Fire safety	10.6%
GCM 9-8	Dams, reservoirs, hillside reservoirs	10.6%
GCM 9-9	Environmental policy – Contaminated land	11.48%
GCM 9-10	Inspection, maintenance and repair of structures	6.84%
SAÉ under C2 remit		**%**
SAÉ 9-3	Group solidarity development project: design/preparation phase	10.64%
SAÉ 9-4	Work placement period	89.36%

Competency C3 – Dimensioning structures and systems

Resources for Competency C3		%
R 9-7	Impacts of Environmental Regulations on Design	6.13 %
GCM 9-2	Structural Design 3: Prestressed Concrete 2	17.07%
GCM 9-3	Structural Design 4: Composite Structures	26.26%
GCM 9-4	Advanced Geotechnics	13.13
GCM 9-5	Fire safety analysis	7.88%
GCM 9-7	Maritime and Port Structures 2	12.25%
GCM 9-8	Dams, reservoirs, hillside reservoirs	10.5%
GCM 9-10	Inspection, maintenance and repair of structures	6.78%
SAÉ under competence C3		**%**
SAÉ 9-3	Group solidarity development project: design/preparation phase	10.64%
SAÉ 9-4	Work placement period	89.36%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
R 9-2	Management 8: Marketing and business development strategy	12.15%
R 9-3	Management 9: Employment law – Employees' status	12.15%
GCM 9-7	Maritime and Port Structures 2	22.67%
GCM 9-8	Dams, reservoirs, hillside reservoirs	19.43 %
GCM 9-9	Environmental policy – Contaminated land	21.05%
GCM 9-10	Inspection, maintenance and repair of structures	12.55%
SAÉ under competence C4		**%**
SAÉ 9-3	Collective solidarity development project: design/preparation phase	10.64%
SAÉ 9-4	Work placement period	89.36%

Semester 9 – H&E pathway

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
R 9-2	Management 8: Marketing and business development strategy	3.21 %
R 9-3	Management 9: Employment Law – Employees' Status	3.21%
R 9-4	Management 6: Risk Management and Psychosocial Benefits	1.6%
FISE 9-5	English S9	10.26%
FISE 9-6	Spanish S9	8.98%
R 9-7	Impact of Environmental Regulations on Design	2.99%
R 9-8	Natural Resource Management – Energy Management	3.85
R 9-9	Technology 7: Seismic Design and Regulations	3.85%
FISE 9-10	Organisation 12: Quality management, application to the building site	2.89%
R 9-11	Organisation 13: Financial management of the construction site	2.57%
R 9–12	Digital environment: data, connected devices, smart cities, smart grids	5.13%
R 9-13	ERP regulations – Fire safety	5.13%
H&E 9-1	Building Electrical Systems	7.84%
H&E 9-2	Refurbishment, energy-efficient renovation	6.09%
H&E 9-3	CES: Scheduling, Management, Coordination	3.21%
H&E 9-4	Heating and Domestic Hot Water	5.45%
H&E 9-5	Industrial equipment and installations 2	3.21%
H&E 9-6	Finite element thermography	11.12%
H&E 9-7	Acoustics, Optics and Lighting	9.41%
SAÉ for competence C1		**%**
SAÉ 9-1	Specialist workshops and design offices	23.81%
SAÉ 9-2	Individual synthesis project	38.1
SAÉ 9-3	Collective solidarity-based development project: design/preparation phase	38.1%

Competence C2 – Proposing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
R 9-4	Management 6: Risk management and psychosocial benefits	1.71 %
FISE 9-5	English S9	10.97%
FISE 9-6	Spanish S9	9.6%
R 9-7	Impact of Environmental Regulations on Design	3.2%
R 9-8	Natural Resource Management – Energy Management	4.11%
R 9-9	Technology 7: Seismic design and regulations	4.11%
FISE 9-10	Organisation 12: Quality management, application to the construction site	3.08%
R 9-11	Organisation 13: Financial management of the construction site	2.74%
R 9-12	Digital environment: data, connected devices, smart cities, smart grids	5.48
R 9-13	ERP regulations – Fire safety	5.48%
H&E 9-1	Building Electrical Systems	8.38%
H&E 9-2	Refurbishment, energy-efficient renovation	6.51%
H&E 9-3	CES: Scheduling, Management, Coordination	3.43%
H&E 9-4	Heating and Domestic Hot Water	5.83%
H&E 9-5	Industrial equipment and installations 2	3.43%
H&E 9-6	Finite element thermography	11.88%
H&E 9-7	Acoustics, Optics and Lighting	10.05%
SAÉ for competence C2		**%**
SAÉ 9-1	Specialist workshops and design offices	23.81%
SAÉ 9-2	Individual synthesis project	38.1
SAÉ 9-3	Group project on solidarity-based development: design/preparation phase	38.1

Competency C3 – Dimensioning structures and systems

Resources for Competency C3		%
R 9-4	Management 6: Risk management and psychosocial benefits	2.84%
R 9-7	Impacts of Environmental Regulation on Design	5.31%
FISE 9-10	Organisation 12: Quality management, application to the construction site	5.12%
R 9-11	Organisation 13: Financial management of the construction site	4.55%
H&E 9-1	Building Electrical Systems	13.91%
H&E 9-2	Refurbishment, energy-efficient renovation	10.81%
H&E 9-3	CES: Scheduling, Management, Coordination	5.69%
H&E 9-4	Heating and Domestic Hot Water	9.67%
H&E 9-5	Industrial equipment and installations 2	5.69%
H&E 9-6	Finite element thermography	19.72%
H&E 9-7	Acoustics, Optics and Lighting	16.69%
SAÉ for competence C3		**%**
SAÉ 9-1	Specialist workshops and design offices	23.81%
SAÉ 9-2	Individual synthesis project	38.1
SAÉ 9-3	Group project on solidarity-based development: design/preparation phase	38.1%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
R 9-2	Management 8: Marketing and business development strategy	10.2 %
R 9-3	Management 9: Employment law – Employees' status	10.2%
R 9-4	Management 6: Risk management and psychosocial benefits	5.1%
FISE 9-10	Organisation 12: Quality management, application to the construction site	9.18%
R 9-11	Organisation 13: Financial management of the construction site	8.16%
H&E 9-2	Refurbishment, energy-efficient renovation	19.39%
H&E 9-3	CES: Scheduling, Management, Coordination	10.2%
H&E 9-4	Heating and Domestic Hot Water	17.35%
H&E 9-5	Industrial equipment and installations 2	10.2%
SAÉ for competence C4		**%**
SAÉ 9-1	Specialist workshops and design offices	23.81%
SAÉ 9-2	Individual synthesis project	38.1
SAÉ 9-3	Group project on solidarity-based development: design/preparation phase	38.1%

Semester 9 – H&E Programme – *Professional Contracts*

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
R 9-2	Management 8: Marketing and Business Development Strategy	4.35%
R 9-3	Management 9: Employment Law – Employees' Status	4.35%
R 9-5	English S9	10.45%
R 9-6	Spanish S9	7.84%
R 9-7	Impacts of Environmental Regulations on Design	4.06%
R 9-8	Natural Resource Management – Energy Management	5.22%
R 9-9	Technology 7: Seismic Design and Regulations	5.22%
R 9-12	Digital environment: data, connected devices, smart cities, smart grids	6.97
R 9-13	ERP regulations – Fire safety	6.97%
H&E 9-1	Building Electrical Systems	7.98%
H&E 9-2	Refurbishment, energy-efficient renovation	8.27
H&E 9-4	Heating and domestic hot water	7.4%
H&E 9-6	Finite element thermography	11.32%
H&E 9-7	Acoustics, Optics and Lighting	9.58%
SAÉ for competence C1		**%**
SAÉ 9-3	Group solidarity development project: design/preparation phase	10.64%
SAÉ 9-4	Work placement period	89.36%

Competency C2 – Proposing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
R 9-5	English S9	11.45 %
R 9-6	Spanish S9	8.59%
R 9-7	Impacts of Environmental Regulation on Design	4.45%
R 9-8	Natural Resource Management – Energy Management	5.72%
R 9-9	Technology 7: Seismic Design and Regulations	5.72%
R 9-12	Digital environment: data, connected devices, smart cities, smart grids	7.63%
R 9-13	ERP regulations – Fire safety	7.63%
H&E 9-1	Building Electrical Systems	8.74%
H&E 9-2	Refurbishment, energy-efficient renovation	9.06%
H&E 9-4	Heating and domestic hot water	8.11%
H&E 9-6	Finite element thermography	12.4%
H&E 9-7	Acoustics, Optics and Lighting	10.49%
SAÉ for competence C2		**%**
SAÉ 9-3	Group solidarity development project: design/preparation phase	10.64%
SAÉ 9-4	Work placement period	89.36%

Competency C3 – Dimensioning structures and systems

Resources for Competency C3		%
R 9-7	Impacts of Environmental Regulations on Design	8.36%
H&E 9-1	Building electrical systems	16.42%
H&E 9-2	Refurbishment, energy-efficient renovation	17.01%
H&E 9-4	Heating and domestic hot water	15.22%
H&E 9-6	Finite element thermography	23.28%
H&E 9-7	Acoustics, Optics and Lighting	19.7%
SAÉ for competence C3		**%**
SAÉ 9-3	Group project on solidarity-based development: design/preparation phase	10.64%
SAÉ 9-4	Work placement period	89.36

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
R 9-2	Management 8: Marketing and business development strategy	8.17%
R 9-3	Management 9: Employment Law – Employees' Status	8.17%
H&E 9-1	Building Electrical Systems	14.99%
H&E 9-2	Refurbishment, energy-efficient renovation	15.53%
H&E 9-4	Heating and domestic hot water	13.9%
H&E 9-6	Finite element thermography	21.25%
H&E 9-7	Acoustics, Optics and Lighting	17.98%
SAÉ for competence C4		**%**
SAÉ 9-3	Collective social development project: design/preparation phase	10.64%
SAÉ 9-4	Work placement period	89.36%

Semester 9 – RIS pathway

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
R 9-2	Management 8: Marketing and business development strategy	2.64 %
R 9-3	Management 9: Employment Law – Employees' Status	2.64%
R 9-4	Management 6: Risk Management and Psychosocial Benefits	2.64%
FISEA 9-5	English S9	8.45%
FISEA 9-6	Spanish S9	7.39%
R 9-7	Impacts of Environmental Regulation on Design	2.46%
R 9-8	Natural Resource Management – Energy Management	3.17%
R 9-9	Technology 7: Seismic design and regulations	3.17%
FISEA 9-10	Organisation 12: Quality management, application to the building site	2.46%
R 9-11	Organisation 13: Financial management of the construction site	4.23
R 9–12	Digital environment: data, connected devices, smart cities, smart grids	4.23%
R 9-13	ERP regulations – Fire safety	4.23%
FISEA 9-14	Management 7: Business Start-ups and Takeovers	3.17%
FISEA 9-18	Organisation 10: Public and private works contracts	4.23
FISEA 9-19	Module 11: Contractual management of contracts during the execution phase	2.46%
RIS 9-1	Engineering Structures 2: tunnels, covered cuttings	3.17%
RIS 9-2	Engineering Structures 3: river, maritime and port structures	3.17%
RIS 9-3	Inspection, maintenance and repair of structures	3.17 %
RIS 9-4	Water supply and sewerage networks	3.17%
RIS 9-5	Dry networks and energy infrastructure	4.75%
RIS 9-6	Environmental policy – Contaminated land	3.17%
RIS 9-7	VRD 2	2.38%
RIS 9-8	Rock Mechanics	6.34%
RIS 9-9	Shallow and deep foundations	5.99%
RIS 9-10	Soil improvement and stabilisation	4.58
RIS 9-11	Earthworks 3	2.55%

Competence C2 – Prescribing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
FISEA 9-5	English S9	10.5 %
FISEA 9-6	Spanish S9	9.19%
R 9-7	The Impact of Environmental Regulations on Design	3.06 %
R 9-8	Natural Resource Management – Energy Management	3.94%
R 9-9	Technology 7: Seismic Design and Regulations	3.94%
FISEA 9–10	Organisation 12: Quality management, application to the building site	3.06%
R 9–12	Digital environment: data, connected devices, smart cities, smart grids	5.25%
R 9-13	ERP regulations – Fire safety	5.25%
FISEA 9-19	Organisation 11: Contract management of projects in the execution phase	3.06%
RIS 9-1	Engineering Structures 2: tunnels, covered cuttings	3.94%
RIS 9-2	Engineering Structures 3: river, maritime and port structures	3.94%
RIS 9-3	Inspection, maintenance and repair of structures	3.94%
RIS 9-4	Water supply and sewerage networks	3.94
RIS 9-5	Dry networks and energy infrastructure	5.91%
RIS 9-6	Environmental policy – Contaminated land	3.94%
RIS 9-7	VRD 2	2.95%
RIS 9-8	Rock Mechanics	7.88%
RIS 9-9	Shallow and deep foundations	7.44%
RIS 9-10	Soil improvement and stabilisation	5.69
RIS 9-11	Earthworks 3	3.17%

Competence C3 – Designing structures and systems

Resources for Competency C3		%
R 9-7	Impacts of Environmental Regulations on Design	5.19 %
FISEA 9-16	Numerical optimisation	22.22%
FISEA 9-17	Numerical Methods – Partial Differential Equations	33.33%
RIS 9-4	Wastewater networks and sanitation	6.67%
RIS 9-7	VRD 2	5%
RIS 9-9	Shallow and deep foundations	12.59%
RIS 9-10	Soil improvement and stabilisation	9.63%
RIS 9-11	Earthworks 3	5.37%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
R 9-2	Management 8: Marketing and business development strategy	4.82 %
R 9-3	Management 9: Employment Law – Employees' Status	4.82%
R 9-4	Management 6: Risk Management and Psychosocial Benefits	4.82%
FISEA 9-10	Organisation 12: Quality management, application to the construction site	4.5%
R 9–11	Organisation 13: Financial management of the construction site	7.72%
FISEA 9-14	Management 7: Business Start-ups and Takeovers	5.79%
FISEA 9-15	Management 4: Innovation and Development – Engineers' Agility	17.36
FISEA 9–18	Organisation 10: Public and private works contracts	7.72%
FISEA 9-19	Organisation 11: Contract management of contracts in the EXE phase	4.5%
RIS 9-1	Engineering Structures 2: tunnels, covered cuttings	5.79%
RIS 9-2	Engineering Structures 3: river, maritime and port structures	5.79%
RIS 9-3	Inspection, maintenance and repair of structures	5.79%
RIS 9-4	Water supply and sewerage networks	5.79%
RIS 9-6	Environmental policy – Contaminated land	5.79%
RIS 9-7	VRD 2	4.34%
RIS 9-11	Earthworks 3	4.66%

Semester 9 – RIS Programme – *Professional Contracts*

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
SAÉ for Competency C1		**%**
SAÉ 9-3	Collective solidarity development project: design/preparation phase	17.41
SAÉ 9-5	Work placement period	73.88%
SAÉ 9-6	Career path project	8.71

Competence C2 – Prescribing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
SAÉ for Competency C2		**%**
SAÉ 9-3	Collective solidarity development project: design/preparation phase	17.41
SAÉ 9-5	Work placement period	73.88%
SAÉ 9-6	Career path project	8.71%

Competence C3 – Dimensioning structures and systems

Resources for Competency C3		%
SAÉ for Competency C3		**%**
SAÉ 9-3	Collective solidarity-based development project: design/preparation phase	17.41%
SAÉ 9-5	Work placement period	73.88%
SAÉ 9-6	Career path project	8.71

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
SAÉ for Competency C4		**%**
SAÉ 9-3	Collective solidarity development project: design/preparation phase	17.41
SAÉ 9-5	Work placement period	73.88%
SAÉ 9-6	Career path project	8.71%

Semester 9 – MHS Programme

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
R 9-2	Management 8: Marketing and business development strategy	2.68 %
R 9-3	Management 9: Employment Law – Employees' Status	2.68%
R 9-4	Management 6: Risk Management and Psychosocial Benefits	2.68%
FISEA 9-5	English S9	8.56%
FISEA 9-6	Spanish S9	7.49%
R 9-7	Impacts of Environmental Regulation on Design	2.5%
R 9-8	Natural Resource Management – Energy Management	3.21%
R 9-9	Technology 7: Seismic design and regulations	3.21%
FISEA 9-10	Organisation 12: Quality management, application to the construction site	2.5%
R 9-11	Organisation 13: Financial management of the construction site	4.28%
R 9-12	Digital environment: data, connected devices, smart cities, smart grids	4.28
R 9-13	ERP regulations – Fire safety	4.28%
FISEA 9-14	Management 7: Business Start-ups and Takeovers	3.21%
FISEA 9-18	Organisation 10: Public and private works contracts	4.28
FISEA 9-19	Module 11: Contractual management of contracts during the execution phase	2.5%
MHS 9-1	Lightweight structural connections: foundations, complex assemblies	3.93
MHS 9-2	Composite frames	5.35 %
MHS 9-3	Eco-design and eco-construction	7.49%
MHS 9-4	Methods 3: methods module, complex projects	3.21%
MHS 9-5	Numerical Modelling and BIM 2	3.57
MHS 9-6	Structural, thermal and waterproofing interfaces	4.28
MHS 9-7	Temporary stability and shoring 2: complex elements	2.68
MHS 9-8	Organisation and management of prefabrication 3: complex elements	2.94
MHS 9-9	Production, processes and robotisation 2	3.93%
MHS 9-10	Quality and environmental management	4.28%
SAÉ for competence C1		**%**
SAÉ 9-3	Collective solidarity development project: design/preparation phase	17.41%
SAÉ 9-5	Work placement	73.88%

Competence C2 – Proposing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
FISEA 9-5	English S9	10.68 %
FISEA 9-6	Spanish S9	9.34%
R 9-7	Impacts of Environmental Regulations on Design	3.11%
R 9-8	Natural Resource Management – Energy Management	4 %
R 9-9	Technology 7: Seismic design and regulations	4%
FISEA 9-10	Organisation 12: Quality management, application to the building site	3.11%
R 9–12	Digital environment: data, connected devices, smart cities, smart grids	5.34
R 9-13	ERP Regulations – Fire Safety	5.34%
FISEA 9-19	Organisation 11: Contract management of projects in the execution phase	3.11%
MHS 9-1	Lightweight structural connections: foundations, complex assemblies	4.89
MHS 9-2	Composite structures	6.67
MHS 9-3	Eco-design and eco-construction	9.34%
MHS 9-4	Methods 3: methods module, complex projects	4%
MHS 9-5	Numerical Modelling and BIM 2	4.45
MHS 9-6	Structural, thermal and waterproofing interfaces	5.34%
MHS 9-7	Temporary stability and shoring 2: complex elements	3.34
MHS 9-8	Organisation and management of prefabrication 3: complex elements	3.67
MHS 9-9	Production, processes, robotisation 2	4.89%
MHS 9–10	Quality and environmental management	5.34%
SAÉ for competence C2		**%**
SAÉ 9-3	Collective solidarity development project: design/preparation phase	17.41%
SAÉ 9-5	Work placement period	73.88%

Competence C3 – Dimensioning structures and systems

Resources for Competency C3		%
R 9-7	Impacts of environmental regulations on design	5.27 %
FISEA 9-16	Numerical optimisation	22.6%
FISEA 9-17	Numerical Methods – Partial Differential Equations	33.9%
MHS 9-1	Connections in lightweight structures: foundations, complex assemblies	8.29%
MHS 9-2	Composite frames	11.3
MHS 9-4	Methods 3: Methods module, complex projects	6.78%
MHS 9-7	Temporary stability and shoring 2: complex elements	5.65%
MHS 9-8	Organisation and management of prefabrication 3: complex elements	6.21%
SAÉ for competence C3		**%**
SAÉ 9-3	Collective solidarity development project: design/preparation phase	17.41%
SAÉ 9-5	Work placement period	73.88%

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
R 9-2	Management 8: Marketing and business development strategy	4.51 %
R 9-3	Module 9: Employment Law – Employees' Status	4.51%
R 9-4	Management 6: Risk Management and Psychosocial Benefits	4.51%
FISEA 9-10	Organisation 12: Quality management, application to the construction site	4.21%
R 9-11	Organisation 13: Financial management of the construction site	7.22%
FISEA 9-14	Management 7: Business Start-ups and Takeovers	5.41%
FISEA 9-15	Management 4: Innovation and Development – Engineers' Agility	16.24%
FISEA 9–18	Organisation 10: Public and private works contracts	7.22%
FISEA 9-19	Organisation 11: Contract management of contracts in the EXE phase	4.21%
MHS 9-4	Methods 3: Methods dossier, complex projects	5.41
MHS 9-5	Numerical Modelling and BIM 2	6.02%
MHS 9-6	Structural, thermal and waterproofing interfaces	7.22%
MHS 9-7	Temporary stability and shoring 2: complex elements	4.51
MHS 9-8	Organisation and management of prefabrication 3: complex elements	4.96
MHS 9-9	Production, processes and robotisation 2	6.62%
MHS 9-10	Quality and environmental management	7.22%
SAÉ for competence C4		**%**
SAÉ 9-3	Collective solidarity-based development project: design/preparation phase	17.41%
SAÉ 9-5	Work placement period	73.88%

Semester 9 – MHS pathway – *Professional contracts*

Competency C1 – Analysing a construction project within its context

Resources for Competency C1		%
SAÉ for Competency C1		**%**
SAÉ 9-6	Learning pathway	8.71 %

project

Competency C2 – Prescribing technical solutions for sustainable and more durable construction

Resources for Competency C2		%
SAÉ for Competency C2		**%**
SAÉ 9-6	Course project	8.71%

Competency C3 – Designing structures and systems

Resources for Competency C3		%
SAÉ for Competency C3		**%**
SAÉ 9-6	Learning pathway project	8.71

Competency C4 – Managing a construction organisation

Resources for Competency C4		%
SAÉ for Competency C4		**%**
SAÉ 9-6	Learning pathway project	8.71%

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R 9-1 – Management 5: Soft Skills and Personal Development

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Duration	
CM	4h30
Tutorial	4h30
Total hours	**9**

Assessment
Assessed as SAÉ

Prerequisites

- R 6-1: Management 2: HRM, recruitment and induction of employees
- R 7-3: Management 3: HRM, behavioural psychology and conflict management
- R 8-3: Management 4: Innovation and Development – Agility in Engineering

Objectives

To understand and be familiar with:

- The key factors (knowledge, skills, interpersonal skills) that characterise:
  - a good interpersonal relationship
  - a good business relationship
- The benefits of soft skills

Programme

- Soft skills: what are they? Why are they important? What are they used for?
- How can you inspire confidence?
- The basics of good interpersonal communication
- The attitudes and behaviours to adopt to start building a lasting and trusting relationship
- The basics of NVC (Non-Violent Communication)

Key takeaways

- Active listening and curiosity (genuine and honest)
- The ability to ask questions (to discover and understand the other person's needs)
- Practising NVC 511

Bibliography

- *The Four Agreements* – D. M. Ruiz
- *Practising Non-Violent Communication,* Françoise Keller
- *The Thirst for the Essential,* R. Moghaddassi

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R 9-2 – Management 8: Marketing and Business Development Strategy

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
Tutorial	7.5 hours
Total	**7h30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

- Previous modules in Law

Objectives

- To understand the organisation of the company's economic activities and the principles of its commercial management
- To understand and select options for the company's future development
- To analyse the implications of strategic choices for the company
- Plan for the company's future by identifying key milestones: forward-looking management
- Define the strategy and the resources required to achieve its objectives

Programme

This module examines the implications for the company of choosing a development strategy: a strategy of independence, a strategy of cooperation and a strategy of openness. For each of these strategies, the motivations, legal and economic consequences, as well as the limitations and benefits, are discussed.

Key learning points

- Analysing the different growth strategies available to a business
- Assess the legal and economic consequences of strategic choices
- Develop a suitable business strategy
- Implementing forward-looking

Bibliography

- *Marketing, Management*, Kotler and Dubois, Publi Union
- *Strategic Choices and Competition*, Michael Porter, Economica, 1982
- *Strategor: General Corporate Policy*, a collective work by lecturers, École des Hautes Études Commerciales
- *Handbook of Commercial Law*, Jacques Mestres, LCDJ, 23rd edition
- *Vademecum*, Economica
- *Competitive Advantage*, Michael Porter, InterEditions, 1986
- *Business Partnerships*, P. Dussauge, X. Ramanantso
- *Handbook of Strategic Foresight (2 volumes)*, Michel Godet, Dunod

Keywords: Marketing, business strategy, commercial management, business development, forward-looking management

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R 9-3 - Management 9: Employment Law – Employees' Status

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face teaching

Duration
Tutorial .....7.5 hours
Total **7h30**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

- None

Objectives

By the end of this course, students will be able to:

- To navigate the regulatory framework applicable to employment relationships within a construction company
- To understand the key stages of an employment relationship and their specific features within the construction sector
- To understand the rights and obligations of employees

Syllabus

The four sessions, each lasting 1.5 hours, will cover the following topics in turn:

- Sources of employment law
- Employment contracts
- Working hours
- Remuneration

Key learning points

- Identify the regulatory sources of labour law
- Understand the different types of employment contracts and their specific features in the construction industry
- Apply the regulations on working hours
- Understand remuneration mechanisms 515

Bibliography

- Collective Agreements for the BUILDING / CIVIL ENGINEERING / CONSULTANCY FIRMS / CONSTRUCTION COST CONSULTANTS sectors

Keywords: Employment law, employment contracts, working time, remuneration, employees' status, construction and public works sector

R 9-4 - Management 6: Risk management and psychosocial benefits

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face teaching

Duration
Tutorial .....7.5 hours
Total **7h30**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 – Designing structures and systems
C4 - Managing a construction organisation

Prerequisites

- Previous management modules

Objectives

- To understand communication mechanisms and interpersonal challenges
- Develop a managerial approach suited to the professional environment
- To be able to identify and manage existing psychosocial risks
- To be able to identify and consolidate existing psychosocial benefits
- To integrate the concept of professional ethics into day-to-day practice

Programme

- Communication: knowing how to express yourself and being able to listen
- Professional positioning and the dynamics of identity and otherness
- Management: providing support, empowering and recognising staff
- Psychosocial risks (PSRs):
  - The employer's responsibilities
  - The Single Document: analysis and prevention of technical risks
  - Work-related distress, bore-out and burn-out
- Psychosocial benefits (PSBs):
  - Safe support points

  - Well-being at work
  - Identity and social development
- Harmonising and balancing psychosocial risks and psychosocial benefits
- Respecting, preserving and passing on appropriate professional ethics

Key learning points

- Mastering professional communication techniques
- Adopting an appropriate managerial approach
- Identify and prevent psychosocial risks
- Develop and maintain psychosocial well-being
- Integrating professional ethics into managerial practices

Bibliography

- To be completed

Keywords: Management, psychosocial risks, psychosocial benefits, communication, professional ethics, well-being at work

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R 9-7 – Impacts of Environmental Regulation on Design

Timetable	
Semester	9
Term	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	4h30
Practical hours	6
Total hours	**10.5**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Objectives

- To analyse the impact of environmental standards and regulations on design
- Present technical solutions to address environmental design issues
- Take part in a 'climate forum'

Programme

- Choosing a topic
- Research into relevant regulations and standards
- Group work
- Producing a poster as a final output
- Oral presentation during a 'climate forum'-style exhibition

Key learning outcomes

- Ability to identify and explain relevant standards and regulations
- Ability to formulate a research question
- Defining the limitations, uncertainties or contradictions between regulations and technical constraints
- Ability to explain complex concepts in simple terms, defend one's choices and engage in dialogue with teachers and peers

Bibliography

- Regulatory documents

Keywords: Environmental regulations, standards, design, Climate Forum 519

R 9-8 – Natural Resource Management – Energy Management

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
Lectures.....6 hours
Practical sessions.....3 hours
Total.....**9**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

- Materials technology
- Analysis of environmental issues (LCA, waste management)

Objectives

The aim of the course is to train students in the energy transition and the challenges of sustainable resource management at global and national levels.

- To identify and classify different resources according to their nature and renewability
- Analyse the geopolitical, economic and environmental issues surrounding resource management
- Propose appropriate strategies for sustainable management in different contexts
- Interpret the challenges associated with integrated water management
- Understand the production dynamics and the territorial and environmental constraints associated with the management of quarries and aggregates. Assess the potential and limitations of recycling and secondary aggregates
- Understand how nuclear energy works, and assess its benefits and limitations, taking into account issues relating to waste
- Understand the various techniques for generating energy from renewable resources (solar, wind, hydro, biomass, etc.)
- Identify and analyse the principles of *Enhanced Geothermal Systems* (EGS)

Syllabus

- Definition and classification of resources
- Resource management worldwide and in France: global challenges, disparities and prospects
- Case study: integrated water management

- Case study: Quarry and aggregate management
  - Production, consumption and the market in France
  - Regulatory, environmental and regional challenges: nuisance, site conservation, sustainable development
- Energy resources:
  - Renewable energy (hydropower, solar, wind, biomass and geothermal)
  - Non-renewable energy sources (nuclear and fossil fuels)

Key learning points

- Distinguish and classify resources according to their nature, availability and renewability
- Assess possible strategies for sustainable management and evaluate their relevance in various contexts (global, national, local)
- Understand the water balance and its role in defining integrated water management
- Understand the mechanisms involved in aggregate production and identify the associated territorial, environmental and regulatory impacts
- Understand how nuclear energy works, taking into account issues of safety, sustainability and waste management
- Understand the processes involved in wind and geothermal energy production, their benefits and their social and environmental impacts

Bibliography

- *Integrated water resources management at the catchment level. Analytical techniques*, Berland, Jean-Marc, 2015, 10.51257/a-v1-w2150
- *Aggregates, Soils, Cements and Concrete*, Raymond Dupain, Jean-Claude Saint-Arroman, A. Capliez Collection
- *The Physics of Energy*, Jaffe, R. L., & Taylor, W., 2018, Cambridge: Cambridge University Press
- https://www.ecologie.gouv.fr/politiques-publiques/gestion-leau-france

Keywords: Management and sustainable development, Integrated water management, Quarry management, Energy transition, Fossil fuels, Nuclear energy, Renewable energy

R 9-9 - Technology 7: Seismic design and regulations

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....6 hours
Practical sessions.....3 hours
Total.....**9**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

- Resource R6-9 'RdM 8: Solid Dynamics – Kinetics'
- Resource R6-10 'Risk Management'
- Previous Technology courses

Syllabus

Lectures:

- Natural hazards and their effects on structures
- Seismic phenomena and effects: origin and characteristics of earthquakes, direct and induced effects of earthquakes
- Dynamic behaviour of structures during earthquakes: inertial forces, stiffness, dissipation
- Seismic design: appropriate architecture, structural systems
- Regulations: seismic hazard, structures with normal or special risk, categories of importance Tutorials:
- Application of Eurocode 8 and the Decree of 22 October 2010: plotting of elastic response spectra $S_e(T)$
- Principles of structural design according to different ductility classes (DCL, DCM, DCH), energy dissipation, design spectra $S_d(T)$ with behaviour coefficient q

Key learning points

- Seismic phenomena and effects
- Equilibrium of a structure under seismic actions A_{Ed} (forces Fi, Fr, Fd) and EC8 design principles (DCL, DCM, DCH)
- Regulations
- Plotting and interpreting a spectrum

Bibliography

- Website of the French Association for Earthquake Engineering: https://www.afps-seisme.org/
- NF EN 1998 + AN and Decree of 22 October 2010 and Amended Order of 25 October 2012
- *Seismic Design and Construction*, Eyrolles Publishing

Keywords: Risks, hazards, waves, magnitude, inertia, stiffness, dissipation, bracing, diaphragms, regulations, spectra, ductility

R 9-11 – Organisation 13: Financial management of the construction site

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....7.5 hours
Tutorials 4h30
Total.....12 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Knowledge of profit and loss accounts and cost analysis
- Knowledge of how to calculate the direct costs of a construction project, through the calculation of direct costs for basic works
- Knowledge of standard methods for calculating prices in the building and civil engineering sectors

Objectives

A company's profitability depends on the profitability of its construction projects; achieving this requires financial, technical and organisational skills. To realise their full potential within the company, engineers must be convinced of the absolute necessity of implementing procedures for calculating and controlling costs, and require appropriate training.

- To implement a cost analysis system enabling a rational calculation of selling prices, tailored to the specific characteristics of the company and its construction sites
- Establish procedures and documentation to enable financial monitoring of construction projects, based on an understanding of the cash flow implications involved
- Calculate and analyse the profitability of a project and derive lessons and various ratios from this, both during the course of the project and upon its completion

Programme

- The need to forecast costs prior to any pricing process
- Analysing projected costs into fixed and variable costs, and into direct and indirect costs
- Allocation of costs to cost centres
- Analysing the breakdown of a project's direct costs

- The choice of unit of measurement for direct cost components
- The allocation, calculation and management of direct site costs
- The issue of choosing methods for allocating indirect costs and their impact on full cost
- Presenting the price of a project according to the specific requirements of the client and the project; the strategic aspects of pricing
- The challenges of site cash flow forecasting
- Cash flow forecasts for construction projects
- The challenges of profitability monitoring during and at the end of a project
- Implementing procedures for monitoring direct project costs
- Identifying any potential cost overruns during the project
- The profitability analysis and identification of relevant project ratios.

R 9-12 – Digital environment: data, connected devices, smart cities, smart grids

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial.....3 hours
Total.....**12**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

- General digital literacy (files, cloud storage, email, spreadsheets).
- Basic understanding of measurement and indicators (units, frequency, averages).
- Awareness of privacy (GDPR) and cybersecurity issues.

Objectives

Digital environments are transforming the urban, energy, industrial, construction and mobility sectors. To capitalise on these developments, it is necessary to integrate data, connected devices, networks and practical applications, whilst addressing security and governance issues.

This module aims to provide a practical understanding of this field through an introduction to the key concepts *of the Internet of Things, Smart Cities* and *Smart Grids*. The aim is as much to explain what these concepts entail as to outline the underlying technologies and the implementations that exist today.

Syllabus

- **Data**: Introduction to and understanding of fundamental concepts: variables, indicators, units, frequency, simple uncertainty (sources of error), representativeness of a dataset.
- **Connected objects & use cases**: concrete, cross-sector examples (construction, public spaces, housing, transport, energy): what they measure and what this enables.
- **Smart cities**: Presentation of typical case studies and underlying architectures: parking, lighting, air quality/noise, waste. Simple indicators (levels, trends, thresholds).
- **Energy & 'smart grids'**: An introduction to how consumption monitoring, local energy production and demand peaks work.
- **Quality, ethics and data protection**: Who collects **the data**? For what purpose? How long should it be retained ? Principles of restraint and basic security.

Key learning points

- A high-level understanding of how an information processing architecture works.
- Identification of relevant use cases for digital environments in the construction industry and Smart Cities.
- Knowledge of the stakeholders who may be involved in the data chain, from collection to utilisation.

Keywords: Data, Smart City, Smart Grid, Connected objects

R 9-13 – Public Building Regulations – Fire Safety

Timetable
Term 9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....7.5 hours
Tutorials 4h30
Total.....**12 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

General knowledge of building technology and regulations

Objectives

- To master the regulations relating to fire safety in buildings
- Be able to design projects that comply with safety and accessibility standards
- To understand the impact of regulations during the design phase

Syllabus

- Fire safety regulations: Building Code, decrees and regulations
- Classification of buildings: public access buildings, residential buildings, high-rise buildings
- Fire behaviour of materials, fire resistance of structures
- Fire compartmentation, smoke extraction, emergency exits

Key learning points

- Identifying the regulations applicable to a project
- Designing circulation routes and emergency exits in compliance with regulations
- Dimensioning fire safety systems

Bibliography

- *Building and Housing Code*, Articles R. 121-1 to R. 143-46
- *Fire Safety in Public Access Buildings*, Jean-Paul Koscielny, Le Moniteur, 2020

Keywords: Fire safety, public access buildings, regulations

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ÉCOLE D'INGÉNIEURS

ISA BTP
FORMATION INGÉNIEUR

R 9-1 - Management 5: Soft Skills and Personal Development - *Professional Contracts*

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face in person	

Duration	
CM	4h30
Tutorial	4h30
Total hours	**9**

Assessment
Assessed as SAÉ

Prerequisites

- R 6-1: Management 2: HRM, recruitment and induction of employees
- R 7-3: Management 3: HRM, behavioural psychology and conflict management
- R 8-3: Management 4: Innovation and Development – Agility in Engineering

Objectives

To understand and be familiar with:

- The key factors (knowledge, skills, interpersonal skills) that characterise:
  - a good interpersonal relationship
  - a good business relationship
- The benefits of soft skills

Programme

- Soft skills: what are they? Why are they important? What are they used for?
- How can you inspire confidence?
- The basics of good interpersonal communication
- The attitudes and behaviours to adopt to start building a lasting and trusting relationship
- The basics of NVC (Non-Violent Communication)

Key takeaways

- Active listening and curiosity (genuine and honest)
- The ability to ask questions (to discover and understand the other person's needs)
- Practising NVC 529

Bibliography

- *The Four Agreements* – D. M. Ruiz
- *Practising Non-Violent Communication,* Françoise Keller
- *The Thirst for the Essential,* R. Moghaddassi

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ISA BTP
FORMATION INGÉNIEUR

R 9-2 – Management 8: Marketing and Business Development Strategy – *Professional Contracts*

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration	
Tutorial	7.5 hours
Total	**7h30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

- Previous Legal modules

Objectives

- To understand the organisation of the company's economic activities and the principles of its commercial management
- To understand and select options for the company's future development
- To analyse the implications of strategic choices for the company
- Plan for the company's future by identifying key milestones: forward-looking management
- Define the strategy and the resources required to achieve its objectives

Programme

This module examines the implications for the company of choosing a development strategy: a strategy of independence, a strategy of cooperation and a strategy of openness. For each of these strategies, the motivations, legal and economic consequences, as well as the limitations and benefits, are discussed.

Key learning points

- Analysing the different growth strategies available to a business
- Assess the legal and economic consequences of strategic choices
- Develop a suitable business strategy
- Implement forward-looking management

Bibliography

- *Marketing, Management*, Kotler and Dubois, Publi Union
- *Strategic Choices and Competition*, Michael Porter, Economica, 1982
- *Strategor: General Corporate Policy*, a collective work by lecturers, École des Hautes Études Commerciales
- *Handbook of Commercial Law*, Jacques Mestres, LCDJ, 23rd edition
- *Vademecum*, Economica
- *Competitive Advantage*, Michael Porter, InterEditions, 1986
- *Business Partnerships*, P. Dussauge, X. Ramanantso
- *Handbook of Strategic Foresight (2 volumes)*, Michel Godet, Dunod

Keywords: Marketing, business strategy, commercial management, business development, forward-looking management

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ÉCOLE D'INGÉNIEURS

ISA BTP
FORMATION INGÉNIEUR

R 9-3 - Management 9: Employment Law – Employees' Status – *Professional Contracts*

Timetable	
Term	9
Period	Sept. – Jan
Face-to-face teaching	

Duration	
Tutorial	7.5 hours
Total	**7h30**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

- None

Objectives

By the end of this course, students will be able to:

- To navigate the regulatory framework applicable to employment relationships within a construction company
- To understand the key stages of an employment relationship and their specific features within the construction sector
- To understand the rights and obligations of employees

Syllabus

The four sessions, each lasting 1.5 hours, will cover the following topics in turn:

- Sources of employment law
- Employment contracts
- Working hours
- Remuneration

Key learning points

- Identify the regulatory sources of labour law
- Understand the different types of employment contracts and their specific features in the construction industry
- Apply the regulations on working hours
- Understand remuneration mechanisms 533

Bibliography

- Collective Agreements for the BUILDING / PUBLIC WORKS / CONSULTANCY FIRMS / CONSTRUCTION COST ENGINEERS sectors

Keywords: Employment law, employment contracts, working hours, pay, employees' status, construction industry

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ÉCOLE D'INGÉNIEURS

ISA BTP
FORMATION INGÉNIEUR

R 9-5 – English S9 – *Professional Contracts*

Timetable	
Semester	9
Term	Sept. – Jan
Face-to-face	

Assessment
Continuous assessment

Duration
Total	**18 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

R 6-3 - English 6

Objectives

- To improve professional and technical English
- To prepare students for a career in an international context
- Achieve a B2/C1 level on the CEFR

Syllabus

- Advanced technical English for civil engineering
- Communication in an international professional context
- Writing technical reports and documents
- Negotiation and meetings in English
- Oral presentations on complex projects
- Preparation for the TOEIC or equivalent
- International case studies
- Business English and professional correspondence

Key learning outcomes

- Communicating confidently in a professional context
- Writing professional technical documents
- Negotiating and presenting arguments in English
- Presenting and defending a technical project 535

Bibliography

- *English for Construction*, D. Glendinning, Oxford University Press
- *Professional English in Use – Engineering*, M. Ibbotson, Cambridge
- *Business English*, I. MacKenzie, Cambridge

Keywords: Professional English, international communication, technical, TOEIC, business English

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FORMATION INGÉNIEUR

R 9-6 – Spanish S9 – *Professional Contracts*

Timetable
Term 9
Term .....Sept. – Jan
Face-to-face

Assessment
Continuous assessment

Duration
Total **13h30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

Spanish ISA 1, 2 and 3

Objectives

In Semester 5, students must acquire the skills necessary to aim for level B2 in international certification exams (such as DELE or SIELE).

Level B2 certifies that the learner can understand the main points of concrete or abstract topics in a complex text, including a technical discussion within their field of specialisation. They can communicate with such spontaneity and fluency that interaction with a native speaker is natural and effortless for both parties. They can express themselves clearly and in detail on a wide range of topics, put forward a reasoned opinion, and outline the advantages and disadvantages of different options.

In Semester 6, teaching focuses on preparing for official Spanish language qualifications (DELE, SIELE). The aim is to consolidate and expand B2-level skills, enabling students to:

- To sit international exams in the best possible conditions
- To ensure sufficient linguistic fluency to function effectively in a Spanish-speaking academic or professional context

The target is B2 level: in-depth comprehension; fluent and nuanced oral and written expression; and the ability to interact without difficulty with native speakers and to defend a well-argued point of view.

Syllabus

- Familiarisation with the DELE and SIELE exams: structure, duration, assessment criteria
- Systematic practice in the four assessed skills: listening comprehension, reading comprehension, written expression, and oral expression and interaction
- Grammar and vocabulary consolidation to achieve the level of accuracy and correctness required for B2
- Development of specific strategies for time management, understanding lengthy texts and producing coherent and well-argued written work
- Mock exams under real exam conditions 537

Key learning objectives

- Understanding complex texts, identifying main ideas and relevant details
- Producing clear, structured and well-argued written work on a variety of topics (society, culture, the world of work, current affairs)
- Interacting spontaneously and confidently in spoken English, expressing and defending one's opinions with nuance
- Using an appropriate register (formal/informal) depending on the situation
- Develop strategies for self-correction and managing exam-related stress

Bibliography

- https://eduscol.education.fr/1971/cadre-europeen-commun-de-reference-pour-les-langues-cecrl
- https://leblogdespagnol.com/
- Official DELE and SIELE resources: guides, sample exams, past papers
- Preparation books for B2-level certification exams (DELE/SIELE)

Keywords: CEFR, B2, DELE, SIELE, argumentation, opinion, comprehension, expression, exam, mock exam

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ÉCOLE D'INGÉNIEURS

ISA BTP
FORMATION INGÉNIEUR

R 9-7 - Impacts of Environmental Regulation on Design - *Professional Contracts*

Timetable	
Semester	9
Term	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	4h30
Practical hours	6
Total hours	**10.5**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 – Designing structures and systems

Objectives

- To analyse the impact of environmental standards and regulations on design
- Present technical solutions to address environmental design challenges
- Take part in a 'climate forum'

Programme

- Choosing a topic
- Research into relevant regulations and standards
- Group work
- Producing a poster as a final output
- Oral presentation during a 'climate forum'-style exhibition

Key learning outcomes

- Ability to identify and explain relevant standards and regulations
- Ability to formulate a research question
- Defining the limitations, uncertainties or contradictions between regulations and technical constraints
- Ability to explain complex concepts in simple terms, defend one's choices and engage in dialogue with teachers and peers

Bibliography

- Regulatory documents

Keywords: Environmental regulations, standards, design, Climate Forum 539

R 9-8 – Natural resource management – Energy management – *Professional Contracts*

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
Lectures.....6 hours
Practical sessions.....3 hours
Total.....**9**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

- Materials technology
- Analysis of environmental issues (LCA, waste management)

Objectives

The aim of the course is to train students in the energy transition and the challenges of sustainable resource management at global and national levels.

- To identify and classify different resources according to their nature and renewability
- Analyse the geopolitical, economic and environmental issues surrounding resource management
- Propose appropriate strategies for sustainable management in different contexts
- Interpret the challenges associated with integrated water management
- Understand the production dynamics and the territorial and environmental constraints associated with the management of quarries and aggregates. Assess the potential and limitations of recycling and secondary aggregates
- Understand how nuclear energy works, and assess its benefits and limitations, taking into account issues relating to waste
- Understand the various techniques for generating energy from renewable resources (solar, wind, hydro, biomass, etc.)
- Identify and analyse the principles of *Enhanced Geothermal Systems* (EGS)

Syllabus

- Definition and classification of resources
- Resource management worldwide and in France: global challenges, disparities and prospects
- Case study: integrated water management
- Case study: Quarry and aggregate management
  - Production, consumption and the market in France
  - Regulatory, environmental and regional challenges: pollution, site conservation, sustainable development
- Energy resources:
  - Renewable energy (hydropower, solar, wind, biomass and geothermal)
  - Non-renewable energy sources (nuclear and fossil fuels)

Key learning points

- Distinguish and classify resources according to their nature, availability and renewability
- Assess possible strategies for sustainable management and evaluate their relevance in various contexts (global, national, local)
- Understand the water balance and its role in defining integrated water management
- Understand the mechanisms involved in aggregate production and identify the associated territorial, environmental and regulatory impacts
- Understand how nuclear energy works, taking into account issues of safety, sustainability and waste management
- Understand the processes involved in wind and geothermal energy production, their benefits and their social and environmental impacts

Bibliography

- *Integrated water resources management at the catchment level. Analytical techniques*, Berland, Jean-Marc, 2015, 10.51257/a-v1-w2150
- *Aggregates, Soils, Cements and Concrete*, Raymond Dupain, Jean-Claude Saint-Arroman, A. Capliez Collection
- *The Physics of Energy*, Jaffe, R. L., & Taylor, W., 2018, Cambridge: Cambridge University Press
- https://www.ecologie.gouv.fr/politiques-publiques/gestion-leau-france

Keywords: Management and sustainable development, Integrated water management, Quarry management, Energy transition, Fossil fuels, Nuclear energy, Renewable energy

R 9-9 – Technology 7: Seismic Design and Regulations – *Professional Contracts*

Timetable	
Semester	9
Term	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
Lectures	6 hours
Practical sessions	3 hours
Total	**9**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

- Resource R6-9 'RdM 8: Solid Dynamics – Kinetics'
- Resource R6-10 'Risk Management'
- Previous Technology courses

Syllabus

Lectures:

- Natural hazards and their effects on structures
- Seismic phenomena and effects: origin and characteristics of earthquakes, direct and induced effects of earthquakes
- Dynamic behaviour of structures during an earthquake: inertial forces, stiffness, dissipation
- Seismic design: appropriate architecture, structural systems
- Regulations: seismic hazard, structures with normal or special risk, categories of importance Tutorials:
- Application of Eurocode 8 and the Decree of 22 October 2010: plotting of elastic response spectra $S_e(T)$
- Principles for the design of structures according to different ductility classes (DCL, DCM, DCH), energy dissipation, design spectra $S_d(T)$ with behaviour coefficient q

Key learning points

- Seismic phenomena and effects
- Equilibrium of a structure under seismic actions A_{Ed} (forces Fi, Fr, Fd) and EC8 design principles (DCL, DCM, DCH)
- Regulations
- Plotting and interpreting a spectrum

Bibliography

- Website of the French Association for Earthquake Engineering: https://www.afps-seisme.org/
- NF EN 1998 + AN and Decree of 22 October 2010 and Amended Order of 25 October 2012
- *Seismic Design and Construction*, Eyrolles Publishing

Keywords: Risks, hazards, waves, magnitude, inertia, stiffness, dissipation, bracing, diaphragms, regulations, spectra, ductility

R 9-12 – Digital environment: data, connected devices, smart cities, smart grids – *Professional Contracts*

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial.....3 hours
Total.....**12**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

- General digital literacy (files, cloud storage, email, spreadsheets).
- Basic understanding of measurement and indicators (units, frequency, averages).
- Awareness of privacy (GDPR) and cybersecurity issues.

Objectives

Digital environments are transforming the urban, energy, industrial, construction and mobility sectors. To capitalise on these developments, it is necessary to integrate data, connected devices, networks and practical applications, whilst addressing security and governance issues.

This module aims to provide a practical understanding of this field through an introduction to the key concepts *of the Internet of Things, Smart Cities* and *Smart Grids*. The aim is as much to explain what these concepts entail as to outline the underlying technologies and the implementations that exist today.

Syllabus

- **Data**: Introduction to and understanding of fundamental concepts: variables, indicators, units, frequency, simple uncertainty (sources of error), representativeness of a dataset.
- **Connected objects & use cases**: concrete, cross-sector examples (construction, public spaces, housing, transport, energy): what they measure and what this enables.
- **Smart cities**: Presentation of typical case studies and underlying architectures: parking, lighting, air quality/noise, waste. Simple indicators (levels, trends, thresholds).
- **Energy & 'smart grids'**: An introduction to how consumption monitoring, local energy production and peak demand are tracked.
- **Quality, ethics and data protection**: Who collects **the data**? For what purpose? How long should it be retained ? Principles of restraint and basic security.

Key learning points

- A high-level understanding of how an information processing architecture works.
- Identification of relevant use cases for digital environments in the construction industry and Smart Cities.
- Knowledge of the stakeholders who may be involved in the data chain, from collection to utilisation.

Keywords: Data, Smart City, Smart Grid, Connected objects

R 9-13 – Public Building Regulations – Fire Safety – *Professional Contracts*

Timetable	
Term	9
Period	Sept. – Jan
Face-to-face teaching	

Assessment
Comprehensive continuous assessment

Duration	
CM	7.5 hours
Tutorials	4h30
Total	**12 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

General knowledge of building technology and regulations

Objectives

- To master the regulations relating to fire safety in buildings
- Be able to design projects that comply with safety and accessibility standards
- To understand the impact of regulations during the design phase

Syllabus

- Fire safety regulations: Building Code, decrees and regulations
- Classification of buildings: public access buildings, residential buildings, high-rise buildings
- Fire behaviour of materials, fire resistance of structures
- Fire compartmentation, smoke extraction, emergency exits

Key learning points

- Identifying the regulations applicable to a project
- Designing circulation routes and emergency exits in compliance with regulations
- Dimensioning fire safety systems

Bibliography

- *Building and Housing Code*, Articles R. 121-1 to R. 143-46
- *Fire Safety in Public Access Buildings*, Jean-Paul Koscielny, Le Moniteur, 2020

Keywords: Fire safety, public access buildings, regulations

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R 9-4 - Management 6: Risk management and psychosocial benefits

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face teaching

Duration
Tutorial .....7.5 hours
Total **7h30**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 – Manage a construction organisation

Prerequisites

- Previous management modules

Objectives

- To understand communication mechanisms and interpersonal challenges
- Develop a managerial approach suited to the professional environment
- To be able to identify and manage existing psychosocial risks
- To be able to identify and consolidate existing psychosocial benefits
- To integrate the concept of professional ethics into day-to-day practice

Programme

- Communication: knowing how to express yourself and being able to listen
- Professional positioning and the dynamics of identity and otherness
- Management: providing support, empowering and recognising staff
- Psychosocial risks (PSRs):
  - The employer's responsibilities
  - The Single Document: analysis and prevention of technical risks
  - Work-related distress, bore-out and burn-out
- Psychosocial benefits (PSBs):
  - Safe support networks
  - Well-being at work
  - Identity and social development
- Harmonising and balancing psychosocial risks and psychosocial benefits
- Respecting, upholding and passing on appropriate professional ethics 547

Key learning points

- Mastering professional communication techniques
- Adopting an appropriate managerial approach
- Identifying and preventing psychosocial risks
- Develop and maintain psychosocial well-being
- Integrating professional ethics into managerial practices

Bibliography

- To be completed

Keywords: Management, psychosocial risks, psychosocial benefits, communication, professional ethics, well-being at work

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R 9-11 - Organisation 13: Financial management of the construction site

Timetable
Term 9
Period .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....7.5 hours
Tutorials 4h30
Total.....**12 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

- Knowledge of the profit and loss account and cost analysis
- Knowledge of how to calculate the direct costs of a construction site, through the calculation of direct costs for individual works
- Knowledge of standard pricing methods in the building and civil engineering sectors

Objectives

A company's profitability depends on the profitability of its construction projects; achieving this requires financial, technical and organisational skills. To realise their full potential within the company, engineers must be convinced of the absolute necessity of implementing procedures for calculating and controlling costs, and require appropriate training.

- To implement a cost analysis system enabling a rational calculation of selling prices, tailored to the specific characteristics of the company and its construction sites
- Establish procedures and documentation to enable financial monitoring of construction projects, based on an understanding of the cash flow implications involved
- Calculate and analyse the profitability of a project and derive lessons and various ratios from this, both during the course of the project and upon its completion

Programme

- The need to forecast costs prior to any pricing process
- Analysis of projected costs into fixed and variable costs, and into direct and indirect costs
- The allocation of costs to cost centres
- Analysis of the composition of a structure in terms of direct costs
- The choice of unit of measurement for the components of direct loads
- The allocation, calculation and management of direct site costs 549

- The issue of choosing methods for allocating indirect costs and its impact on full cost
- Presenting the price of a project according to the specific requirements of the client and the project; the strategic aspects of price setting
- The challenges of site cash flow forecasting
- Cash flow forecasts for construction projects
- The challenges of profitability monitoring during and at the end of the project
- Implementing procedures for monitoring direct project costs
- Identifying any potential cost overruns during the project
- The profitability analysis and identification of relevant project ratios.

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ISA BTP
FORMATION INGÉNIEUR

FISE 9-5 - English S9

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face in person

Assessment
Continuous assessment

Duration
Practical sessions.....24 hours
Total.....24 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

R 6-3 – English 6

Objectives

- To improve professional and technical English
- To prepare students for a career in an international environment
- Achieve a B2/C1 level on the CEFR

Syllabus

- Advanced technical English for civil engineering
- Communication in an international professional context
- Writing technical reports and documents
- Negotiation and meetings in English
- Oral presentations on complex projects
- Preparation for the TOEIC or equivalent
- International case studies
- Business English and professional correspondence

Key learning outcomes

- Communicating confidently in a professional context
- Writing professional technical documents
- Negotiating and presenting arguments in English
- Presenting and defending a technical

project 551

Bibliography

- *English for Construction*, D. Glendinning, Oxford University Press
- *Professional English in Use – Engineering*, M. Ibbotson, Cambridge
- *Business English*, I. MacKenzie, Cambridge

Keywords: Professional English, international communication, technical, TOEIC, business English

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ISA BTP
FORMATION INGÉNIEUR

FISE 9-6 - Spanish S9

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face in person

Assessment
Continuous assessment

Duration
Tutorial .....9.00 pm
Total.....21 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

Spanish ISA 1, 2 and 3

Objectives

In Semester 5, students must acquire the skills necessary to aim for level B2 in international certification tests (such as DELE or SIELE).

Level B2 certifies that the learner can understand the main points of concrete or abstract topics in a complex text, including a technical discussion within their field of specialisation. They can communicate with such spontaneity and fluency that interaction with a native speaker is natural and effortless for both parties. They can express themselves clearly and in detail on a wide range of topics, put forward a reasoned opinion, and outline the advantages and disadvantages of different options.

In Semester 6, teaching focuses on preparing for official Spanish language qualifications (DELE, SIELE). The aim is to consolidate and expand B2-level skills, enabling students to:

- To sit international exams in the best possible conditions
- To ensure sufficient linguistic fluency to function effectively in a Spanish-speaking academic or professional context

The target is B2 level: in-depth comprehension; fluent and nuanced oral and written expression; and the ability to interact without difficulty with native speakers and to defend a well-argued point of view.

Syllabus

- Familiarisation with the DELE and SIELE exams: structure, duration, assessment criteria
- Systematic practice in the four assessed skills: listening comprehension, reading comprehension, written expression, and oral expression and interaction
- Grammar and vocabulary consolidation to achieve the accuracy and correctness expected at B2 level
- Development of specific strategies for time management, understanding long texts and producing coherent and well-argued written work
- Mock exams under real exam conditions 553

Key learning outcomes

- Understanding complex texts, identifying main ideas and relevant details
- Producing clear, structured and well-argued written work on a variety of topics (society, culture, the world of work, current affairs)
- Interacting spontaneously and confidently in spoken English, expressing and defending one's opinions with nuance
- Using an appropriate register (formal/informal) depending on the situation
- Develop strategies for self-correction and managing exam-related stress

Bibliography

- https://eduscol.education.fr/1971/cadre-europeen-commun-de-reference-pour-les-langues-cecrl
- https://leblogdespagnol.com/
- Official DELE and SIELE resources: guides, sample exams, past papers
- Preparation books for B2-level certification exams (DELE/SIELE)

Keywords: CEFR, B2, DELE, SIELE, argumentation, opinion, comprehension, expression, exam, mock exam

Institut Supérieur Aquitain
ÉCOLE D'INGÉNIEURS

ISA BTP
FORMATION INGÉNIEUR

FISE 9-10 - Organisation 12: Quality management, application to the construction site

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....6 hours
Tutorial .....7.5 hours
Total **1.30**
Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

Work experience

Objectives

- Gaining a comprehensive overview of the organisation
- Understanding what a quality management system is
- Be familiar with and use tools for analysing the context in which the organisation/project/site operates
- Understand and implement tools for steering and monitoring the company, project or construction site
- Understand the skills and personal qualities required to implement processes related to the role of a civil engineering manager
- Understand the importance of traceability at the various stages of a construction site or project
- Integrate into and develop within a company that has implemented a management system, whether focused on Quality, the Environment and/or Health and Safety
- Draw up a Quality Action Plan (PAQ) applicable to the various phases of a construction site
- Implement procedures for evaluating the quality management system on a construction site
- Lead a quality management initiative on site

Programme

- **Quality is nothing new:**
  - History and standards
  - Vocabulary, definitions and philosophy

- **Quality isn't complicated:**
  - The principles of the quality management system
- **Quality is effective:**
  - Quality management system: steering the performance of a company / a project / a construction site
  - Quality tools: PDCA / Problem-solving / Risk analysis / Audits, etc.
  - Continuous improvement
- **Quality is documented and traceable:**
  - Document management
  - Procedures
  - Monitoring of equipment and staff skills
  - The PAQ

Bibliography

- *Construction Site*, Vuillerme and Richaud, published by NATHAN
- *Construction Site Handbook, by* Didier, Girard, Le Brazidec, Nataf, Pralat and Thiesset, published by NATHAN-AFNOR
- *Managing Your Construction Site*, J. Armand and Y. Raffestin, published by LE MONITEUR
- Magazines: *Le Moniteur, TRAVAUX* and *CHANTIERS de France*

Keywords: Quality, ISO 9001, PAQ, control, certification, continuous improvement, management

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ISA BTP
FORMATION INGÉNIEUR

FISE 9-10 - Organisation 12: Quality management, application to the construction site

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face in person

Duration
Lectures.....6 hours
Tutorial .....7.5 hours
Total .....1.30 pm

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

Work experience

Objectives

- Gain a comprehensive overview of the organisation
- To understand what a quality management system is
- To understand and use tools for analysing the context in which the organisation/project/site operates
- To understand and implement tools for managing and monitoring one's organisation, project or construction site
- Understand the skills and personal qualities required to carry out processes related to the role of a civil engineering manager
- Understand the importance of traceability at the various stages of a construction site or project
- Integrate into and develop within a company that has implemented a management system, whether focused on Quality, the Environment and/or Health and Safety
- Draw up a Quality Action Plan (PAQ) applicable to the various phases of a construction site
- Implement procedures for evaluating the quality management system on a construction site
- Lead a quality initiative on site

Programme

- **Quality is nothing new:**
  - History and standards

557

  - Vocabulary, definitions and philosophy

- **Quality isn't complicated:**
  - The principles of the quality management system
- **Quality means efficiency:**
  - Quality management system: steering the performance of a company / a project / a construction site
  - Quality tools: PDCA / Problem-solving / Risk analysis / Audits, etc.
  - Continuous improvement
- **Quality is documented and traceable:**
  - Document management
  - Procedures
  - Monitoring of equipment and staff skills
  - The PAQ

Bibliography

- *Construction Site*, Vuillerme and Richaud, published by NATHAN
- *Construction Site Handbook, by* Didier, Girard, Le Brazidec, Nataf, Pralat and Thiesset, published by NATHAN-AFNOR
- *Managing Your Construction Site*, J. Armand and Y. Raffestin, published by LE MONITEUR
- *The French* magazines **Le Moniteur**, **TRAVAUX** and **CHANTIERS**

Keywords: Quality, ISO 9001, PAQ, inspection, certification, continuous improvement, management

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FORMATION INGÉNIEUR

FISEA 9-5 - English S9

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
Practical sessions	24 hours
Total	**24 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

R 6-3 – English 6

Objectives

- To improve professional and technical English
- Prepare for a career in an international context
- Achieve a B2/C1 level on the CEFR

Syllabus

- Advanced technical English for civil engineering
- Communication in an international professional context
- Writing technical reports and documents
- Negotiations and meetings in English
- Oral presentations on complex projects
- Preparation for the TOEIC or equivalent
- International case studies
- Business English and professional correspondence

Key learning outcomes

- Communicating confidently in a professional context
- Writing professional technical documents
- Negotiating and presenting arguments in English
- Presenting and defending a technical

project 559

Bibliography

- *English for Construction*, D. Glendinning, Oxford University Press
- *Professional English in Use – Engineering*, M. Ibbotson, Cambridge
- *Business English*, I. MacKenzie, Cambridge

Keywords: Professional English, international communication, technical, TOEIC, business English

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FISEA 9-6 - Spanish S9

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
Tutorial .....9.00 pm
Total.....21 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

Spanish ISA 1, 2 and 3

Objectives

In Semester 5, students must acquire the skills necessary to aim for level B2 in international certification exams (such as DELE or SIELE).

Level B2 certifies that the learner can understand the main points of concrete or abstract topics in a complex text, including a technical discussion within their field of specialisation. They can communicate with such spontaneity and fluency that interaction with a native speaker is natural and effortless for both parties. They can express themselves clearly and in detail on a wide range of topics, put forward a reasoned opinion, and outline the advantages and disadvantages of different options.

In Semester 6, teaching focuses on preparing for official Spanish language qualifications (DELE, SIELE). The aim is to consolidate and expand B2-level skills, enabling students to:

- To sit international exams in the best possible conditions
- To ensure sufficient linguistic fluency to function effectively in a Spanish-speaking academic or professional context

The target is B2 level: in-depth comprehension; fluent and nuanced oral and written expression; and the ability to interact without difficulty with native speakers and to defend a well-argued point of view.

Syllabus

- Familiarisation with the DELE and SIELE exams: structure, duration, assessment criteria
- Systematic practice in the four assessed skills: listening comprehension, reading comprehension, written expression, and oral expression and interaction
- Grammar and vocabulary consolidation to achieve the accuracy and correctness expected at B2 level
- Development of specific strategies for time management, understanding lengthy texts and producing coherent, well-argued written work
- Mock exams under real exam conditions 561

Key learning outcomes

- Understanding complex texts, identifying main ideas and relevant details
- Producing clear, structured and well-argued written work on a variety of topics (society, culture, the world of work, current affairs)
- Interacting spontaneously and confidently in spoken English, expressing and defending one's opinions with nuance
- Using an appropriate register (formal/informal) depending on the situation
- Develop strategies for self-correction and managing exam-related stress

Bibliography

- https://eduscol.education.fr/1971/cadre-europeen-commun-de-reference-pour-les-langues-cecrl
- https://leblogdespagnol.com/
- Official DELE and SIELE resources: guides, sample exams, past papers
- Preparation books for B2-level certification exams (DELE/SIELE)

Keywords: CEFR, B2, DELE, SIELE, argumentation, opinion, comprehension, expression, exam, mock exam

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FISEA 9-10 - Organisation 12: Quality management, application to the construction site

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
Lectures	6 hours
Tutorial	4½ hours
Total	**10.5**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

Work experience

Objectives

- Gain a comprehensive overview of the business
- To understand the fundamentals of quality management
- To understand the key aspects of the 'ISO 9001:2000' quality standard and the limitations of such a rational system
- To understand the skills and personal qualities required to implement processes related to the role of a civil engineering technician
- To integrate into and progress within a company that has implemented a management system, whether focused on Quality, the Environment and/or Health and Safety
- To draft a Quality Action Plan (PAQ) applicable to the various phases of a construction site
- Implement procedures for evaluating the quality management system on a construction site
- Lead a quality management initiative on the construction site

Programme

- Introduction to quality management: what constitutes a high-quality project, what is quality, the principles of quality management, description of a quality management system
- The quality approach: why adopt such an approach, applicable standards (similarities between ISO 9001, ISO 14001 (environment) and ISO 18011 (safety)), documentation, the project manager, total duration of the process, estimated cost of certification

- The international standard ISO 9001:2000: general overview, certification requirements, comparison with the EFQM framework
- The role of the site manager: their place within the system, their role, methods, tools and contribution to the improvement process
- The limitations of such a rational system: reflection/debate on the day-to-day reality of such a management system, feasibility, constraints, and the perceived level of involvement depending on individual status
- Integration of a company's quality approach into the operational procedures for carrying out works
- Those involved in quality control, checkpoints, critical points,
- Case study and development of procedures integrated into the Quality Assurance Plan

Bibliography

- *Construction Site*, Vuillerme and Richaud, published by NATHAN
- *Construction Site Handbook, by* Didier, Girard, Le Brazidec, Nataf, Pralat and Thiesset, published by NATHAN-AFNOR
- *Managing Your Construction Site*, J. Armand and Y. Raffestin, published by LE MONITEUR
- *The French* magazines **Le Moniteur**, **TRAVAUX** and **CHANTIERS**

Keywords: Quality, ISO 9001, PAQ, inspection, certification, continuous improvement, management

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FISEA 9-14 - Management 7: Business start-ups and takeovers

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	9 hours
Total	**9 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 - Manage a construction organisation

Prerequisites

- Previous management modules

Objectives

- To understand the concept of a business beyond theoretical knowledge
- Exploring a new path to personal fulfilment and creating value in your future career: setting up or taking over a business in the construction industry
- Developing your own approach to setting up or taking over a business
- Becoming an entrepreneur, and therefore taking on a commitment
- Be independent, responsible, a team player and tenacious

Programme

- Raising students' awareness of how to develop and present a business model. Basic concepts relating to business plans will be covered
- Training-focused awareness-raising covering aspects of valuation, innovation, industrial property rights, market identification, and accounting and legal-financial matters
- Students will have covered the essential elements needed to understand what a business plan is
- The basic mechanisms of strategy, management and steering a business
- The path of the business buyer: business analysis, takeover plan, negotiation, financing, change management
- Innovation in the broadest sense of the term

Method:

- Half-day seminars
- Initiatives by ISA BTP alumni will be highlighted during these seminars
- The construction sector will be highlighted as soon as possible to maintain a link with their core

Key learning points

- Developing a business model
- Drawing up a business plan
- Understanding the mechanisms of business strategy, management and governance
- Analysing the legal, financial and accounting aspects of setting up or taking over a business
- Identifying market and innovation opportunities

Keywords: Business start-up, business takeover, entrepreneurship, business model, business plan, innovation, construction

Note: Students planning to start or take over a business may apply for National Student Entrepreneur Status to benefit from personalised support. In particular, they may use the 'Conducting an R&D project' module in Semester 8 and the 'Synthesis project' module in Semester 10 (begun in Semester 9) to work on their entrepreneurial project, or even undertake a work placement.

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FISEA 9-15 – Management 4: Innovation and Development – Agility in Engineering

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
Lecture	4h30
Tutorial hours	9
Tutorial hours	0
Total	**1.30**

Targeted skill(s)
C4 – Managing a construction organisation

Prerequisites

- R6-1 - Management 2: HRM
- R4-1 - Management 1

Objectives

- To understand the challenges and dynamics of innovation in the construction industry and other sectors
- Master agile methods and their application
- Develop the mindset of an innovative and adaptable engineer
- To understand the barriers and drivers associated with an innovative mindset

Programme

- Innovation in the construction industry: types, processes, barriers
- Innovation management: creativity, R&D, open innovation
- Agile methods: Scrum, Kanban, Lean and others
- Organisational agility and agile project management
- Design thinking and a user-centred approach
- Digital transformation and new ways of working
- Change management and managing uncertainty 567

Key takeaways

- Managing a project using agile methods
- Facilitating creativity and innovation sessions
- Adapting your management style to changing contexts
- Integrating innovation into professional practices

Bibliography

- *Innovation Management*, F. Le Roy, Dunod
- *Scrum*, J. Sutherland, Dunod
- *Design Thinking*, T. Brown, Eyrolles

Keywords: Innovation, agility, agile methods, design thinking, digital transformation, creativity

FISEA 9-16 – Numerical Optimisation

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
Lecture	4h30
Tutorial	4h30
Tutorial hours	6
Total hours	**15**

Targeted skill(s)
C3 – Designing structures and systems

Prerequisites

- Concepts relating to numerical sequences
- Basic concepts of computer programming
- Python

Objectives

- To be able to programme and evaluate the main methods of numerical optimisation

Syllabus

- Generalised Newton's method
- Gradient descent methods

Key learning outcomes

- Master the programming of the main numerical optimisation methods
- Evaluate and compare the performance of different methods

Bibliography

- To be completed

Keywords: Numerical optimisation, Newton's method, gradient descent methods, Python

FISEA 9-17 – Numerical methods – Partial differential equations

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face in person

Assessment
Continuous assessment

Duration
CM.....10.30 am
Tutorial 12.00

Targeted skill(s)
C3 – Designing structures and systems

Prerequisites

- Basic computer programming concepts
- Python

Objectives

- To understand the transition from a physical problem to a partial differential equation and the physical meaning of this equation
- To be familiar with the different types of partial differential equations (PDEs) and be able to solve a simple problem numerically using the finite difference method
- To be aware of numerical issues (stability, consistency, etc.) associated with PDEs
- To be familiar with certain methods for the exact solution of simple PDEs

Syllabus

- Basics of the Python language
- Partial differential equations – classification
- Relationship with physics
- Numerical solution methods and associated problems
- Exact solution methods
- Project

Key learning outcomes

- Solve a simple PDE problem numerically using finite differences
- Analysing numerical problems relating to stability and consistency
- Apply exact solution methods to simple PDEs

Bibliography

- *Numerical Methods for Engineers and Scientists*, J. D. Hoffman, CRC Press, 2001

Keywords: PDEs, partial differential equations, finite differences, numerical methods, Python

FISEA 9-18 – Organisation 10: Public and private works contracts

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face in person	

Assessment
Continuous assessment

Duration	
Lectures	6 hours
Practical sessions	6 hours
Total	**12**

Targeted skill(s)
C1 – Analysing a construction project within its context
C4 – Managing a construction organisation

Prerequisites

- R6-2 - Management 5: Construction and insurance law
- R4-3 - Organisation 4: Organisational context of the construction industry

Objectives

- To gain a thorough understanding of the different types of construction contracts
- To understand the specific features of public and private contracts
- Be able to analyse a tender dossier

Syllabus

- Public procurement: legal framework, Public Procurement Code
- Procurement procedures: calls for tenders, negotiated procedures
- Private contracts: CCMI, works contracts
- Contractual documents: CCAP, CCTP, DPGF, plans
- General Administrative Terms and Conditions (CCAG)
- Analysis of contract documents and tender documentation
- Preparation of a tender and response to a call for tenders
- Award criteria and analysis of tenders

Key learning points

- Analysing a tender documentation pack
- Identifying contractual obligations
- Drafting a response to a call for tenders
- Distinguish between public and private sector contracts

Bibliography

- *Public Procurement Code*, Dalloz
- *Works Contracts*, J.-P. Monceau, Le Moniteur
- *Practical Guide to Public Procurement*, CCAG Travaux

Keywords: Works contracts, public procurement, calls for tenders, CCAG, Public Procurement Code

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FORMATION INGÉNIEUR

FISEA 9-19 - Organisation 11: Contractual management of contracts during the EXE phase

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face teaching

Duration
CM 6am
Tutorial .....4.5 hours
Total .....10.5 hours

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

Resource R 8-10 'Organisation 10: public and private works contracts'

Objectives

- Carry out contractual management of the contract: stakeholders, technical execution, financial execution, possible penalties, contract closure
- Identify the company's commitments: services, price, deadlines, guarantees

Syllabus

- **Course**:
  - Launching a project: stages, administrative and technical arrangements
  - Identification and roles of the various parties involved in a contract
  - Monitoring the construction site with the project manager: site orders, technical specifications, progress reports, technical specifications, amendments, price variations, environmental and social clauses
  - Dispute resolution, imposition of penalties
  - Contract closure: handover, guarantees, final accounts, dispute resolution
- **Examples of practical exercises**:
  - Group presentations on a topic relating to site supervision / Case studies
  - Price updates and revisions
  - Written correspondence in the context of a contract
  - Identifying key concepts relating to contract management in the tender documents

Key learning points

- Understanding the various parties involved in a contract
- Understanding and being able to manage the technical, financial and administrative aspects of a construction project from start to finish

Keywords: Management, construction site, responsibilities

BCR 9-1 – Structural Dynamics 2

Timetable	
Semester	9
Term	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorial	7h30
Total	**15 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Designing structures and systems
C4 - Manage a construction organisation

Prerequisites

- Resource BCR 8-2 or GCM 8-1 'Structural Dynamics 1'
- 1D Solid Dynamics (previous course)
- Knowledge of linear algebra (eigenvalues and eigenvectors, matrices)
- Basics of matrix calculations applied to mechanics
- Basic understanding of seismic regulations (Eurocodes)

Objectives

- To model a vibrating system with n degrees of freedom (n DDL / MDOF – Multi Degrees of Freedom)
- Construct the mass and stiffness matrices of a mechanical or structural system
- Determine the natural modes and natural frequencies of a system
- Analyse the dynamic response using modal superposition
- Apply these methods to calculate seismic effects on simple structures

Syllabus

- Matrix formulation of the equation of motion with n DDLs
- Natural modes and natural frequencies (orthogonality, normalisation)
- Free and forced response with proportional damping
- Modal superposition and the principle of decomposition
- Application to seismic dynamics: simplified calculation of seismic forces

Key learning outcomes

- Ability to formulate and solve a dynamic system with multiple DDLs
- To interpret the natural modes and their influence on the response in physical terms
- Be able to apply modal analysis to estimate seismic forces
- Linking mathematical concepts (eigenvalues, eigenvectors) to a mechanical interpretation

Bibliography

- *Practical Seismic Design: A Guide to the Application of Eurocode 8*, V. Davidovici, D. Corvez, A. Capra, S. Ghavamian, V. Le Corvec, C. Saintjean, AFNOR, 2013
- *Seismic Risk and the Built Environment: Reducing Vulnerability: Knowledge and Expertise*, Alain Billard, AFNOR, 2014
- *Earthquakes and Buildings – Structural Analysis*, André Plumier, Techniques de l'Ingénieur, 2014
- *Taking seismic risk into account for existing bridges*, Denis Davi, Techniques de l'Ingénieur, 2014

Keywords: Dynamics, earthquake, design, multiple degrees of freedom, natural modes

BCR 9-2 – Structural Design 3: Masonry

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
Lectures.....6 hours
Practical sessions.....6 hours
Total.....**12**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Previous technology modules
- Previous materials modules
- Previous RDM modules

Objectives

- To understand the properties of masonry: materials, areas of application, construction
- To be able to design a simple masonry structure
- To understand the main structural arrangements of a masonry structure

Syllabus

- Overview of general rules and structural provisions in accordance with DTU 20.1 and Eurocode 6
- Design of a masonry structure
- Dimensioning a masonry structure: bricks or lightweight masonry blocks

Key learning points

- Understand the main rules and construction requirements for a masonry structure
- Be able to design a simple masonry structure
- Be able to check the dimensions of a simple masonry structure

Bibliography

- NF EN 1996: Eurocode 6 – Design of masonry structures
- *Structural masonry: technical essentials*, French Building Federation, Union of Masonry and Structural Work, 2011
- *Masonry for Detached Houses: Terracotta or Concrete Blocks*, Benoit Mac-Mahon, Le Moniteur, 2023
- *Structural work: shallow foundations and floor slabs, small-element masonry, floors and thermal breaks*, Bernard Blache, Ménad Chenaf, Patrick Delmotte, Angel Junes, CSTB, 2022

Keywords: Masonry, structural arrangements, dimensioning

BCR 9-3 – Structural Design 4: Composite Structures

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....7.5 hours
Tutorial 7h30
Total.....15 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- RdM resources
- Steel construction
- Timber construction
- Reinforced concrete construction

Objectives

To analyse, dimension and justify composite steel–concrete and timber–concrete structures in simple configurations, applying the relevant mechanical principles, calculation methods and standard requirements.

Syllabus

To design components in composite timber–concrete and steel–concrete structures.

Key learning outcomes

- **Identify** the main composite construction systems (steel–concrete composite beams, composite slabs, timber–concrete floors, etc.) and their areas of application
- **Understand** the overall behaviour of composite structures, in particular the role of the connection between materials and the effects of interaction (shear, redistribution of forces)
- **Apply** design methods for composite structures in accordance with the Eurocodes (EC4 for steel–concrete, EC5 for timber–concrete), taking into account ultimate and serviceability limit states

Bibliography

- A Structural Perspective on Composite Structures – Véronique Klimine
- Eurocode 5 – Application to composite timber/concrete bridges with glued-laminated beams – Cerema
- Steel–concrete composite structures: Design and calculation of composite beams for standard building floors – CSTB

Keywords: Composite – Timber – Metal – Concrete – Steel

BCR 9-4 – Structural Design 5: Complex Frameworks

Calendar
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial.....9 hours
Total.....**18h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- Concrete and EC2 modules: ISA 2 and 3
- Steel course and EC3: ISA 2 and 3
- Timber course and EC5: ISA 2 and 3
- Previous RdM courses

Objectives

- To understand the mechanical behaviour of curved structures
- To explain the possibilities offered by curved structures
- To identify the construction methods associated with curved structures, from the definition of the form through to its execution
- Design a double-curved structure
- Propose appropriate procedures for the (safe) construction of the load-bearing structure during the building phase

Programme

- Introduction to double-curved structures: a review of second-order effects (general case, buckling (Euler's critical load)), an introduction to the stiffness of shells, and design principles
- Introduction to rigid gridshells: overview of recent structures with non-standard geometries and presentation of existing construction techniques and associated design methods. Introduction to structures using ETFE (Ethylene Tetrafluoroethylene)
- Introduction to fabric structures: An overview of the key principles of textile architecture and its distinctive features, exploring the interplay between form, strength, structure, materials and technology
- Design project for a double-curved structure: structural design (load-bearing elements, joints, etc.), structural analysis (Cast3m), 3D printing of the structure

Key learning outcomes

- Understand the fundamental principles of the mechanical behaviour of curved structures
- Understand the main types of gridshell structures and their construction methods

Bibliography

- *Shells and Membranes: Foundations of the Non-linear Approach*, Anh Le Van, Ellipses, 2015
- *Analysis of Structures and Continuous Media: Shells*, François Frey, Marc-André Studer, Maurice Fiaux, Presses polytechniques et universitaires romandes, 2003
- *Structural optimisation of gridshells*, L. Bouhaya, PhD thesis, University of Paris-Est, 2010
- *Form-finding for Grid Shells*, L. Bouhaya, O. Baverel, C. Douthe, J.F. Caron, French Congress of Mechanics, 2009

Keywords: Design, curved structure, textile, gridshell

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ÉCOLE D'INGÉNIEURS

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BCR 9-5 – Technology of historic buildings 2 (timber, brick, steel)

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face in person

Assessment
Continuous assessment

Duration
Lectures.....6 hours
Practical sessions.....6 hours
Total.....**12**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 – Managing a construction organisation

Prerequisites

- Previous technology modules
- Previous modules on materials

Objectives

- To understand the construction techniques used in historic structures made of timber, steel, brick or concrete
- To analyse a historic structure made of timber, steel, brick or concrete and identify the various observable defects
- Propose repair solutions for historic structures made of timber, steel, brick or concrete

Syllabus

- Half-timbered buildings
  - Composition of half-timbered structures
  - Defects: structural problems, fungal or insect damage, damp
  - Repair techniques: reinforcing or replacing timber components, treating infill materials
- Historic steel-framed buildings (iron-framed)
  - Structure of iron-framed buildings
  - Filling elements
  - Problems and repairs
- Brick framework

  - Manufacture and laying of bricks
  - Specific defects: efflorescence, calcite deposits, saltpetre
  - Maintenance of brick walls
- Concrete
  - Main defects in concrete structures
  - Design and repair solutions

Key lessons learnt

- Identifying construction techniques used in historic structures
- Diagnosing common defects in historic structures
- Proposing appropriate repair solutions

Bibliography

- *Half-timbered buildings*, Techniques for improving existing housing, EDF Habitat
- *Brick construction*, Techniques for improving existing housing, EDF Habitat
- Compendium of fact sheets on building defects, Agence Qualité Construction
- *Maintenance, Renovation and Refurbishment of Buildings*, Le Moniteur

Keywords: Timber-framed, steel-framed, brick-built, construction methods, defects, repairs

BCR 9-6 – Organisation of works 2 (occupied site, restricted site, etc.)

Timetable
Term 9
Period .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....7.5 hours
Tutorial 7h30
Total.....15 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

The course handout for this resource is in English, but the course is largely bilingual (French-English) in order to acquire technical vocabulary related to prestressing in both languages.

The course handout for this resource is in English, but the course is largely bilingual (French-English) in order to acquire technical vocabulary related to prestressing in both languages.

Prerequisites

- Strength of materials, theory of beams: isostatic structures, concepts of strains and stresses

Objectives

- Describe the principles of prestressing: the effect of applying a compressive force to connected elements; how a compressive force eliminates tension in a beam; advantages compared with reinforced concrete
- Distinguish between the different types of rules in Eurocode 2
- Calculate the loss of stress
- Design and troubleshoot a section of prestressed concrete with regard to normal stresses to the Serviceability Limit State (SLS)
- Describe the principles of design and troubleshoot a section of prestressed concrete with regard to normal stresses to the Ultimate Limit State (ULS)

Programme

- General principles, operating principles, methods of application, examples of prestressing
- Technological aspects of prestressing (pre-tensioning, precast concrete structural systems, post-tensioning)
- Regulatory aspects (Eurocode 2): safety principle, material properties (concrete and steel)
- Determination of the probable tension in the prestressing cables: evaluation of stress losses

- Bending of isostatic beams: design at the Serviceability Limit State (SLS) under normal stresses
- Bending of isostatic beams: design justifications at the Ultimate Limit State (ULS) under normal stresses
- Resistance of prestressed concrete to shear force: justifications and design under tangential loads

Key learning points

- Determine the critical phases in the life of a prestressed isostatic structure and specify the associated SLS combinations
- Check a prestressed isostatic structure against normal stresses using the SLS

Bibliography

- NF EN 1992: Eurocode 2
- *Prestressed Concrete at Limit States*, H. Thonier, 2nd edition, ENPC Press
- *Prestressing*, R. Chaussin, A. Fuentes, R. Lacroix, J. Perchat, ENPC Press
- *Properties of Reinforced and Prestressed Concrete*, edited by R. Lacroix and J.L. Cement, Lavoisier Hermès, 2002
- *Applications of Eurocode 2: Design of Concrete Buildings*, edited by J.A. Galgaro and J. Cortade, 2nd edition, ENPC Press, 2008
- *Design of prestressed concrete members using adherent wires*, P. Passeman, C. Vinot, CSTB, 2010
- *Prestressed Concrete under the Eurocodes*, P. Le Delliou, ENTPE, 2003
- *Eurocode 2: Application to Concrete Road Bridges – Methodological Guide*, Bui, Ngoc-Vu, SETRA, 2008
- Online: www.ba-cortex.com

Keywords: Pre-stressing, ULS calculation

BCR 9-7 – Building Services and Equipment

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face in person

Assessment
Continuous assessment

Duration
CM.....10.30 am
Tutorial 11.00

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Environmental approaches in construction
- Thermal regulations
- Piping and heating

Objectives

- Design a ventilation system: air exchange and cooling
- Understand the different types of heat generation
- Describe and size heating and domestic hot water systems
- Carry out an energy consumption assessment for the building (heating and electricity)
- Be able to propose the most suitable heating system for a building
- Check that the planned heating installation meets the relevant requirements (RE2020 regulations, BBC environmental labels, etc.)

Syllabus

- General principles of ventilation systems: natural and mechanical
- Design of natural and forced ventilation systems: air exchange and cooling
- Schematic diagrams of installation layouts for a detached house
- Schematic diagrams of installations for commercial and multi-occupancy buildings
- Boiler room components: operation and safety

- Pumps: selection and sizing
- EDF tariffs: choice of contracts
- Domestic hot water: in-depth analysis, control and selection of suitable systems
- Renewable energy, solar panels The focus

will be consistently on:

- Sustainable development and energy savings
- Understanding of systems
- Project sizing
- Design and implementation
- Relationship with structural and concrete plans, etc.

The course is complemented by a site visit. The focus will be on practical aspects (technical handbook, reading plans, supplier documentation). This module will tie in with the dynamic thermal simulation module. It will be explored in greater depth during the end-of-year project.

Key learning outcomes

- Be able to design a simple ventilation system
- Understand the main heat generation systems (heating and domestic hot water)
- Be able to analyse the installation in a small building in relation to regulatory requirements and low-energy building standards
- Be able to make some suggestions for improving a simple existing installation

Bibliography

- *Mémotech Génie Énergétique*, Pascal Dal Zotto, Jean-Marie Larre, Alain Merlet, Lucien Picau, Casteilla, 2014
- Supplier documents (FINIMETAL radiators, VAILLANT boilers, etc.)
- *Génie climatique*, H. Recknagel, E. Sprenger, Dunod, 2007
- *The Handbook of Control and Technical Management*, R. Cyssau, PYC ed., 2000
- http://www.techniques-ingenieur.com

Keywords: Networks, heating, domestic hot water, consumption analysis

BCR 9-8 – Comfort Analysis: Acoustics, Lighting, Thermo-Hydraulic Analysis

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Duration	
CM	18h
Tutorial	21h
Total hours	**39**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- Previous technology modules
- Previous materials modules
- Physics modules
- Dynamic Thermal Simulation Module

Objectives

- To understand the fundamental principles of comfort
- To be able to analyse the comfort of existing spaces using the laws of physics and physiology
- To be able to propose solutions

Syllabus

- General principles of comfort
- Acoustics
  - Sound and its characteristics
  - How the ear perceives sound
  - Noise measurements
  - Acoustic correction and sound insulation
  - Acoustic characteristics of products
  - Partition walls
- Lighting

  - Characteristics of light and photometric quantities
  - Artificial lighting
  - Natural lighting
  - Visual comfort
  - Designing indoor lighting
  - Determining street lighting
- Thermohygric comfort
  - Hygrothermal comfort parameters
  - Hydric comfort parameters
- Overall comfort assessment: comprehensive analysis, case studies

Key learning points

- Understanding the fundamental principles of comfort
- Be able to carry out a comprehensive analysis of spaces in terms of comfort
- Be able to suggest some areas for improvement to address comfort issues in spaces

Bibliography

- *Energy Efficiency in Buildings: Optimising Energy Performance, Comfort and Value in Commercial and Industrial Buildings*, Richard Franck, Guy Jover, Franck Hovorka, Eyrolles, 2014
- *Smart Buildings and Energy Efficiency – Optimisation, New Technologies and BIM*, Karim Beddiar and Jean Lemale, Dunod, 2016
- *Building Thermal Engineering: From Thermal Comfort to the Selection of Heating and Air-Conditioning Equipment*, Jedidi, Malek, Benjeddou, Omrane, Dunod, 2016
- *Building 4.0 – Challenges, Concepts and Technologies*, Karim Beddiar, Techniques de l'Ingénieur, 2020
- *Modelling Comfort in Open and Semi-Open Spaces*, Edouard Walther, Techniques de l'Ingénieur, 2018

Keywords: Comfort, acoustics, lighting, thermal, water

BCR 9-9 – Environmental Analysis (LCA, HQE, etc.)

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial.....9 hours
Total.....**18h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- Previous modules on materials
- Previous modules on thermal engineering
- Previous modules on technology

Objectives

- To understand environmental issues in the construction sector
- To be able to carry out and analyse a life cycle assessment of a product or a building
- To be aware of the environmental impacts of construction choices
- Knowledge of environmental regulations and certifications

Programme

- Global environmental issues
- Environmental issues as they apply to construction
- Life cycle assessment
- Environmental regulations 2020
- Certifications: HQE, BREEAM, LEED

Key learning points

- Understanding the data in an FDES (environmental and health declaration form)
- Be able to carry out an environmental analysis of a building and evaluate it critically
- Eco-design a material or a building
- In-depth knowledge of the RE2020
- Be able to anticipate changes to the RE2020
- Knowing how to propose construction methods that enable certification to be obtained

Bibliography

- IPCC AR6 Synthesis Report, IPCC, 2023
- *Consequential life cycle analysis applied to built environments*, PhD thesis, Charlotte Roux, 2016
- RE2020 Guide, CEREMA, 2024
- HQE Sustainable Building Reference Framework, HQE Association, 2023

Keywords: Life cycle assessment, environmental quality, regulations, certification

BCR 9-10 – Assessment 3: building management and maintenance

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial.....9 hours
Total.....**18h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- Previous technology modules
- Previous modules in accounting and finance

Objectives

- Understand the principles of building management
- To understand the principles of building maintenance
- To be able to analyse a building's energy performance and suggest ways to improve it
- Be able to implement a maintenance plan for a simple building

Syllabus

- Principles and content of the DUIO (Document d'Intervention ultérieure sur l'Ouvrage) and the general regulatory framework for maintenance
- A refresher on energy metering and the analysis of a building's energy expenditure
- Implementation of a maintenance plan
  - Use of a digital model
  - CMMS (Computerised Maintenance Management System) tools
  - Data available for drawing up a maintenance plan
  - Method for drawing up a maintenance plan
- Financial analysis of maintenance operations
  - Risk analysis
  - Prioritisation of maintenance operations

- Organisation of maintenance operations
  - Existing arrangements
  - Organisation of the construction site

Key learning points

- Be able to analyse a maintenance plan for a simple building
- Be able to suggest some improvements to a building maintenance plan

Bibliography

- *Maintaining and Renovating Energy Systems for Buildings and Industry*, Christophe Marvillet, Techniques de l'Ingénieur, 2025
- *The Building as a System*, Christophe Gobin, Techniques de l'Ingénieur, 2014
- *European and International Maintenance Standards*, Antoine Despujols, Techniques de l'Ingénieur, 2015
- *Organising the Operation and Maintenance of Buildings in 40 Practical Guides*, Bertrand Santaguiliana, Christian Fringant, Le Moniteur, 2022
- *BIM and Building Energy Efficiency: From Design to Operation*, Karim Beddiar, Fabien Imbault, Dunod, 2017
- *Planning, Designing, Constructing and Operating a Sustainable Building: Implementing an Operations Management System: A Practical Guide*, Sylviane Nibel, Dominique de Valicourt, CSTB, 2012

Keywords: Servicing, maintenance, CMMS, DUIO

BCR 9-2 – Structural Design 3: Masonry – *Professional Contracts*

Timetable	
Semester	9
Term	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
Lectures	6 hours
Practical sessions	6 hours
Total	**12**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 – Designing structures and systems

Prerequisites

- Previous technology modules
- Previous materials modules
- Previous RDM modules

Objectives

- To understand the properties of masonry: materials, areas of application, construction methods
- To be able to design a simple masonry structure
- To understand the main structural arrangements of a masonry structure

Syllabus

- Overview of general rules and structural provisions in accordance with DTU 20.1 and Eurocode 6
- Design of a masonry structure
- Dimensioning a masonry structure: bricks or lightweight masonry blocks

Key learning points

- Understand the main rules and construction requirements for a masonry structure
- Be able to design a simple masonry structure
- Be able to check the dimensioning of a simple masonry structure

Bibliography

- NF EN 1996: Eurocode 6 – Design of masonry structures
- *Structural masonry: technical essentials*, French Building Federation, Union of Masonry and Structural Work, 2011
- *Masonry for Detached Houses: Terracotta or Concrete Blocks*, Benoit Mac-Mahon, Le Moniteur, 2023
- *Structural work: shallow foundations and slabs, small-element masonry, floors and thermal breaks,* Bernard Blache, Ménad Chenaf, Patrick Delmotte, Angel Junes, CSTB, 2022

Keywords: Masonry, structural arrangements, dimensioning

BCR 9-3 – Structural Design 4: Composite Structures – *Professional Contracts*

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....7.30 am
Tutorial .....7.30 am
Total.....**15**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- RdM resources
- Steel construction
- Timber construction
- Reinforced concrete construction

Objectives

To analyse, dimension and justify composite steel–concrete and timber–concrete structures in simple configurations, applying the relevant mechanical principles, calculation methods and standard requirements.

Syllabus

To design components in composite timber–concrete and steel–concrete structures.

Key learning outcomes

- **Identify** the main composite construction systems (steel–concrete composite beams, composite slabs, timber–concrete floors, etc.) and their areas of application
- **Understand** the overall behaviour of composite structures, in particular the role of the connection between materials and the effects of interaction (shear, redistribution of forces)
- **Apply** design methods for composite structures in accordance with the Eurocodes (EC4 for steel–concrete, EC5 for timber–concrete), taking into account ultimate and serviceability limit states

Bibliography

- A Structural Perspective on Composite Structures – Véronique Klimine
- Eurocode 5 – Application to composite timber/concrete bridges with glued-laminated beams – Cerema
- Composite steel-concrete structures: Design and calculation of composite floor beams in standard buildings – CSTB

Keywords: Composite – Timber – Metal – Concrete – Steel

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BCR 9-4 – Structural design 5: complex frameworks – *Professional Contracts*

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial.....9 hours
Total.....**18h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- Concrete and EC2 courses: ISA 2 and 3
- Steel course and EC3: ISA 2 and 3
- Timber course and EC5: ISA 2 and 3
- Previous RdM courses

Objectives

- To understand the mechanical behaviour of curved structures
- To explain the possibilities offered by curved structures
- To identify the construction methods associated with curved structures, from the definition of the form through to its execution
- Design a double-curved structure
- Propose appropriate procedures for the (safe) construction of the load-bearing structure during the building phase

Programme

- Introduction to double-curved structures: a review of second-order effects (general case, buckling (Euler's critical load)), an introduction to shell stiffness, and design principles
- Introduction to rigid gridshells: overview of recent structures with non-standard geometries and presentation of existing construction techniques and associated design methods. Introduction to structures using ETFE (Ethylene Tetrafluoroethylene)

- Presentation of fabric structures: Overview of the key principles of textile architecture and its specific characteristics through the interplay of form, force, structure, materials and technology
- Design project for a double-curved structure: structural design (load-bearing elements, connections, etc.), structural analysis (Cast3m), 3D printing of the structure

Key learning outcomes

- Understand the fundamental principles of the mechanical behaviour of curved structures
- Understand the main types of gridshell structures and their construction methods

Bibliography

- *Shells and Membranes: Foundations of the Non-linear Approach*, Anh Le Van, Ellipses, 2015
- *Analysis of Structures and Continuous Media: Shells*, François Frey, Marc-André Studer, Maurice Fiaux, Presses polytechniques et universitaires romandes, 2003
- *Structural optimisation of gridshells*, L. Bouhaya, PhD thesis, Université Paris-Est, 2010
- *Form-finding for Grid Shells*, L. Bouhaya, O. Baverel, C. Douthe, J.F. Caron, French Congress of Mechanics, 2009

Keywords: Design, curved structure, textile, gridshell

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BCR 9-5 – Technology of Historic Buildings 2 (timber, brick, steel) – *Professional Contracts*

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face teaching

Duration
CM 6am
Tutorial.....6 hours
Total.....12 hours

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Previous technology modules
- Previous modules on materials

Objectives

- To understand the construction techniques used in historic structures made of timber, steel, brick or concrete
- To analyse a historic structure made of timber, steel, brick or concrete and identify the various observable defects
- To propose repair solutions for old structures made of timber, steel, brick or concrete

Programme

- Half-timbered buildings
  - Construction of half-timbered structures
  - Problems: structural issues, fungal or insect damage, damp
  - Repair techniques: reinforcing or replacing timber components, treating infill materials
- Historic steel-framed buildings (iron-framed)
  - Structure of iron-framed buildings
  - Filling elements
  - Problems and repairs
- Brick framework

  - Manufacture and laying of bricks
  - Specific defects: efflorescence, calcite deposits, saltpetre
  - Maintenance of brick walls
- Concrete
  - Main defects in concrete structures
  - Design and repair solutions

Key lessons learnt

- Identifying construction techniques used in historic structures
- Diagnosing common defects in historic structures
- Proposing appropriate repair solutions

Bibliography

- *Half-timbered buildings*, Techniques for improving existing housing, EDF Habitat
- *Brick construction*, Techniques for improving existing housing, EDF Habitat
- Compendium of fact sheets on building defects, Agence Qualité Construction
- *Maintenance, Renovation and Refurbishment of Buildings*, Le Moniteur

Keywords: Timber-framed, steel-framed, brick-built, construction methods, defects, repairs

BCR 9-7 – Building Services and Equipment – *Professional Contracts*

Calendar
Semester.....9
Period .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM.....10.30 am
Tutorial 11.00

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 – Specify technical solutions for sustainable and more durable construction
C3 - Designing structures and systems

Prerequisites

- Environmental approaches in construction
- Thermal regulations
- Services and heating

Objectives

- Designing a ventilation system: air exchange and cooling
- Understand the different types of heat generation
- Describe and size heating and domestic hot water systems
- Carry out an energy consumption assessment for the building (heating and electricity)
- Be able to propose the most suitable heating system for a building
- Check that the planned heating installation meets the relevant requirements (RE2020 regulations, BBC environmental labels, etc.)

Syllabus

- General principles of ventilation systems: natural and mechanical
- Design of natural and forced ventilation systems: air exchange and cooling
- Schematic diagrams of installation layouts for a detached house
- Schematic diagrams of installations for commercial and multi-occupancy buildings
- Boiler room components: operation and safety
- Pumps: selection and sizing

- EDF tariffs: choice of contracts
- Domestic hot water: in-depth analysis, control and selection of suitable systems
- Renewable energy, solar panels The focus

will be consistently on:

- Sustainable development, energy savings
- Understanding systems
- Project sizing
- Design and implementation
- Relationship with structural and concrete plans, etc.

The course is complemented by a site visit. The focus will be on practical aspects (technical handbook, reading plans, supplier documentation). This module will tie in with the dynamic thermal simulation module. It will be explored in greater depth during the end-of-year project.

Key learning outcomes

- Be able to design a simple ventilation system
- Understand the main heat generation systems (heating and domestic hot water)
- Be able to analyse the installation in a small building in relation to regulatory requirements and low-energy building standards
- Be able to make some suggestions for improving a simple existing installation

Bibliography

- *Mémotech Génie Énergétique*, Pascal Dal Zotto, Jean-Marie Larre, Alain Merlet, Lucien Picau, Casteilla, 2014
- Supplier documents (FINIMETAL radiators, VAILLANT boilers, etc.)
- *Génie climatique*, H. Recknagel, E. Sprenger, Dunod, 2007
- *The Handbook of Control and Technical Management*, R. Cyssau, PYC ed., 2000
- http://www.techniques-ingenieur.com

Keywords: Networks, heating, domestic hot water, energy consumption analysis

BCR 9-8 – Comfort assessment: acoustics, lighting, thermohydraulic analysis – *Professional Contracts*

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Duration	
CM	18h
Tutorial	21h
Total hours	**39**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- Previous technology modules
- Previous materials modules
- Physics modules
- Dynamic Thermal Simulation Module

Objectives

- To understand the fundamental principles of comfort
- To be able to analyse the comfort of existing spaces using the laws of physics and physiology
- To be able to propose solutions

Syllabus

- General overview of comfort
- Acoustics
  - Sound and its characteristics
  - How the ear perceives sound
  - Noise measurements
  - Acoustic correction and sound insulation
  - Acoustic characteristics of products
  - Partition walls
- Lighting

  - Characteristics of light and photometric quantities
  - Artificial lighting
  - Natural lighting
  - Visual comfort
  - Designing indoor lighting
  - Determining street lighting
- Thermohygric comfort
  - Hygrothermal comfort parameters
  - Hydric comfort parameters
- Overall comfort assessment: comprehensive analysis, case studies

Key learning points

- Understanding the fundamental principles of comfort
- Be able to carry out a comprehensive analysis of spaces in terms of comfort
- Be able to suggest some areas for improvement to address comfort issues in spaces

Bibliography

- *Energy Efficiency in Buildings: Optimising Energy Performance, Comfort and Value in Commercial and Industrial Buildings*, Richard Franck, Guy Jover, Franck Hovorka, Eyrolles, 2014
- *Smart Buildings and Energy Efficiency – Optimisation, New Technologies and BIM*, Karim Beddiar and Jean Lemale, Dunod, 2016
- *Building Thermal Engineering: From Thermal Comfort to the Selection of Heating and Air-Conditioning Equipment*, Jedidi, Malek, Benjeddou, Omrane, Dunod, 2016
- *Building 4.0 – Challenges, Concepts and Technologies*, Karim Beddiar, Techniques de l'Ingénieur, 2020
- *Modelling Comfort in Open and Semi-Open Spaces*, Edouard Walther, Techniques de l'Ingénieur, 2018

Keywords: Comfort, acoustics, lighting, thermal, water

BCR 9-9 – Environmental Analysis (LCA, HQE, etc.) – *Professional Contracts*

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial .....9.00 am

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- Previous modules on materials
- Previous modules on thermal engineering
- Previous modules on technology

Objectives

- To understand environmental issues in the construction sector
- To be able to carry out and analyse a life cycle assessment of a product or a building
- To be aware of the environmental impacts of construction choices
- Knowledge of environmental regulations and certifications

Programme

- Global environmental issues
- Environmental issues as they apply to construction
- Life cycle assessment
- Environmental regulations 2020
- Certifications: HQE, BREEAM, LEED

Key learning points

- Understanding the data in an FDES (environmental and health declaration form)
- Be able to carry out an environmental analysis of a building and evaluate it critically
- Eco-designing a material or a building
- In-depth knowledge of RE2020
- Ability to anticipate changes to the RE2020
- Knowing how to propose construction methods that enable certification to be obtained

Bibliography

- IPCC AR6 Synthesis Report, IPCC, 2023
- *Consequential life cycle analysis applied to built environments*, PhD thesis, Charlotte Roux, 2016
- RE2020 Guide, CEREMA, 2024
- HQE Sustainable Building Reference Framework, HQE Association, 2023

Keywords: Life cycle assessment, environmental quality, regulations, certification

BCR 9-10 – Diagnosis 3: building management and maintenance – *Professional Contracts*

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial.....9 hours
Total.....**18h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- Previous technology modules
- Previous modules in accounting and finance

Objectives

- Understand the principles of building management
- To understand the principles of building maintenance
- To be able to analyse a building's energy performance and suggest ways to improve it
- Be able to implement a maintenance plan for a simple building

Syllabus

- Principles and content of the DUIO (Document d'Intervention ultérieure sur l'Ouvrage) and the general regulatory framework for maintenance
- A refresher on energy metering and the analysis of a building's energy expenditure
- Implementation of a maintenance plan
  - Use of a digital model
  - CMMS (Computerised Maintenance Management System) tools
  - Data available for drawing up a maintenance plan
  - Method for drawing up a maintenance plan
- Financial analysis of maintenance operations
  - Risk analysis
  - Prioritisation of maintenance operations

- Organisation of maintenance operations
  - Existing arrangements
  - Site organisation

Key learning points

- Be able to analyse a maintenance plan for a simple building
- Be able to suggest some improvements to a building maintenance plan

Bibliography

- *Maintaining and Renovating Energy Systems for Buildings and Industry*, Christophe Marvillet, Techniques de l'Ingénieur, 2025
- *The Building as a System*, Christophe Gobin, Techniques de l'Ingénieur, 2014
- *European and International Maintenance Standards*, Antoine Despujols, Techniques de l'Ingénieur, 2015
- *Organising the Operation and Maintenance of Buildings in 40 Practical Guides*, Bertrand Santaguiliana, Christian Fringant, Le Moniteur, 2022
- *BIM and Building Energy Efficiency: From Design to Operation*, Karim Beddiar, Fabien Imbault, Dunod, 2017
- *Planning, Designing, Constructing and Operating a Sustainable Building: Implementing an Operations Management System: A Practical Guide*, Sylviane Nibel, Dominique de Valicourt, CSTB, 2012

Keywords: Servicing, maintenance, CMMS, DUIO

GCM 9-1 - Structural Dynamics 2

Timetable	
Semester	9
Term	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorial	7h30
Total	**15 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

- Resource BCR 8-2 or GCM 8-1 'Structural Dynamics 1'
- 1D Solid Dynamics (previous course)
- Knowledge of linear algebra (eigenvalues and eigenvectors, matrices)
- Basics of matrix calculations applied to mechanics
- Basic understanding of seismic regulations (Eurocodes)

Objectives

- To model a vibrating system with n degrees of freedom (n DDL / MDOF – Multi Degrees of Freedom)
- Construct the mass and stiffness matrices of a mechanical or structural system
- Determine the natural modes and natural frequencies of a system
- Analyse the dynamic response using modal superposition
- Apply these methods to calculate seismic effects on simple structures

Syllabus

- Matrix formulation of the equation of motion with n DDLs
- Natural modes and natural frequencies (orthogonality, normalisation)
- Free and forced response with proportional damping
- Modal superposition and the principle of decomposition
- Application to seismic dynamics: simplified calculation of seismic forces

Key learning outcomes

- Ability to formulate and solve a dynamic system with multiple DDLs
- To interpret the natural modes and their influence on the response in physical terms
- Be able to apply modal analysis to estimate seismic forces
- Linking mathematical concepts (eigenvalues, eigenvectors) to a mechanical interpretation

Bibliography

- *Practical Seismic Design: A Guide to the Application of Eurocode 8*, V. Davidovici, D. Corvez, A. Capra, S. Ghavamian, V. Le Corvec, C. Saintjean, AFNOR, 2013
- *Seismic Risk and the Built Environment: Reducing Vulnerability: Knowledge and Expertise*, Alain Billard, AFNOR, 2014
- *Earthquakes and Buildings – Structural Analysis*, André Plumier, Techniques de l'Ingénieur, 2014
- *Taking seismic risk into account for existing bridges*, Denis Davi, Techniques de l'Ingénieur, 2014

Keywords: Dynamics, earthquake, design, multiple degrees of freedom, natural modes

GCM 9-2 – Structural Design 3: Prestressed Concrete 2

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM.....10.30 am
Tutorial 9.00

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

- RDM: Analysis of hyperstatic structures
- Prestressed concrete: isostatic beams / Pre-stressed concrete 1 (R GCM 9-5)

Objectives

- To understand the specific rules relating to prestressing application zones
- To understand how a hyperstatic prestressed structure works and to have a basic understanding of its design

Syllabus

- Specific rules relating to prestressing force application zones
- Bending of continuous hyperstatic beams with tension cables, the concept of hyperstatic prestressing reactions, design principles
- Case study: Calculation of a hyperstatic prestressed concrete bridge deck or portal frame

Key learning outcomes

- Understanding and calculating hyperstatic prestressing effects
- Design a hyperstatic prestressed concrete structure
- Analysing the behaviour of a prestressed continuous beam

Bibliography

Idem R GCM 9-5 Prestressed concrete: isostatic beams / Pre-stressed concrete 1

Keywords: Prestressed concrete, continuous beam, hyperstatic prestressing reactions, hyperstatic structures

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GCM 9-3 – Structural Design 4: Composite Structures

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration	
CM	15h
Tutorial	15 hours
Total	**30 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 – Designing structures and systems

Prerequisites

Part I: common with BCR 9-3

- RdM resources
- Structural Analysis Resources: steel, timber and reinforced concrete construction

Objectives

To analyse, design and justify composite steel–concrete and timber–concrete structures in simple configurations, applying the relevant mechanical principles, calculation methods and standard requirements.

Syllabus

To design components in composite timber–concrete and steel–concrete structures.

Key Learning Outcomes

- **Identify** the main composite construction systems (steel–concrete composite beams, composite slabs, timber–concrete floors, etc.) and their areas of application
- **Understand** the overall behaviour of composite structures, in particular the role of the connection between materials and the effects of interaction (shear, redistribution of forces)
- **Apply** design methods for composite structures in accordance with the Eurocodes (EC4 for steel–concrete, EC5 for timber–concrete), taking into account ultimate and serviceability limit states

Bibliography

- A Structural Perspective on Composite Structures – Véronique Klimine
- Eurocode 5 – Application to composite timber/concrete bridges with glued-laminated beams – Cerema
- Composite steel–concrete structures: Design and calculation of composite beams for standard building floors – CSTB

Keywords: Composite – Timber – Metal – Concrete

– Steel 615

Prerequisites

- Technology resources:
  - R1-13: Technology 2: General Principles of Road and Drainage Works – Roads – Earthworks
  - R2-14: Technology 4: Engineering Structures – Civil Engineering
  - R5-17: Technology 6: Introduction to Planning and Urban Development
  - GCM7-6: Bridges 1
  - GCM8-6: Bridges 2
- RDM Resources: RdM1 to RdM7

Objectives

- To understand the technology of composite bridges
- To carry out preliminary design of a composite bridge
- To analyse the links between the choice of construction method and the design of a composite bridge

Syllabus

- Types and construction principles of composite bridges
- Preliminary design of structures comprising a PRS and a concrete deck
  - Longitudinal bending of deck sections at the Ultimate Limit State (ULS)
  - Longitudinal bending of deck sections at the Ultimate Limit State (ULS)
  - Connection between PRSs and the concrete slab in a two-beam composite bridge
- Accounting for construction phasing and a difference in bearing elevation

Key learning points

- Mastery of the terminology relating to composite bridges and their construction methods
- 2D mechanical modelling of a composite beam and regulatory checks at ULS and SLS

Bibliography

- Technical guides from SETRA and CEREMA
- Documentation from the APK (Association for the Promotion of Steel Construction Education)

Keywords: Engineering structures, Composite bridge, Technology, Connection, PRS

GCM 9-4 - Advanced Geotechnics

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....7.5 hours
Tutorial 7h30
Total.....15 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

- Previous modules in geotechnics and soil mechanics
- Strength of materials
- Structural analysis

Objectives

- To analyse and critically interpret data obtained from a geotechnical survey
- Compare drained and undrained approaches and justify their use depending on the context
- Apply the principles of critical state mechanics to interpret soil behaviour
- Analyse the response of soils under cyclic loading and identify the implications for design
- Assess methods for calculating shallow and deep foundations
- Verify geotechnical structures against ultimate load (ELU) and service load (ELS)
- Analyse soil-structure interaction effects and the group effect of piles

Syllabus

1. Further study in soil mechanics
    - Geotechnical investigation
    - Shear behaviour of soils:
        - Drained and undrained strength of clays
        - Shear strength of sands
    - Critical state mechanics
    - Cyclic strength and dynamic properties of soils
2. Geotechnical structures

- Excavations and retaining structures
- Supplementary information on shallow foundations: Soil-structure interaction (SSI), raft foundations and slabs
- Design checks for ultimate limit states (ULS) and serviceability limit states (SLS) of deep foundations
- Group effect of piles
- Behaviour of piles subjected to lateral loads (concepts)
- Foundations for engineering structures (basic concepts)

Key learning outcomes

- Be able to distinguish the mechanical behaviour of sand from that of clay
- Be able to correctly dimension an excavation, taking into account the nature of the soil and its short- and long-term mechanical response
- Analyse the response of soils under cyclic loading
- To design and verify shallow and deep foundations

Bibliography

- *Craig's Soil Mechanics*, Jonathan Knappett & R.F. Craig, CRC Press, 2019
- *Calculation of Shallow and Deep Foundations*, Sébastien Burlon, Fahd Cuira, Roger Frank, eds. Presses des Ponts, 2019
- Eurocode 7: Geotechnical Design

Keywords: soil mechanics, foundations, bearing capacity, settlements

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GCM 9-5 – Fire Analysis

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face in person

Assessment
Continuous assessment

Duration	
Lectures	6 hours
Practical sessions	3 hours
Total	**9**

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

The handout for this resource is in English, but the course is largely bilingual (French and English) to enable students to acquire the technical vocabulary of prestressing in both French and English.

Prerequisites

Strength of materials, theory of beams: isostatic structures, concepts of strains and stresses

Learning outcomes

- Describe the principles of prestressing: the effect of applying a compressive force to connected elements; how a compressive force eliminates tension in a beam; advantages compared with reinforced concrete
- Distinguish between the different types of rules in Eurocode 2
- Calculate the loss of stress
- Design and troubleshoot a section of prestressed concrete with regard to normal stresses at the Service Limit State (SLS)
- Describe the principles of design and troubleshoot a section of prestressed concrete with regard to normal stresses under the Ultimate Limit State (ULS)

Programme

- General overview, operating principles, methods of application, examples of prestressing
- Technological aspects of prestressing (pre-tensioning – precast concrete structural systems – post-tensioning prestressing)
- Regulatory aspects (Eurocode 2): safety principle, material properties (concrete and steel)
- Determination of the probable tension in the prestressing cables: evaluation of stress losses
- Bending of isostatic beams: design at the Serviceability Limit State (SLS) under normal stresses
- Bending of isostatic beams: design justifications at the Ultimate Limit State (ULS) under normal stresses
- Resistance of prestressed concrete to shear force: justifications and design under tangential loads 619

Key learning points

- Determine the critical phases in the life of a prestressed isostatic structure and specify the associated ULS combinations
- Verify a prestressed isostatic structure against normal stresses at the Ultimate Limit State (ULS)

Bibliography

- NF EN 1992: Eurocode 2
- *Prestressed Concrete at Limit States*, H. Thonier, 2nd edition, ENPC Press
- *Prestressing*, R. Chaussin, A. Fuentes, R. Lacroix, J. Perchat, ENPC Press
- *Properties of Reinforced and Prestressed Concrete*, edited by R. Lacroix and J.L. Cement, Lavoisier Hermès, 2002
- *Applications of Eurocode 2: Design of Concrete Buildings*, edited by J.A. Calgaro and J. Cortade, 2nd edition, ENPC Press, 2008
- *Design of prestressed concrete members using adherent wires*, P. Passeman, C. Vinot, published by CSTB, 2010
- *Prestressed Concrete under the Eurocodes*, P. Le Delliou, published by ENTPE, 2003
- *Eurocode 2: Application to Concrete Road Bridges – Methodological Guide*, Bui, Ngoc-Vu, published by SETRA, 2008
- Online: www.ba-cortex.com

Keywords: Prestressing, ELS analysis, prestressed concrete, Eurocode 2, prestressing

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GCM 9-6 - Modelling and simulation in coastal engineering

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorial	7h30
Total	**15 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

- GCM8-5 - Coastal processes and coastal defence
- R8-7 - Numerical methods – EDP
- Physical Sciences S3
- Physical Sciences S6

Objectives

- Understand the basic physics and approximations underlying classical wave models (shallow water theory, gentle slope, etc.)
- Be able to construct a mesh and run a numerical model (Artemis, Telemac, etc.) based on Bluekenue/Telemac
- Understand the effects of the model's numerical parameters
- Validate numerical models
- Be able to interpret numerical results

Programme

1. Non-linear shallow water equations
    - From the Navier–Stokes equations to shallow water theory
    - The physics underlying the shallow water equations
    - Numerical aspects
2. Berkhoff equations and other wave agitation models
    - Derivation of the mild slope equation
    - Physics associated with basin resonance
3. Numerical project
    - Pre-processing and post-processing (Bluekenue)
    - Use of Artemis and Telemac models in a joint project

Bibliography

- *Modelling the Hydrodynamics of Free-Surface Flows using the Finite Element Method*, J-M. Hervouet, s.l.: Wiley, 2007 – 978-0-470-03558-0
- *Guide to programming in the Telemac system version 6.0.*, J-M. Hervouet, s.l.: EDF R&D, 2010. H-P74-2009-00801-EN

GCM 9-7 – Marine and Port Structures 2

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
Lectures	6 hours
Practical	15 hours
Total	**9 pm**

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 – Designing structures and systems
C4 - Managing a construction organisation

Prerequisites

- Coastal Engineering 1
- Geotechnics
- Organisation of works

Objectives

- To understand the main types of port structures
- To understand construction methods used on maritime and port sites

Syllabus

- General overview of ports and associated works
- Introduction to the design of port structures
- Site visits to port construction sites

Bibliography

ROSA 2000: Application of the Eurocodes to maritime and inland waterway structures, published by the École Nationale des Ponts et Chaussées.

GCM 9-8 – Dams, reservoirs, hillside embankments

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
Lectures	12 hours
Tutorial	12 hours
Total	**24**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- GCM 7-1: Soil mechanics
- GCM 7-5: Earthworks

Objectives

- To understand the main types of port structures
- To understand construction methods used on maritime and port sites

Syllabus

- **Course**
  - Dams/reservoirs/hill-side dams
    - History of dams / types of dams – reservoirs / uses
    - Pumping and turbine stations and hillside reservoirs
    - Regulatory aspects in France
    - The structural components of a dam
    - Key stages of design (geotechnical, hydraulic, etc.)
    - The project lifecycle
    - The impacts of dams
    - Dams and climate change

- **TD**
  - Feasibility of raising an upstream-masked earth-fill dam

    - Selection of the elevation in relation to the desired volume gain
    - Identification of all associated works
    - Sourcing of quarry materials
  - Stability of the Lurberria dam at Saint-Pée-sur-Nivelle
    - Overview of the dam and its construction phases
    - Stability calculations
    - Introduction to the design of port structures

GCM 9-9 – Environmental approach – Contaminated soils

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM.....10.30 am
Tutorial 9.00

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- R 1-15: Introduction to environmental issues
- Materials Resources
- Technology resources
- Management Resources

Objectives

- To integrate an environmental approach from the design stage of a construction project
- To understand the technical and administrative process involved in an environmental assessment
- To draft an environmental assessment for construction projects
- To understand the different types of soil pollution and propose appropriate remediation measures

Syllabus

- Definition of the concept of the environment: physical, natural, social, cultural, economic and aesthetic factors
- Examining the different phases of a project's life cycle
- Use and adaptation of environmental impact assessment systems: interaction matrices, project activities, environmental factors
- French legal and regulatory framework: the Environment Code, written documents
- Soil pollution: types, in-situ characterisation, remediation

Academic teaching is put into practice through real-world case studies to produce a partial environmental impact assessment. An oral presentation, with peer assessment, concludes this Resource.

Key learning outcomes

- Understanding the regulatory framework for an environmental assessment
- Drafting an 'Environmental Impact Assessment' deliverable
- Understanding the types of soil pollution

Bibliography

- Environment Code

Keywords: Environment Code, assessment, design, environmental approach, sustainable development, remedial treatments

GCM 9-10 – Inspection, maintenance and repair of structures

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM	9.30 am
Tutorial	6 hours
Total	**3.30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Knowledge of structural design and structural analysis
- Fundamentals of the design of steel and reinforced concrete elements
- Basics of Eurocodes 0 and 1
- Reading and interpreting structural drawings
- Introduction to modelling and technical drawing software

Objectives

- To understand the maintenance and monitoring policy for a portfolio of engineering structures
- Understanding the constraints and methods involved in carrying out bridge repairs
- Applying theoretical and technical knowledge to the design of repairs to engineering structures
- Organise and manage repair works on these bridges

Programme

- Participation in the 'Le Pont' conference in Toulouse in October
  - Developments in knowledge of materials and structures: concrete, metallic materials, structures
  - Changes to the technical regulatory framework
  - Developments in diagnostic and management techniques
  - Developments in remedial intervention techniques: in masonry and concrete structures, in steel structures and in foundations
  - AI in civil engineering

Key lessons learnt

- Understanding the maintenance and monitoring policy for a portfolio of engineering structures

Bibliography

- *Design and Construction of Bridges*, Virlogeux and Calgaro, Presses des Ponts et Chaussées
- *Maintenance and Repair of Engineering Structures*, R. Lacroix and J.-A. Calgaro, Presses ENPC, 1997
- Proceedings of the 'Le Pont' symposium, Toulouse, Association Le Pont
- Civil Engineering Structures Bulletins, SETRA journal and subsequently the Cerema online journal https://www.cerema.fr/fr/centre-ressources/newsletters/boa-bulletin-ouvrages-art
- https://www.cerema.fr/fr/activites/infrastructures-transport/ouvrages-art
- Online encyclopaedia 'Techniques de l'Ingénieur', accessible via the UPPA libraries' website, under 'Electronic Resources'

Keywords: Inspection, maintenance, repair, civil engineering structures, upkeep, monitoring, IQOA, bridges

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GCM 9-2 – Structural Design 3: Prestressed Concrete 2 – *Professional Contracts*

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM.....10.30 am
Tutorial 9.00

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

- RDM: study of hyperstatic structures
- Prestressed concrete: isostatic beams / Pre-stressed concrete 1 (R GCM 9-5)

Objectives

- To understand the specific rules relating to prestressing application zones
- To understand how a hyperstatic prestressed structure works and to have a basic understanding of its design

Syllabus

- Specific rules relating to prestressing force application zones
- Bending of continuous hyperstatic beams with tension cables, the concept of hyperstatic prestressing reactions, design principles
- Case study: Calculation of a hyperstatic prestressed concrete bridge deck or portal frame

Key learning outcomes

- Understanding and calculating hyperstatic prestressing effects
- Design a hyperstatic prestressed concrete structure
- Analysing the behaviour of a prestressed continuous beam

Bibliography

Idem R GCM 9-5 Prestressed concrete: isostatic beams / Pre-stressed concrete 1

Keywords: Prestressed concrete, continuous beam, hyperstatic prestressing reactions, hyperstatic structures

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GCM 9-3 – Structural design 4: composite structures – *Professional Contracts*

Timetable	
Semester	9
Term	Sept. – Jan
Face-to-face in person	

Duration	
CM	15h
Tutorial	3 pm
Total	**30 hours**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

Prerequisites

Part I: common with BCR 9-3

- RdM resources
- Structural Analysis Resources: steel, timber and reinforced concrete construction

Objectives

To analyse, design and justify composite steel–concrete and timber–concrete structures in simple configurations, applying the relevant mechanical principles, calculation methods and standard requirements.

Syllabus

To design components in composite timber–concrete and steel–concrete structures.

Key Learning Outcomes

- **Identify** the main composite construction systems (steel–concrete composite beams, composite slabs, timber–concrete floors, etc.) and their areas of application
- **Understand** the overall behaviour of composite structures, in particular the role of the connection between materials and the effects of interaction (shear, redistribution of forces)
- **Apply** design methods for composite structures in accordance with the Eurocodes (EC4 for steel–concrete, EC5 for timber–concrete), taking into account ultimate and serviceability limit states

Bibliography

- A Structural Perspective on Composite Structures – Véronique Klimine
- Eurocode 5 – Application to composite timber/concrete bridges with glued-laminated beams –

- Composite steel–concrete structures: Design and calculation of composite beams for standard building floors – CSTB

Keywords: Composite – Timber – Metal – Concrete – Steel

Prerequisites

- Technology resources:
  - R1-13: Technology 2: General Principles of Road and Drainage Works – Roads – Earthworks
  - R2-14: Technology 4: Engineering Structures – Civil Engineering
  - R5-17: Technology 6: Introduction to Planning and Urban Development
  - GCM7-6: Bridges 1
  - GCM8-6: Bridges 2
- RDM resources: RdM1 to RdM7

Objectives

- To understand composite bridge technology
- To carry out a preliminary design of a composite bridge
- To analyse the links between the choice of construction method and the design of a composite bridge

Syllabus

- Types and construction principles of composite bridges
- Preliminary design of structures comprising a PRS and a concrete deck
  - Longitudinal bending of deck sections at the Ultimate Limit State (ULS)
  - Longitudinal bending of deck sections at the Ultimate Limit State (ULS)
  - Connection between PRSs and the concrete slab in a two-beam composite bridge
- Accounting for construction phasing and a difference in support levels

Key learning points

- Mastery of the terminology relating to composite bridges and their construction methods
- 2D mechanical modelling of a composite beam and regulatory checks at ULS and SLS

Bibliography

- Technical guides from SETRA and CEREMA
- Documentation from the APK (Association for the Promotion of Steel Construction Education)

Keywords: Engineering structures, Composite bridge, Technology, Connection, PRS

GCM 9-4 - Advanced Geotechnics - *Professional Contracts*

Timetable	
Semester	9
Term	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorial	7h30
Total	**15 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 – Designing structures and systems

Prerequisites

- Previous modules in geotechnics and soil mechanics
- Strength of materials
- Structural analysis

Objectives

- To critically analyse and interpret data from a geotechnical investigation
- Compare drained and undrained approaches and justify their use depending on the context
- Apply the principles of critical state mechanics to interpret soil behaviour
- To analyse the response of soils under cyclic loading and identify the implications for design
- Assess methods for calculating shallow and deep foundations
- Verify geotechnical structures against ultimate load (ELU) and service load (ELS)
- Analyse soil-structure interaction effects and the group effect of piles

Syllabus

1. Further study in soil mechanics
    - Geotechnical investigation
    - Shear behaviour of soils:
        - Drained and undrained strength of clays
        - Shear strength of sands
    - Critical state mechanics
    - Cyclic strength and dynamic properties of soils
2. Geotechnical structures

- Excavations and retaining structures
- Supplementary information on shallow foundations: Soil-structure interaction (SSI), raft foundations and slabs
- Design checks for ultimate limit states (ULS) and serviceability limit states (SLS) of deep foundations
- Group effect of piles
- Behaviour of piles subjected to lateral loads (concepts)
- Foundations for engineering structures (basic concepts)

Key learning outcomes

- Be able to distinguish the mechanical behaviour of sand from that of clay
- Be able to correctly dimension an excavation, taking into account the nature of the soil and its short- and long-term mechanical response
- Analyse the response of soils under cyclic loading
- To design and verify shallow and deep foundations

Bibliography

- *Craig's Soil Mechanics*, Jonathan Knappett & R.F. Craig, CRC Press, 2019
- *Calculation of Shallow and Deep Foundations*, Sébastien Burlon, Fahd Cuira, Roger Frank, eds. Presses des Ponts, 2019
- Eurocode 7: Geotechnical Design

Keywords: soil mechanics, foundations, bearing capacity, settlements

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GCM 9-5 – Fire Analysis – *Professional Contracts*

Calendar
Semester.....9
Period .....Sept. – Jan
Face-to-face in person

Assessment
Continuous assessment

Duration	
Lectures	6 hours
Practical sessions	3 hours
Total	**9**

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 - Dimensioning structures and systems

The handout for this resource is in English, but the course is largely bilingual (French and English) to help students acquire the technical vocabulary of prestressing in both French and English.

Prerequisites

Strength of materials, theory of beams: isostatic structures, concepts of strains and stresses

Learning outcomes

- Describe the principles of prestressing: the effect of applying a compressive force to connected elements; how a compressive force eliminates tension in a beam; advantages compared with reinforced concrete
- Distinguish between the different types of rules in Eurocode 2
- Calculate the loss of stress
- Design and troubleshoot a section of prestressed concrete with regard to normal stresses at the Service Limit State (SLS)
- Describe the principles of design and troubleshoot a section of prestressed concrete with regard to normal stresses under the Ultimate Limit State (ULS)

Programme

- General overview, operating principles, methods of application, examples of prestressing
- Technological aspects of prestressing (pre-tensioning – precast concrete structural systems – post-tensioning prestressing)
- Regulatory aspects (Eurocode 2): safety principle, material properties (concrete and steel)
- Determination of the probable tension in prestressing cables: evaluation of stress losses
- Bending of isostatic beams: design at the Serviceability Limit State (SLS) under normal stresses
- Bending of isostatic beams: design justifications at the Ultimate Limit State (ULS) under normal stresses
- Resistance of prestressed concrete to shear force: justifications and design under tangential loads 635

Key lessons learnt

- Determine the critical phases in the life of a prestressed isostatic structure and specify the associated ULS combinations
- Verify a prestressed isostatic structure against normal stresses at the Ultimate Limit State (ULS)

Bibliography

- NF EN 1992: Eurocode 2
- *Prestressed Concrete at Limit States*, H. Thonier, 2nd edition, ENPC Press
- *Prestressing*, R. Chaussin, A. Fuentes, R. Lacroix, J. Perchat, ENPC Press
- *Properties of Reinforced and Prestressed Concrete*, edited by R. Lacroix and J.L. Cement, Lavoisier Hermès, 2002
- *Applications of Eurocode 2: Design of Concrete Structures*, edited by J.A. Calgaro and J. Cortade, 2nd edition, ENPC Press, 2008
- *Design of prestressed concrete members using bonded wires*, P. Passeman, C. Vinot, published by CSTB, 2010
- *Prestressed Concrete under the Eurocodes*, P. Le Delliou, published by ENTPE, 2003
- *Eurocode 2: Application to Concrete Road Bridges – Methodological Guide*, Bui, Ngoc-Vu, published by SETRA, 2008
- Online: www.ba-cortex.com

Keywords: Prestressing, ELS analysis, prestressed concrete, Eurocode 2, prestressing

GCM 9-7 – Marine and Port Structures 2 – *Professional Contracts*

Timetable	
Semester	9
Term	Sept. – Jan
Face-to-face in person	

Assessment
Continuous assessment

Duration	
Lectures	6 hours
Practical	15 hours
Total	**9 pm**

Targeted skill(s)
C1 – Analysing a construction project within its context
C3 – Designing structures and systems
C4 - Managing a construction organisation

Prerequisites

- Coastal Engineering 1
- Geotechnics
- Organisation of works

Objectives

- To understand the main types of port structures
- To understand construction methods used on maritime and port sites

Syllabus

- General overview of ports and associated works
- Introduction to the design of port structures
- Site visits to port construction sites

Bibliography

ROSA 2000: Application of the Eurocodes to maritime and inland waterway structures, published by the École Nationale des Ponts et Chaussées.

GCM 9-8 – Dams, reservoirs, hillside embankments – *Professional Contracts*

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....12 hours
Tutorial .....12 hours
Total.....**24**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- GCM 7-1: Soil mechanics
- GCM 7-5: Earthworks

Objectives

- To understand the main types of port structures
- To understand construction methods used on maritime and port sites

Syllabus

- **Course**
  - Dams/reservoirs/hill-side dams
    - History of dams / types of dams – reservoirs / uses
    - Pumping and turbine stations and hillside reservoirs
    - Regulatory aspects in France
    - The structural components of a dam
    - Key stages of design (geotechnical, hydraulic, etc.)
    - The project lifecycle
    - The impacts of dams
    - Dams and climate change

- **TD**
  - Feasibility of raising an upstream-masked earth-fill dam

    - Selection of the elevation in relation to the desired volume gain
    - Identification of all associated works
    - Sourcing of quarry materials
  - Stability of the Lurberria dam at Saint-Pée-sur-Nivelle
    - Overview of the dam and its construction phases
    - Stability calculations
    - Introduction to the design of port structures

GCM 9-9 – Environmental approach – Contaminated soil – *Pro contracts*

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM.....10.30 am
Tutorial 9.00

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- R 1-15: Introduction to environmental issues
- Materials Resources
- Technology resources
- Management Resources

Objectives

- To integrate an environmental approach from the design stage of a construction project
- To understand the technical and administrative process involved in an environmental assessment
- To draft an environmental assessment for construction projects
- To understand the different types of soil pollution and propose appropriate remediation measures

Syllabus

- Definition of the concept of the environment: physical, natural, social, cultural, economic and aesthetic factors
- Examining the different phases of a project's life cycle
- Use and adaptation of environmental impact assessment systems: interaction matrices, project activities, environmental factors
- French legal and regulatory framework: the Environment Code, written documents
- Soil pollution: types, in-situ characterisation, remediation

Academic teaching is put into practice through real-world case studies to produce a partial environmental impact assessment. An oral presentation, with peer assessment, concludes this Resource.

Key learning outcomes

- Understanding the regulatory framework for an environmental assessment
- Drafting an 'Environmental Impact Assessment' deliverable
- Understanding the types of soil pollution

Bibliography

- Environment Code

Keywords: Environment Code, assessment, design, environmental approach, sustainable development, remedial treatments

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GCM 9-10 – Inspection, maintenance and repair of structures – *Professional Contracts*

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Comprehensive continuous assessment

Duration
CM .....9.30 am
Tutorial.....6 hours
Total **3.30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Knowledge of structural design and structural analysis
- Basics of the design of steel and reinforced concrete elements
- Basics of Eurocodes 0 and 1
- Reading and interpreting structural drawings
- Introduction to modelling and technical drawing software

Objectives

- To understand the maintenance and monitoring policy for a portfolio of engineering structures
- To understand the constraints and methods involved in carrying out bridge repairs
- Apply theoretical and technical knowledge to the design of civil engineering structure repairs
- Organise and manage the repair works on these bridges

Programme

- Participation in the 'Le Pont' conference in Toulouse in October
  - Developments in knowledge of materials and structures: concrete, metallic materials, structures
  - Changes to the regulatory technical framework
  - Developments in diagnostic and management techniques
  - Developments in remedial intervention techniques: in masonry and concrete structures, in steel structures and in foundations
  - AI in civil engineering

Key lessons learnt

- Understanding the maintenance and monitoring policy for a portfolio of engineering structures

Bibliography

- *Design and Construction of Bridges*, Virlogeux and Calgaro, Presses des Ponts et Chaussées
- *Maintenance and Repair of Engineering Structures*, R. Lacroix and J.-A. Calgaro, Presses ENPC, 1997
- Proceedings of the 'Le Pont' symposium, Toulouse, Association Le Pont
- Civil Engineering Structures Bulletins, SETRA journal and subsequently the Cerema online journal https://www.cerema.fr/fr/centre-ressources/newsletters/boa-bulletin-ouvrages-art
- https://www.cerema.fr/fr/activites/infrastructures-transport/ouvrages-art
- Online encyclopaedia 'Techniques de l'Ingénieur', accessible via the UPPA libraries' website, under 'Electronic Resources'

Keywords: Inspection, maintenance, repair, civil engineering structures, upkeep, monitoring, IQOA, bridges

H&E 9-1 – Building Electrical Systems

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face

Assessment
Continuous assessment

Duration
Total **27h30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- Ventilation and Air Treatment
- Thermodynamic systems
- Environmental approaches in construction
- Thermal regulations

Programme

- Building analysis: type, occupancy, use, architectural constraints, available energy sources, etc.
- Defining objectives with the client: budget, target energy performance level, comfort, aesthetics
- Building survey: walls, heating systems, ventilation, domestic hot water, air conditioning
- Assessment of current energy consumption and the breakdown of consumption
- Monitoring of energy consumption in real time or over several years
- Use of a thermal imaging camera
- Energy optimisation of the building envelope and technical systems
- Drafting of a summary report: condition survey, proposed works, cost estimates, quantification of energy savings, feasibility study and payback period
- Oral presentation

Key learnings

- Assessing the current building's energy performance
- Identifying user comfort requirements
- Proposing appropriate works to improve the building's energy efficiency
- Cost the selected solutions
- Knowing how to calculate payback periods

Bibliography

- http://www.rt-batiment.fr
- Supplier documentation (insulation, equipment)
- Thermal imaging documentation

Keywords: diagnosis, recommendations, measurements

H&E 9-2 – Refurbishment, energy-efficient renovation

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face	

Assessment
Continuous assessment

Duration	
Total	**28h30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- R6-15 - Materials 8: Eco-materials
- R6-11 - Building Thermodynamics 2

Objectives

- To understand the context of renovation in France (barriers and drivers)
- To master energy-efficient refurbishment and renovation techniques
- To design high-performance renovation projects using a holistic and systems-based approach
- To incorporate regulatory and environmental requirements
- Manage project interfaces
- Draw up a programme
- Draw up the necessary construction documents

Programme

- Energy Performance Certificate (EPC) and existing building regulations
- Energy audit and recommendations
- Renovation of the building envelope: external wall insulation, joinery, roofing
- High-performance energy systems: heat pump, dual-flow mechanical ventilation
- Comprehensive and phased renovation
- Regulations: RE2020, financial assistance (MaPrimeRénov')
- Site management in occupied properties
- Case studies of exemplary renovations and applications to detached houses or small blocks of flats

Key lessons learnt

- Carrying out a comprehensive energy audit
- Design an energy-efficiency refurbishment project
- Costing and planning the renovation works
- Optimise the cost-performance ratio

Bibliography

- *Energy-efficient building renovation*, B. Sesolis, Dunod
- *Guide to Energy-Efficient Renovation*, ADEME
- *The refurbishment of existing buildings*, P. Broise, Le Moniteur
- PACTE Programme

Keywords: Refurbishment, energy-efficient renovation, Energy Performance Certificate (EPC), audit, external wall insulation, performance, RE2020

H&E 9-3 - CES: Scheduling, Management, Coordination

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face

Assessment
Continuous assessment throughout the course

Duration
Total.....15 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Site organisation and management
- Building techniques and knowledge of trades
- Project planning

Objectives

- To understand the complexity of construction operations involving numerous technical trades
- To analyse the interactions between the various works packages and their impact on design and execution
- Identify risks associated with technical and organisational interfaces
- Implement scheduling, management and coordination tools suited to complex projects

Programme

- Role and responsibilities of Scheduling, Management and Coordination (OPC)
- Analysis of interfaces between secondary trades
- Interactions between technical trades: HVAC, plumbing, electrical, building management systems, fire safety, renewable energy
- Management of interface conflicts and space constraints
- Spatial and temporal coordination of works
- Technical summary and digital model
- Organisation of construction phases in highly technical buildings
- Management of works in occupied premises: maintaining operations, phasing, user safety and minimising disruption
- Management of unforeseen events and adjustment of schedules
- Feedback on complex building projects

Key Lessons Learnt

- Identifying critical interactions between the various trades involved in a project
- Analysing the technical, economic and organisational consequences of coordination decisions
- Anticipate interface conflicts and propose appropriate solutions
- Develop a management strategy to manage the complexity of a project
- Utilise technical synthesis tools to facilitate coordination between stakeholders
- Adapt the organisation of a construction site to the specific constraints of an occupied site

Bibliography

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Keywords

Project Management Organisation (PMO) – Technical interfaces – Coordination – Technical synthesis – Secondary trades – Occupied site – Complexity – BIM – Planning – Site management

H&E 9-4 – Heating and Domestic Hot Water

Timetable	
Semester	9
Term	Sept. – Jan
Face-to-face	

Assessment
Continuous assessment

Duration	
Total	**25h30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- Ventilation and air treatment
- Thermodynamic systems
- Environmental approaches in construction
- Thermal regulations

Objectives

- To understand the different types of heat generation
- To understand the various distribution systems within a building
- To describe and size heating and domestic hot water systems
- To draw up an energy consumption analysis for the building
- Be able to recommend the most suitable heating and domestic hot water systems for a building
- Check that the proposed heating installation complies with regulatory requirements

Programme

- Overview of heat generation equipment
- Introduction to energy selection
- Overview of the different heating circuits
- Schematic diagrams of heating systems for a detached house and a multi-occupancy commercial building
- Pumps: selection and sizing
- Boiler room components: operation and safety
- Overview of the different types of heat emitters

- Design and sizing of the various circuits
- Overview of the DHW and recirculation circuits
- Control systems

The focus is consistently on:

- Sustainable development and energy savings
- Understanding the systems
- Project sizing
- The layout of networks on various plans
- Design and implementation
- Relationship with structural plans

The course is supplemented by one or more site visits. The focus will be on practical aspects (technical handbook, reading plans, supplier documentation).

Key learning outcomes

- Understanding the different types of heat generation
- Understand the various distribution networks within a building
- Describe and size heating and domestic hot water systems
- Carry out an energy consumption assessment of the building
- Be able to recommend the most suitable heating and domestic hot water systems for a building
- Check that the proposed heating installation complies with regulatory requirements

Bibliography

- *Memotech Energy Engineering*, P. Dal Zotto, J.-M. Larre, A. Merlet, L. Picau
- Supplier documents
- *The Handbook of Control and Technical Management*, R. Cyssau, PYC ed., 2000

Keywords: Heating, DHW, domestic hot water, heat generation, networks, emitters, control

H&E 9-5 – Industrial Equipment and Installations 2

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face

Assessment
Continuous assessment

Duration
Total.....15 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

Heating Systems

Objectives

- Functional analysis of an existing energy system
- Commissioning of the installation, checks and adjustments to optimise the system

Programme

Functional and structural analysis:

- Schematic diagram
- Identification of the various components

Behavioural analysis:

- Operation and use of measuring instruments
- Commissioning procedure
- Adjustments and checks of nominal air flow rates and pressures
- Adjustment and checking of nominal hydraulic flow rates and pressures
- Performance checks

Practical training facilities (examples):

- KIMO air handling test bench
- AIC hybrid heat pump heating test rig (heat pump + gas boiler + storage tank)
- Salmson hydraulic test bench
- Domestic wiring

Key skills

- Knowing how to use measuring instruments
- Commissioning an installation
- Testing an installation
- Calculating a system's performance

Keywords: Energy systems, commissioning, monitoring, performance, aerodynamics, hydraulics

H&E 9-6 – Finite Element Thermography

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face in person

Assessment
Continuous assessment

Duration
Total.....39 hours
Targeted skill(s)
C1 – Analyse a construction project within its environment
C2 - Recommend technical solutions for sustainable and more durable construction
C3 – Dimensioning structures and systems

This module is the fourth of five modules focusing on 'Architecture and Urban Physics' within the Housing and Energy programme. It aims to provide an understanding of the algorithmic concepts (structured meshing, ray tracing) upon which Urban Physics is based.

Prerequisites

The first three modules of the 'Architecture and Urban Physics' stream within the Housing and Energy programme (RHEE 7-6, RHEE 8-4, RHEE 8-5)

Objectives

- To understand the principles of finite element thermography
- To master the numerical modelling of heat transfer
- Apply the finite element method to building thermal problems
- Link experimental measurements to numerical simulations

Programme

Thermal imaging has revolutionised our understanding of heat transfer in many fields, as it has enabled the visualisation of surface temperature fields, which were previously only measurable using point sensors. However, thermal images are difficult to interpret and can only be captured in existing scenarios. To understand them and extrapolate them to projects not yet realised, it is necessary to have a digital twin. This course demonstrates how the finite element method can be used to obtain idealised thermal images that explain and extend the measured situations.

The first part deals with steady-state and transient thermal behaviour, based on the diffusion equations. Their discretisation leads to the historical formulation of the finite element method. Isoparametric elements are used, which means that the discretisation of the field under study—in this case, the temperature field—is the same as that of the geometry, i.e. Cartesian coordinates. Dirichlet boundary conditions are introduced without altering the global conductivity matrix, but by defining linear constraints on the nodal variables. This method can also be used to perform mesh merging of incompatible meshes, for example to connect two independently modelled regions. The outer surface of the model can be covered with elements representing convection, which have a virtual node to which heat transfer occurs.

The second part presents the blackbody model as applied to solar radiation, which involves a brief description of the apparent paths of the Sun. Long-wave radiation is also discussed, as it significantly influences heat transfer during transient conditions. Thermal inertia is fundamental here, as are sight factors.

The final chapter addresses the challenges of representing results and adapting them to the calculation of derived quantities, such as the Mean Radiant Temperature. In conclusion, the finite element method is indeed the numerical twin of experimental thermography.

Key learning outcomes

- Mastering the finite element method as applied to thermal analysis
- Understanding the relationship between experimental thermography and numerical simulation
- Modelling heat transfer in steady-state and transient conditions
- Analysing and interpreting the results of thermal simulations

Bibliography

- Lecture notes (138 pages, in English) available at `www.heliodon.net`; book in preparation (2025)

Keywords: Finite elements, thermal camera, thermography, numerical simulation, urban physics

H&E 9-7 – Acoustics, Optics and Lighting

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face

Assessment
Continuous assessment

Duration
Total.....**33 hours**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

Ventilation and air treatment, Thermodynamic systems, Environmental approaches in construction, Thermal regulations

Objectives

- Understand the different types of heat generation
- Understanding the different distribution systems in a building
- Describe and size heating and domestic hot water systems
- Carry out an energy consumption assessment of the building
- Be able to recommend the most suitable heating and domestic hot water systems for a building
- Check that the proposed heating installation complies with regulatory requirements

Programme

- Overview of heat generation equipment
- Introduction to energy selection
- Overview of the different heating circuits
- Schematic diagrams of heating systems for a detached house and a multi-occupancy commercial building
- Pumps: selection and sizing
- Boiler room components: operation and safety
- Overview of the different types of heat emitters
- Design and sizing of the various circuits
- Overview of the DHW and recirculation circuits
- Control systems

The focus is consistently on:

- Sustainable development, energy savings
- System knowledge
- Project sizing
- The layout of networks on the various plans
- Design and implementation
- Relationship with structural plans

The course is supplemented by one or more site visits. The focus will be on practical aspects (technical guidelines, reading plans, supplier documentation).

Key learning outcomes

- Understanding the different types of heat generation
- Understand the various distribution networks within a building
- Describe and size heating and domestic hot water systems
- Carry out an energy consumption assessment of the building
- Be able to recommend the most suitable heating and domestic hot water systems for a building
- Check that the proposed heating installation complies with regulatory requirements

Bibliography

- *Memotech Energy Engineering*, P. Dal Zotto, J-M. Larre, A. Merlet, L. Picau
- Supplier documents
- *The Handbook of Control and Technical Management*, R. Cyssau, PYC ed., 2000

Keywords: Heating, DHW, heat emitters, control, sizing, heat generation

H&E 9-1 – Building Electrical Systems – *Professional Qualifications*

Timetable	
Semester	9
Term	Sept. – Jan
Face-to-face	

Assessment
Continuous assessment

Duration	
Total	**27h30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 – Designing structures and systems
C4 - Managing a construction organisation

Prerequisites

- Ventilation and air treatment
- Thermodynamic systems
- Environmental approaches in construction
- Thermal regulations

Programme

- Building analysis: type, occupancy, use, architectural constraints, available energy sources, etc.
- Defining objectives with the client: budget, target energy performance level, comfort, aesthetics
- Building survey: walls, heating systems, ventilation, domestic hot water, air conditioning
- Assessment of current energy consumption and the breakdown of consumption
- Monitoring of energy consumption in real time or over several years
- Use of a thermal imaging camera
- Energy optimisation of the building envelope and technical systems
- Drafting of a summary report: condition survey, proposed works, cost estimates, quantification of energy savings, feasibility study and payback period
- Oral presentation

Key learnings

- Assessing the current building's energy performance
- Identifying user comfort requirements
- Propose appropriate works to improve the building's energy efficiency
- Costing the selected solutions
- Knowing how to calculate payback periods

Bibliography

- http://www.rt-batiment.fr
- Supplier documentation (insulation, equipment)
- Thermal imaging documentation

Keywords: diagnosis, recommendations, measurements

H&E 9-2 – Refurbishment, energy-efficient renovation – *Professional Contracts*

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face	

Assessment
Continuous assessment throughout the course

Duration	
Total	**28h30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- R6-15 – Materials 8: Eco-materials
- R6-11 - Building Thermodynamics 2

Objectives

- To understand the context of renovation in France (barriers and drivers)
- To master energy-efficient refurbishment and renovation techniques
- To design high-performance renovation projects using a holistic and systems-based approach
- To incorporate regulatory and environmental requirements
- Manage project interfaces
- Draw up a programme
- Draw up the necessary construction documents

Scope

- Energy Performance Certificate (EPC) and existing building regulations
- Energy audit and recommendations
- Renovation of the building envelope: external wall insulation, joinery, roofing
- High-performance energy systems: heat pump, dual-flow mechanical ventilation
- Comprehensive and phased renovation
- Regulations: RE2020, financial assistance (MaPrimeRénov')
- Site management in occupied properties
- Case studies of exemplary renovations and applications to detached houses or small blocks of flats

Key lessons learnt

- Carrying out a comprehensive energy audit
- Design an energy-efficient renovation project
- Costing and planning the renovation works
- Optimise the cost-performance ratio

Bibliography

- *Energy-efficient building renovation*, B. Sesolis, Dunod
- *Guide to Energy-Efficiency Renovation*, ADEME
- *The refurbishment of existing buildings*, P. Broise, Le Moniteur
- PACTE Programme

Keywords: Refurbishment, energy-efficient renovation, Energy Performance Certificate (EPC), audit, external wall insulation, performance, RE2020

H&E 9-4 – Heating and Domestic Hot Water – *Professional Contracts*

Timetable
Term 9
Term .....Sept. – Jan
Face-to-face

Assessment
Continuous assessment

Duration
Total **25h30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 – Managing a construction organisation

Prerequisites

- Ventilation and air treatment
- Thermodynamic systems
- Environmental approaches in construction
- Thermal regulations

Objectives

- To understand the different types of heat generation
- To understand the different distribution systems in a building
- To describe and size heating and domestic hot water systems
- To draw up an energy consumption analysis for the building
- Be able to recommend the most suitable heating and domestic hot water systems for a building
- Check that the proposed heating installation complies with regulatory requirements

Programme

- Overview of heat generation equipment
- Introduction to energy selection
- Overview of the different heating circuits
- Schematic diagrams of heating systems for a detached house and a multi-occupancy commercial building
- Pumps: selection and sizing
- Boiler room components: operation and safety
- Overview of the different types of heat emitters

- Design and sizing of the various circuits
- Overview of the DHW and recirculation circuits
- Control systems

The focus is consistently on:

- Sustainable development and energy savings
- Understanding the systems
- Project sizing
- The layout of networks on the various plans
- Design and implementation
- Relationship with structural plans

The course is supplemented by one or more site visits. The focus will be on practical aspects (technical handbook, reading plans, supplier documentation).

Key learning outcomes

- Understanding the different types of heat generation
- Understand the various distribution networks within a building
- Describe and size heating and domestic hot water systems
- Carry out an energy consumption assessment of the building
- Be able to recommend the most suitable heating and domestic hot water systems for a building
- Check that the proposed heating system complies with regulatory requirements

Bibliography

- *Memotech Energy Engineering*, P. Dal Zotto, J.-M. Larre, A. Merlet, L. Picau
- Supplier documents
- *The Handbook of Control and Technical Management*, R. Cyssau, PYC ed., 2000

Keywords: Heating, DHW, domestic hot water, heat generation, networks, emitters, control

H&E 9-6 – Finite Element Thermography – *Professional Contracts*

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face

Assessment
Continuous assessment throughout the course

Duration
Total.....39 hours
Targeted skill(s)
C1 – Analyse a construction project within its environment
C2 - Recommend technical solutions for sustainable and more durable construction
C3 – Dimensioning structures and systems
C4 – Manage a construction organisation

This module is the fourth of five modules focusing on 'Architecture and Urban Physics' within the Housing and Energy programme. It aims to provide an understanding of the algorithmic concepts (structured meshing, ray tracing) upon which Urban Physics is based.

Prerequisites

The first three modules of the 'Architecture and Urban Physics' stream within the Housing and Energy programme (RHEE 7-6, RHEE 8-4, RHEE 8-5)

Objectives

- To understand the principles of finite element thermography
- To master the numerical modelling of heat transfer
- Apply the finite element method to building thermal problems
- To link experimental measurements to numerical simulations

Programme

Thermal imaging has revolutionised our understanding of heat transfer in many fields, as it has enabled the visualisation of surface temperature fields, which were previously only measurable using point sensors. However, thermal images are difficult to interpret and can only be captured in existing scenarios. To understand them and extrapolate them to projects not yet realised, it is necessary to have a digital twin. This course demonstrates how the finite element method can be used to obtain idealised thermal images that explain and extend the measured situations.

The first part deals with steady-state and transient thermal behaviour, based on the diffusion equations. Their discretisation leads to the historical formulation of the finite element method. Isoparametric elements are used, which means that the discretisation of the field under study—in this case, the temperature field—is the same as that of the geometry, i.e. Cartesian coordinates. Dirichlet boundary conditions are introduced without altering the global conductivity matrix, but by defining linear constraints on the nodal variables. This method can also be used to perform mesh merging of incompatible meshes, for example to connect two independently modelled regions. The outer surface of the

model can be covered with elements representing convection, which have a virtual node to which heat transfer occurs.

The second part presents the blackbody model as applied to solar radiation, which involves a brief description of the apparent paths of the Sun. Long-wave radiation is also discussed, as it significantly influences heat exchange during transient conditions. Thermal inertia is fundamental here, as are sight factors.

The final chapter addresses the challenges of representing results and adapting them to the calculation of derived quantities, such as the Mean Radiant Temperature. In conclusion, finite element analysis is indeed the numerical counterpart of experimental thermography.

Key learning outcomes

- Mastering the finite element method as applied to thermal analysis
- Understand the relationship between experimental thermography and numerical simulation
- Modelling heat transfer in steady-state and transient conditions
- Analysing and interpreting the results of thermal simulations

Bibliography

- Lecture notes (138 pages, in English) available at `www.heliodon.net`; book in preparation (2025)

Keywords: Finite elements, thermal camera, thermography, numerical simulation, urban physics

H&E 9-7 – Acoustics, Optics and Lighting – *Professional Contracts*

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face

Assessment
Continuous assessment

Duration
Total.....33 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

Ventilation and air treatment, Thermodynamic systems, Environmental approaches in construction, Thermal regulations

Objectives

- To understand the different types of heat generation
- To understand the various distribution networks within a building
- To describe and size heating and domestic hot water systems
- To draw up an energy consumption assessment for the building
- Be able to recommend the most suitable heating and domestic hot water systems for a building
- Check that the proposed heating installation complies with regulatory requirements

Programme

- Overview of heat generation equipment
- Introduction to energy selection
- Overview of the different heating circuits
- Schematic diagrams of heating systems for a detached house and a multi-occupancy commercial building
- Pumps: selection and sizing
- Boiler room components: operation and safety
- Overview of the different types of heat emitters
- Design and sizing of the various circuits
- Overview of the DHW and recirculation circuits

- Control systems

The focus is always on:

- Sustainable development, energy savings
- System expertise
- Project sizing
- The layout of networks on various plans
- Design and implementation
- Relationship with structural plans

The course is supplemented by one or more site visits. The focus will be on practical aspects (technical guidelines, reading plans, supplier documentation).

Key learning outcomes

- Understanding the different types of heat generation
- Understand the various distribution networks within a building
- Describe and size heating and domestic hot water systems
- Carry out an energy consumption assessment of the building
- Be able to recommend the most suitable heating and domestic hot water systems for a building
- Check that the proposed heating installation complies with regulatory requirements

Bibliography

- *Memotech Energy Engineering*, P. Dal Zotto, J-M. Larre, A. Merlet, L. Picau
- Supplier documents
- *The Handbook of Control and Technical Management*, R. Cyssau, PYC ed., 2000

Keywords: Heating, DHW, radiators, control, sizing, heat generation

RIS 9-1 – Engineering Structures 2: Tunnels, Covered Tunnels

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
Lectures	6 hours
Tutorial	7.5 hours
Total	**1.30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 – Managing a construction organisation

Prerequisites

- Advanced geotechnics and soil mechanics
- Fundamentals of rock mechanics
- Fundamentals of materials and structural strength

Objectives

- To understand the principles of design and dimensioning for tunnels and covered trenches
- To identify excavation and support methods suited to geological conditions
- To integrate safety, cost and environmental considerations into underground projects

Syllabus

- Types of tunnels (road, rail, water, urban)
- Excavation methods: conventional (NATM), tunnel boring machines, covered trenches
- Geotechnical investigations and soil/rock assessment
- Design of linings and support structures
- Fire safety, ventilation, evacuation and operation
- Economic analysis: construction and maintenance costs
- Environmental constraints and urban impacts

Key lessons learnt

- Identify suitable tunnel types and excavation methods
- Designing tunnel support structures and linings
- Integrating safety, costs and environmental considerations into an underground project

Bibliography

- *Design and Construction of Tunnels*, Lunardi, P., Springer
- *Guidelines for Tunnel Design*, ITA-AITES

Keywords: Tunnels, covered trenches, tunnelling, support, NATM, geotechnics, safety

RIS 9-2 – Engineering Structures 3: River, Maritime and Port Structures

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
Lectures	6 hours
Tutorial	7.30 am
Total	**1.30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- General and marine hydraulics
- Fundamentals of geotechnics and foundations
- Fundamentals of structural mechanics

Objectives

- To understand the different types of river, maritime and port structures
- To understand their design principles and operational constraints
- To integrate safety, environmental and cost considerations into hydraulic engineering projects

Syllabus

- Types: locks, movable dams, quays, dykes, jetties, harbour basins
- Design and sizing: hydraulic, seismic and maritime loads
- Construction techniques: caissons, sheet piling, piles, rockfill
- Safety and operation of river and maritime structures
- Environmental constraints: ecosystems, sediments, pollution
- Economic analysis: construction, maintenance and port operating costs
- Case studies: recent port developments and river structures

Key learning points

- Identify the main types of hydraulic and port structures
- Analyse design and operational constraints
- Integrate safety, costs and environmental considerations into a river or maritime project

Bibliography

- *Guidelines for the Design of Maritime Structures*, PIANC
- *Maritime and Coastal Engineering Manual*, CIRIA

Keywords: River structures, maritime structures, port structures, locks, dykes, quays, hydraulics

RIS 9-3 – Inspection, maintenance and repair of structures

Schedule	
Half-year	9
Period	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorial	6 hours
Total	**1.30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- Knowledge of structural design and structural analysis
- Basics of the design of steel and reinforced concrete members
- Basics of Eurocodes 0 and 1
- Reading and interpreting structural drawings
- Introduction to modelling and technical drawing software

Objectives

- To understand the maintenance and monitoring policy for a portfolio of engineering structures
- To understand the constraints and methods involved in carrying out bridge repairs
- Apply theoretical and technical knowledge to the planning of civil engineering structure repairs
- To organise and manage repair works on these bridges

Programme

- Participation in the 'Le Pont' conference in Toulouse in October
  - Developments in knowledge of materials and structures: concrete, metallic materials, structures
  - Changes to the technical regulatory framework
  - Developments in diagnostic and management techniques
  - Developments in remedial intervention techniques: in masonry and concrete structures, in steel structures and in foundations
  - AI in civil engineering

Key lessons learnt

- Understanding the maintenance and monitoring policy for a portfolio of engineering structures

Bibliography

- *Design and Construction of Bridges*, Virlogeux and Calgaro, Presses des Ponts et Chaussées
- *Maintenance and Repair of Engineering Structures*, R. Lacroix and J.-A. Calgaro, Presses ENPC, 1997
- Proceedings of the 'Le Pont' symposium, Toulouse, Association Le Pont
- Civil Engineering Structures Bulletins, SETRA journal and subsequently Cerema's online journal https://www.cerema.fr/fr/centre-ressources/newsletters/boa-bulletin-ouvrages-art
- https://www.cerema.fr/fr/activites/infrastructures-transport/ouvrages-art
- Online encyclopaedia 'Techniques de l'Ingénieur', accessible via the UPPA libraries' website, under 'Electronic Resources'

Keywords: Inspection, maintenance, repair, civil engineering structures, upkeep, monitoring, IQOA, bridges

RIS 9-4 – Water Networks and Drainage

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration	
CM	7.30 am
Tutorial	10.30
Total	**18h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- General hydraulics
- Fundamentals of geotechnics and earthworks

Objectives

- To understand the various water networks (drinking water, sewerage, stormwater)
- To understand the operating principles and technical constraints
- Apply the basics of pipe layout and installation
- Incorporate safety, cost and environmental considerations into the design

Syllabus

- Types of water networks: drinking water, wastewater, stormwater
- Pipe materials and fittings
- Network layout: longitudinal profiles, gradients, depths
- Installation techniques, backfilling and compaction
- Waterproofing, inspections and acceptance tests
- Health and safety and risk prevention on network construction sites
- Cost estimation and management of environmental impacts

Key learning points

- Identifying the technical constraints of wet networks
- Plotting and laying out a sewerage or drinking water network
- Integrate safety, costs and environmental considerations into the design

Bibliography

- *Design and sizing of sewerage networks*, ASTEE Guide
- NF EN 805, *Water supply networks – General requirements*

Keywords: Wet networks, sewerage, drinking water, pipes, route planning, installation, inspection

RIS 9-5 – Dry networks and energy infrastructure

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorial	6 hours
Total	**1.30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

- General knowledge of infrastructure and networks
- Basic understanding of electricity and energy systems
- Ability to read plans and technical diagrams

Objectives

- To understand the organisation and operation of the main dry networks
- To identify the design and siting constraints of energy infrastructure
- Integrate the various networks into a development or construction project
- To analyse the interactions between networks and their environment

Syllabus

- Organisation of dry networks in development projects
- Electrical networks: transmission, distribution and connection
- Street lighting networks
- Telecommunications and fibre-optic networks
- Gas networks and associated infrastructure
- Heating and cooling networks
- Network coordination and interface management
- Regulatory and safety requirements
- Case studies relating to development and infrastructure projects

Key Learning Points

- Identify the functions and constraints of the various utility networks
- Design the integration of utility networks into a development project
- Analyse potential interactions and conflicts between networks
- Take regulatory requirements and safety considerations into account in the design

Bibliography

- Technical guides from network operators
- CEREMA publications relating to networks and infrastructure
- Regulations and standards applicable to dry networks

Keywords

Utility networks – Electricity – Gas – Telecommunications – Fibre optics – Street lighting – District heating networks – Energy infrastructure

RIS 9-6 – Environmental approach – Contaminated land

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
Lectures.....6 hours
Tutorial .....7.5 hours
Total **1.30**

Target skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- R 1-15: Introduction to environmental issues
- Materials Resources
- Technology resources
- Management Resources

Objectives

- To integrate an environmental approach from the design stage of a construction project
- To understand the technical and administrative process involved in an environmental assessment
- To draft an environmental assessment for construction projects
- To understand the different types of soil pollution and propose appropriate remediation measures

Syllabus

- Definition of the concept of the environment: physical, natural, social, cultural, economic and aesthetic factors
- Examining the different phases of a project's life cycle
- Use and adaptation of environmental impact assessment systems: interaction matrices, project activities, environmental factors
- French legal and regulatory framework: the Environment Code, written documents
- Soil pollution: types, in-situ characterisation, remediation

Academic teaching is put into practice through real-world case studies to produce a partial environmental impact assessment. An oral presentation, with peer assessment, concludes this Resource.

Key learning outcomes

- Understanding the regulatory framework for an environmental assessment
- Drafting an 'Environmental Impact Assessment' deliverable
- Understanding the types of soil pollution

Bibliography

- Environment Code

Keywords: Environment Code, assessment, design, environmental approach, sustainable development, remedial treatments

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RIS 9-7 - VRD 2

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face in person

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorial	6 hours
Total	**1.30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Knowledge acquired in the VRD 1 course
- Fundamentals of urban design and site organisation

Objectives

- To organise and coordinate the installation of various utility networks in an urban environment
- To integrate road infrastructure within a framework of sustainability and safety
- Assess the costs and constraints associated with utility networks and urban infrastructure
- Take account of environmental and regulatory constraints

Programme

- Planning and coordination of networks (dry and wet)
- Rules governing the overlapping and spacing of networks
- Interfaces with urban infrastructure (mobility, public spaces)
- Cost management and economic optimisation of road and utilities projects
- Environmental constraints and sustainable management (nuisances, construction waste)
- Safety, accessibility and regulations
- Case studies: phasing and planning of road and utilities works

Key takeaways

- Organising the installation and coordination of utility networks in urban areas
- Integrating costs, safety and regulations into projects
- Proposing sustainable solutions tailored to environmental constraints

Bibliography

- *Guide to the Coordination of Networks in Urban Areas*, CERTU
- *Urban Road Infrastructure Development*, SETRA

Keywords: road and utilities infrastructure, coordination, networks, urban integration, planning, costs, sustainability

RIS 9-8 – Rock Mechanics

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face in person

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial.....9 hours
Total.....**18h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Recommend technical solutions for sustainable and more durable construction

Prerequisites

- General geology and mineralogy
- Basic principles of soil mechanics
- Basics of strength of materials

Objectives

- To understand the mechanical properties of rocks
- To identify the modes of failure and stability of rock masses
- Apply survey and testing methods
- To integrate safety, costs and environmental constraints into projects

Syllabus

- Rock classification and mechanical properties
- Concepts of fracturing, joints, diaclases and anisotropy
- Laboratory and in situ tests (compression, shear, rebound hammer)
- Stability of rock slopes and rock faces
- Design criteria for tunnels, foundations and structures
- Safety and risk analysis for rock-based structures
- Economic analysis and project optimisation

Key learning points

- Identify the mechanical properties and behaviour of rock
- Assess the stability of rock masses
- Integrating safety, costs and environmental considerations into the design

Bibliography

- *Rock Engineering for Underground Excavations*, Hoek, E., CRC Press
- *Rock Mechanics Design in Mining and Civil Engineering*, Bieniawski, Z.T.

Keywords: Rock mechanics, mechanical properties, stability, rock masses, fracturing, testing

RIS 9-9 – Shallow and Deep Foundations

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	1.30 pm
Tutorial	12 noon
Total	**25h30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- Previous modules in geotechnics and soil mechanics
- Strength of materials
- Structural analysis

Objectives

This course enables students to acquire more advanced knowledge and skills than those covered in previous courses in the field of structural and geotechnical design of shallow and deep foundations:

- To develop an in-depth understanding of soil behaviour and its interaction with foundations.
- To master limit state analysis and design methods applied to shallow and deep foundations.
- To be able to define, justify and dimension different types of foundations by integrating geotechnical, structural and environmental constraints.
- To incorporate specific phenomena such as settlement, soil-structure interaction and local seismic response into geotechnical design.
- To train students in a critical and methodical approach that links laboratory and in situ tests to calculation models and design decisions.

Syllabus

- Definition of a geotechnical model of the subsoil based on in situ and laboratory tests
- Additional topics relating to shallow foundations: soil-structure interaction (SSI), raft foundations and slab foundations,
- Ultimate limit state (ULS) and serviceability limit state (SLS) checks for deep foundations
- Determination of settlements and negative friction
- Behaviour of piles subjected to lateral loads
- Group effect of piles
- Response of a deep foundation to soil-structure interaction
- ISS during an earthquake

Key lessons learnt

- Identify, based on in situ and laboratory tests, the relevant soil parameters for foundation design.
- Calculate the bearing capacity and settlements of shallow and deep foundations.
- Analyse the behaviour of a pile under lateral loads.
- Determine the overall bearing capacity and tensile strength of a group of piles.
- Assess and verify the permissible displacements of foundations for buildings and engineering structures.
- Analyse the local seismic response of foundation piles.

Bibliography

- *Calculation of Shallow and Deep Foundations*, Sébastien Burlon, Fahd Cuira, Roger Frank, published by Presses des Ponts, 2019
- *Practical Guide to Soil-Structure Interaction during Earthquakes*, Stéphane Brûlé, Fahd Cuira, Librairie Eyrolles, 2018
- NF EN 1997-1 Eurocode 7: Geotechnical design

Keywords: geotechnical subsoil model, foundations, bearing capacity, settlements, ISS, seismic response

RIS 9-10 – Soil Improvement and Reinforcement

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face in person	

Assessment
Continuous assessment

Duration	
CM	9 hours
Tutorial	10.30
Total	**7.30 pm**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- General geotechnics: soil properties
- Settlement and consolidation
- Foundations and retaining structures

Objectives

- To understand soil improvement and reinforcement techniques
- To apply these techniques to optimise bearing capacity and stability
- To take safety, costs and environmental impact into account when making technical decisions
- To be able to select the appropriate method for each type of soil and project

Syllabus

- Mechanical stabilisation: compaction, rigid inclusions, ballasted columns
- Chemical stabilisation: lime, cement, hydraulic binders
- Drainage and hydraulic improvement
- Pre-loading and accelerated consolidation techniques
- Quality control and site supervision
- Economic analysis and environmental constraints

Key learning points

- Identifying and applying soil improvement techniques
- Optimise bearing capacity and stability
- Integrate safety, costs and environmental constraints into projects

Bibliography

- *Construction and Geotechnical Engineering Handbook*, Koerner, R.M.
- *Soil Mechanics and Foundations*, Budhu, M., Wiley

Keywords: Soil improvement, reinforcement, stabilisation, compaction, ballasted columns, geotechnics

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RIS 9-11 – Earthworks 3

Timetable	
Semester	9
Term	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
Lecture	4 hours
Tutorial	10.30
Total	**2.30 pm**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- Proficiency in the concepts covered in Earthworks 1 and 2
- Concepts of applied geotechnics and consolidation
- Basics of structural calculation and design

Objectives

- To master advanced earthworks techniques for complex construction sites
- To optimise processes and equipment for performance and safety
- To take into account specific environmental and geotechnical constraints

Syllabus

- Earthworks techniques for complex structures (covered trenches, sloping embankments and cuttings)
- Management of problematic soils and heterogeneous materials
- Optimisation of earthworks sequences and choice of equipment
- Case studies: road earthworks, engineering structures, industrial platforms
- Risk analysis, safety and advanced regulations
- Detailed cost estimation and integration of environmental constraints
- Monitoring and quality control on complex construction sites

Key lessons learnt

- Applying advanced techniques suited to complex construction sites
- Optimise processes, equipment and costs
- Take into account specific environmental and geotechnical constraints
- Assess risks and implement appropriate safety measures

Bibliography

- *Foundations and Earthworks*, Philipponnat, G., Hubert, B., Eyrolles
- *A Practical Guide to Earthworks and Site Organisation*, LCPC-SETRA

Keywords: Earthworks, complex construction sites, problematic soils, optimisation, safety, geotechnics

RIS 9-12 – Lecture Series 2

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Duration	
CM	3h30
Total	**3h30**

Assessment
Assessed as SAÉ

Prerequisites

Resources specific to the RIS pathway

Objectives

- To deepen knowledge of the field of networks, linear infrastructure and soils through lectures and site visits
- To discover innovative practices and capitalise on feedback
- To link theory with professional practice

Programme

- Lectures by experts or industry representatives
- Site visits

Critical learning

- Identifying best practice and innovation
- Developing critical thinking skills regarding technical or organisational choices

Bibliography

- Speakers' publications or presentations
- OPPBTP or CSTB guidelines on construction methods or operating procedures
- Articles and industrial case studies

Keywords: Conferences, innovative equipment, materials and management practices, lessons learnt, site visits

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MHS 9-1 – Lightweight structural connections: foundations, complex assemblies

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorial	9 hours
Total	**4.30**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- Basic knowledge of the design of lightweight structures
- Knowledge of prefabrication and simple assemblies

Objectives

- To master the connections and foundations specific to lightweight structures
- To safely design complex connections
- To understand the impact of connections on overall stability

Syllabus

- Foundations suitable for lightweight structures
- Types of complex connections and associated calculations
- Case studies and optimisation of solutions

Key learning points

- Selecting connections suited to technical constraints
- Analysing overall stability by incorporating complex

connections 691

Bibliography

- Eurocodes 2 and 3
- CSTB publications on lightweight structures

Keywords: Lightweight structures, connections, foundations, complex assemblies, stability

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MHS 9-2 - Composite structures

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Duration	
CM	10.30 am
Tutorial	12.00
Total	**10.30 pm**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems

Prerequisites

- Basics of BA, BP and steel structures
- Understanding of prefabrication and assemblies

Objectives

- To understand composite steel-concrete structures
- To design and verify composite connections
- Incorporate prefabrication into the design process

Syllabus

- RC/steel and PC/steel structures
- Composite connections and joints
- Prefabricated case studies

Key learning points

- Designing composite structures
- Checking compliance and stability

Bibliography

- Eurocodes 2 and 3
- *Reinforced Concrete Handbook*, P. Guillemont

Keywords: Composite structures, steel-concrete, connections, prefabrication, design 693

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MHS 9-3 – Eco-design and eco-construction

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Duration	
CM	10.30 am
Tutorial	10.30
Total	**9.00 pm**

Assessment
Continuous assessment

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction

Prerequisites

- Basic knowledge of materials and construction
- Concepts of sustainable development and LCA

Objectives

- Apply eco-design principles to prefabricated projects
- Compare the environmental impacts of construction solutions

Syllabus

- Bio-based and geosourced materials
- Simplified LCA and technological choices
- Case studies on prefabricated buildings

Key takeaways

- Justifying the choice of materials and processes
- Assessing and comparing environmental impacts

Bibliography

- *Better Design and Construction with Raw Earth*, Vincent Venzal
- *Building with Cut Stone Today*, Gilles Perraudin
- *Bio-based materials*, Ministry for Ecological and Solidarity Transition

Keywords: Eco-design, green building, LCA, bio-based materials, sustainable development

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MHS 9-4 – Methods 3: methods dossier, complex projects

Timetable	
Semester	9
Term	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	7.5 hours
Tutorial	10.30
Total	**18h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 – Specify technical solutions for sustainable and more durable construction
C3 - Designing structures and systems
C4 - Manage a construction organisation

Prerequisites

- MHS 7-4 and 8-4: Methods 1 and 2
- Knowledge of phasing, scheduling and site management

Objectives

- To draw up a methods dossier for a complex off-site project
- Manage variations and risks
- To plan and coordinate works

Programme

- Analysis of complex projects
- Drawing up a comprehensive methodology document
- Coordination and phasing of works

Key learnings

- Organising and documenting a complex project
- Identifying and managing

risks 695

Bibliography

- *Prefabricated Construction Methods*, B. Cazet
- OPPBTP Guides on Methods and Phasing

Keywords: Methods, methods dossier, complex projects, phasing, coordination, risk management

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MHS 9-5 - Numerical Modelling and BIM 2

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face in person	

Assessment
Continuous assessment

Duration	
Lectures	6 hours
Practical	9 hours
Total	**15h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- MHS 8-5: Numerical Modelling and BIM 1
- Concepts of prefabrication and assembly

Objectives

- To develop a deeper understanding of BIM for prefabrication
- To manage interoperability and digital coordination
- To optimise workflows between design and site

Programme

- Advanced modelling and data management
- Interoperability between disciplines
- Case studies on modular and prefabricated projects

Key takeaways

- Using BIM to coordinate and optimise workflows
- Analysing digital information for decision-making 697

Bibliography

- Autodesk Revit and advanced manuals
- BuildingSMART, BIM standards
- CSTB publications on BIM and prefabrication

Keywords: BIM, digital modelling, interoperability, coordination, prefabrication

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MHS 9-6 – Structural, thermal and waterproofing interfaces

Calendar	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	9 hours
Tutorial	9 hours
Total	**18h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- Basics of prefabricated structures
- Basic concepts of thermal performance and waterproofing

Objectives

- To understand the interfaces between structure, insulation and waterproofing
- Propose integrated solutions for modular projects

Syllabus

- Structural/thermal/waterproofing interfaces
- Analysis of constraints and compatibility
- Case studies on prefabricated buildings

Key learnings

- Identifying critical interface points
- Proposing solutions optimised for performance and durability

Bibliography

- CSTB guides on insulation and waterproofing
- Eurocodes and technical standards

Keywords: Interfaces, structure, thermal, waterproofing, insulation, prefabrication

MHS 9-7 – Temporary stability and shoring 2: complex elements

Calendar
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....7.5 hours
Tutorial 7h30
Total.....15 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 – Designing structures and systems
C4 - Managing a construction organisation

Prerequisites

- MHS 8-9: Organisation and management of prefabrication 2
- Basic concepts of phasing and coordination

Objectives

- To manage the production and assembly of complex prefabricated components
- Optimise logistics and site workflows
- Oversee quality and safety during installation

Programme

- Planning and organisation of complex components
- Production monitoring and quality control
- Modular case studies

Key learnings

- Coordinating the production and assembly of complex components
- Managing logistics and ensuring quality

Bibliography

- *Lean Management for the Construction Industry*, M. Ballé
- OPPBTP guides on prefabrication and complex components

Keywords: Prefabrication, complex components, organisation, logistics, quality, coordination

MHS 9-8 – Organisation and management of prefabrication 3: complex components

Timetable	
Semester	9
Term	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	9 hours
Tutorial	7.30
Total	**4.30 pm**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

- MHS 8-10: Production, Processes, and Robotisation 1
- Fundamentals of industrialisation and emerging technologies

Objectives

- To gain a deeper understanding of robotisation and automation in construction
- To master 3D printing and the IoT for prefabricated production
- To optimise productivity and safety

Programme

- Advanced robotics and automation
- IoT for production monitoring and predictive maintenance
- 3D printing and innovative processes
- Case studies and workflow optimisation

Key takeaways

- Integrating innovative technologies into prefabrication
- Optimising production, safety and quality

Bibliography

- *Automation and Robotics in Construction*, T. Stafford
- Publications and guides on IoT and 3D printing
- Industry reports on robotisation and digitalisation

Keywords: Robotisation, automation, 3D printing, IoT, innovation, prefabrication

MHS 9-9 – Production, processes, robotisation 2

Timetable	
Semester	9
Period	Sept. – Jan
Face-to-face teaching	

Assessment
Continuous assessment

Duration	
CM	9 hours
Tutorial	7.30
Total	**4.30 pm**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- Production, processes, automation 1
- Basic knowledge of project management
- Introduction to BIM and digital tools for construction

Objectives

- To implement robotisation and digitalisation technologies in a real-world project
- To analyse the integration of automated processes into an industrial production line
- Assess the technical, economic and environmental suitability of innovative solutions
- Develop an approach to the design and continuous improvement of production processes

Programme

- Design of a production line incorporating robotics and automation
- Integration of IoT technologies for production monitoring and quality control
- Data utilisation: collection, analysis and decision support
- Advanced applications of 3D printing in construction and prefabrication
- Digital twins and industrial process control
- Case studies and feedback from the construction and manufacturing sectors
- Group project: designing or optimising a production process incorporating innovative technologies
- Multi-criteria analysis of proposed solutions: productivity, quality, safety, costs and environmental impacts

Key Learning Outcomes

- Designing a production process incorporating robotics and digitalisation tools
- Utilise data from sensors and connected systems to manage production
- Assess the feasibility and cost-effectiveness of an innovative solution applied to off-site construction
- Work in a project-based approach to develop an industrial solution that meets a real need
- Take a critical look at the technical, economic, human and environmental challenges of automation

Bibliography

- Publications and guides on the IoT in the construction industry

MHS 9-10 – Quality and environmental management systems

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Continuous assessment

Duration
CM .....9 hours
Tutorial.....9 hours
Total.....**18h**

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C4 - Manage a construction organisation

Prerequisites

- Knowledge of prefabrication and industrial processes
- Basic understanding of sustainable development and quality

Objectives

- To understand quality and environmental management approaches in prefabrication
- Master quality monitoring and audit tools
- To integrate environmental criteria into modular projects

Syllabus

- Quality and environmental standards and certifications
- Implementing indicators and monitoring performance
- Case studies and audits of prefabricated construction sites

Key learnings

- Applying quality standards and procedures
- Assessing and improving environmental and technical performance

Bibliography

- ISO 9001, ISO 14001
- OPPBTP and CSTB guides on quality and the environment
- Publications on green building and prefabrication

Keywords: Quality, environment, certifications, quality management, prefabrication, standards

MHS 9-11 – Lecture series 2

Timetable
Term 9
Period .....Sept. – Jan
Face-to-face teaching

Duration
Lecture.....3 hours
Total.....3 hours

Assessment
Assessed as SAÉ

Prerequisites

- Previous modules on prefabrication and off-site construction
- Basic concepts of site coordination and organisation

Objectives

- To deepen understanding of off-site construction through lectures and site visits
- To discover innovative practices and learn from experience
- To link theory with professional practice

Programme

- Lectures by experts and industry representatives
- Site visits and tours of prefabrication facilities
- Critical analysis of the solutions observed

Key learnings

- Identifying best practices and innovations
- Develop a critical approach to technical and organisational choices

Bibliography

- Publications and reports from specialist organisations
- OPPBTP and CSTB guides on prefabrication
- Articles and industry case studies

Keywords: Conferences, off-site construction, innovation, lessons learnt, site visits, prefabrication

SAÉ 9-1 – Specialist workshops and design offices

Calendar
Semester.....9
Period .....Sept. – Jan
Face-to-face teaching

Assessment
Defences and Portfolio

Duration	2.5 weeks
Supervised hours	25 hours
Self-study	45 hours

Target skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

Courses ISA1, ISA2, ISA3 and ISA4 (+ specialisation)

Objectives

- To carry out workshops or design projects on a specific topic led by a professional in the field

Programme

Specialist workshops are mini-projects lasting 1 or 2 days. In practice, this involves working in groups or individually on a specific or unique area of construction. This work will be supervised by a specialist in the field.

Below is a list of examples of specific areas or topics that could be covered in these workshops:

- Underground works
- Asbestos and lead in construction
- Low-carbon solutions (material formulations, rammed earth, etc.)
- Deconstruction and reuse
- Energy and the local area
- Life cycle assessment
- Structural stability
- Wind turbine
- Site visits
- Etc.

Key learning points

- Acquiring new knowledge in specific or specialised fields
- Applying technical skills in a supervised professional context
- Develop a practical and operational approach to specialised subjects

Bibliography

- Documents provided by guest professionals

Keywords: Workshops, professionals, specialisation, mini-projects, design office

Institut Supérieur Aquitain
ÉCOLE D'INGÉNIEURS

ISA BTP
FORMATION INGÉNIEUR

SAÉ 9-2 – Individual synthesis project

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Defences and Portfolio

Duration	4 weeks
Supervised hours	40 hours
Self-study	72 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- Experience in project management (gained throughout the ISA1 to ISA4 programme)
- Proficiency in technical and cross-disciplinary skills (engineering, multi-criteria analysis, communication, organisation)
- Ability to work independently and to draw on a variety of resources (bibliographic, digital, human)
- Understanding of the professional expectations of an engineer (rigour, the ability to synthesise information, clear communication)

Objectives

- To analyse a project using a holistic, multi-criteria engineering approach (C1, C2, C3, C4)
- To draw on all the skills acquired during the course to address a complex problem
- Develop a participatory and proactive approach, working independently and autonomously on an ambitious project
- To communicate clearly, concisely and succinctly, both in writing and orally, before a panel of industry professionals
- Demonstrate engineering-level competence through the quality of their thinking, methodology and deliverables

Programme

- **Launch and scope definition (Week 42)**:
  - Presentation of expectations and allocation of tutors
  - Definition of the project's main outlines (context, problem statement, objectives)
- **Individual work and supervision (Weeks 43 to 46)**:
  - Research, analysis of the problem, and development of a methodology

  - Individual meetings with tutors for adjustments and advice
- **Interim oral presentation (Week 47)**:
  - Presentation to a panel of two tutors (20 mins: 10 mins' presentation + 10 mins' discussion)
- **Specification (Week 50)**:
  - Structured document including:
    - Context and definition of the problem
    - Project objectives and scope (what is being studied and what is not)
    - Detailed functional description of the work to be carried out
    - Budget (if applicable) and schedule
  - Review of the terms of reference (Week 3):
    - Feedback from tutors to refine the project
- **In-depth work on the project (Weeks 4 to 8)**:
  - Implementation of the project in accordance with the approved terms of reference
  - Production of final deliverables (report, mock-ups, analyses, etc.)
- **Final oral presentation (Week 9)**:
  - Presentation to a panel of two teachers (45 mins: 20 mins' presentation + 25 mins' discussion)

Key learning outcomes

- Formulating a clear and relevant research question, rooted in a real-world professional context
- Organising one's work over the long term and adhering to a demanding schedule
- Draw on multidisciplinary skills to address a complex issue
- Drafting a rigorous set of specifications and defending them before a panel
- Analysing and synthesising information to produce professional-quality deliverables
- Communicate fluently and accurately, both in writing and orally, tailoring one's presentation to an expert audience

Keywords: Individual project, synthesis, multi-criteria engineering, specifications, autonomy, communication

SAÉ 9-3 – Collective solidarity-based development project: design/preparation phase

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face teaching

Assessment
Defences and Portfolio

Duration	4 weeks
Supervised hours	40 hours
Self-study	72 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- Basic knowledge of project management (scheduling, budgeting, logistics).
- Understanding of sustainable construction and building techniques suited to local contexts.
- Awareness of the social, cultural and environmental challenges facing developing countries.
- Ability to work in a multidisciplinary team and in an intercultural setting.

Objectives

- To design and carry out a community-based construction project (school building, healthcare centre, etc.) in response to the identified needs of a local community, **whilst strictly adhering to local building standards and on-site safety regulations**.
- To organise and plan all stages of the project – preparation, funding, travel, construction and evaluation – **whilst minimising risk-taking and prioritising architecture suited to local resources and needs**.
- Collaborate with local partners (NGOs, associations, local authorities) to ensure the project's sustainability and its alignment with real needs.
- Develop cross-disciplinary skills: budget management, fundraising, communication, adaptability and professional ethics.
- Commit to a socially responsible approach: social responsibility, respect for local cultures, and sustainable development, **by adopting a collaborative and participatory approach with beneficiaries**.

Programme

- Preparation (18 months):
  - Identification of the project and local partners.
  - Technical and financial study (plans, cost estimates, securing funding), **taking into account local standards and safety requirements**.
  - Logistical organisation (travel, accommodation, equipment, safety).
  - Communication and fundraising activities (events, partnerships, grants).
- On-site implementation (5 to 6 weeks):
  - Construction work carried out in collaboration with local professionals and supervised by our trainers, **with strict adherence to safety regulations and risk minimisation**.
  - Training beneficiaries in the maintenance and use of the facilities.
  - Ongoing assessment of the work and adjustments where necessary.
- Closure and post-project analysis:
  - Official handover of the project to the community.
  - Technical, financial and human resources review (report, presentation, lessons learnt).
  - Capitalising on lessons learnt for future cohorts.

Key learnings

- The ability to manage a complex project in an international and intercultural context, **whilst ensuring the safety of participants and compliance with local standards**.
- Mastering construction techniques suited to local resources and sustainability standards, **prioritising inclusive architecture that respects identified needs**.
- Developing an ethical and responsible approach: respect for local communities, management of environmental impacts, and financial transparency.
- Acquiring communication skills: fundraising, partnerships, and promoting the project.
- Analysing and learning from successes and challenges encountered to improve future editions, **whilst systematically incorporating feedback from local beneficiaries**.

Key Figures

- 20 projects completed since 2005.
- Annual budget: 170 to 200 k €(self-funding + donations).
- Average built area: 500 m² per project.
- Examples of projects:
  - 2019: Extension of a secondary school in Benin.
  - 2020: School and canteen in Tanzania.
  - 2023: Healthcare centre in Paraguay.
  - 2025: Secondary school in Senegal.

Bibliography

- Technical guides: SETRA, ICTAAL, and local building standards.
- Publications:
  - *Sustainable Development in Practice*, by J. Theys, published by La Découverte.
  - *Building in Solidarity*: NGO collectives and associations.
- Online resources:
  - Websites of partner NGOs (e.g. OVC Rwanda, Électricité Sans Frontières).
  - Feedback from previous Human'ISA cohorts.

Keywords: Solidarity-based development, humanitarian aid, design, adaptation, local resources, project

SAÉ 9-3 – Collective solidarity-based development project: design/preparation phase – *Pro contracts*

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face teaching

Assessment
Defences and Portfolio

Duration	2.5 weeks
Supervised hours	25 hours
Self-study	45 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- Basic knowledge of project management (scheduling, budgeting, logistics).
- Understanding of sustainable construction and building techniques adapted to local contexts.
- Awareness of the social, cultural and environmental challenges facing developing countries.
- Ability to work in a multidisciplinary team and in an intercultural setting.

Objectives

- To design and carry out a community-based construction project (school building, healthcare centre, etc.) in response to the identified needs of a local community, **whilst strictly adhering to local building standards and on-site safety regulations**.
- To organise and plan all stages of the project – preparation, funding, travel, construction and evaluation – **whilst minimising risk-taking and prioritising architecture suited to local resources and needs**.
- Collaborate with local partners (NGOs, associations, local authorities) to ensure the project's sustainability and its alignment with real needs.
- Develop cross-disciplinary skills: budget management, fundraising, communication, adaptability and professional ethics.
- Commit to a socially responsible approach: social responsibility, respect for local cultures, and sustainable development, **by adopting a collaborative and participatory approach with the beneficiaries**.

Programme

- Preparation (18 months):
  - Identification of the project and local partners.
  - Technical and financial study (plans, cost estimates, fundraising), **taking into account local standards and safety requirements**.
  - Logistical organisation (travel, accommodation, equipment, safety).
  - Communication and fundraising activities (events, partnerships, grants).
- On-site implementation (5 to 6 weeks):
  - Construction work carried out in collaboration with local professionals and supervised by our trainers, **with strict adherence to safety regulations and risk minimisation**.
  - Training beneficiaries in the maintenance and use of the facilities.
  - Ongoing assessment of the work and adjustments where necessary.
- Closure and post-project analysis:
  - Official handover of the project to the community.
  - Technical, financial and human resources review (report, presentation, lessons learnt).
  - Capitalising on lessons learnt for future cohorts.

Key learnings

- The ability to manage a complex project in an international and intercultural context, **whilst ensuring the safety of participants and compliance with local standards**.
- Mastering construction techniques suited to local resources and sustainability standards, **prioritising inclusive architecture that respects identified needs**.
- Developing an ethical and responsible approach: respect for local communities, management of environmental impacts, and financial transparency.
- Acquiring communication skills: fundraising, partnerships, and promoting the project.
- Analysing and learning from successes and challenges encountered to improve future editions, **whilst systematically incorporating feedback from local beneficiaries**.

Key Figures

- 20 projects completed since 2005.
- Annual budget: 170 to 200 k €(self-funding + donations).
- Average built-up area: 500 m² per project.
- Examples of completed projects:
  - 2019: Extension of a secondary school in Benin.
  - 2020: School and canteen in Tanzania.
  - 2023: Healthcare centre in Paraguay.
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- Books:
  - *Sustainable Development in Practice*, by J. Theys, published by La Découverte.
  - *Building for Solidarity*, compiled by NGOs and associations.
- Online resources:
  - Websites of partner NGOs (e.g. OVC Rwanda, Électricité Sans Frontières).
  - Feedback from previous Human'ISA cohorts.

Keywords: Solidarity-based development, humanitarian aid, design, adaptation, local resources, project

SAÉ 9-4 – Work Placement – *Professional Contracts*

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face teaching

Duration	15 weeks

Assessment

Targeted skills
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Designing structures and systems
C4 - Manage a construction organisation

This course description is currently being drafted.

A dedicated working group has been set up to define and formalise the details relating to this learning and assessment scenario.

The final version of the description is scheduled to be completed by 15 July 2026 at the latest.

SAÉ 9-3 – Collective solidarity development project: design/preparation phase – *Pro contracts*

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face in person

Assessment
Defences and Portfolio

Duration	2 weeks
Supervised hours	66 hours
Self-study	h

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 – Specify technical solutions for sustainable and more durable construction
C3 - Designing structures and systems
C4 - Manage a construction organisation

Prerequisites

- Basic knowledge of project management (scheduling, budgeting, logistics).
- Understanding of sustainable construction and building techniques adapted to local contexts.
- Awareness of the social, cultural and environmental challenges facing developing countries.
- Ability to work in a multidisciplinary team and in an intercultural setting.

Objectives

- To design and carry out a community-based construction project (school building, healthcare centre, etc.) in response to the identified needs of a local community, **whilst strictly adhering to local building standards and on-site safety regulations**.
- To organise and plan all stages of the project – preparation, funding, travel, construction and evaluation – **whilst minimising risk-taking and prioritising architecture suited to local resources and needs**.
- Collaborate with local partners (NGOs, associations, local authorities) to ensure the project's sustainability and its alignment with real needs.
- Develop cross-disciplinary skills: budget management, fundraising, communication, adaptability and professional ethics.
- Commit to a socially responsible approach: social responsibility, respect for local cultures, and sustainable development, **by adopting a collaborative and participatory approach with the beneficiaries**.

Programme

- Preparation (18 months):
  - Identification of the project and local partners.
  - Technical and financial study (plans, cost estimates, securing funding), **taking into account local standards and safety requirements**.
  - Logistical organisation (travel, accommodation, equipment, safety).
  - Communication and fundraising activities (events, partnerships, grants).
- On-site implementation (5 to 6 weeks):
  - Construction work carried out in collaboration with local professionals and supervised by our trainers, **with strict adherence to safety regulations and risk minimisation**.
  - Training beneficiaries in the maintenance and use of the facilities.
  - Ongoing assessment of the work and adjustments where necessary.
- Closure and post-project analysis:
  - Official handover of the project to the community.
  - Technical, financial and human resources review (report, presentation, lessons learnt).
  - Capitalising on knowledge for future cohorts.

Key learnings

- The ability to manage a complex project in an international and intercultural context, **whilst ensuring the safety of participants and compliance with local standards**.
- Mastering construction techniques suited to local resources and sustainability standards, **prioritising inclusive architecture that respects identified needs**.
- Developing an ethical and responsible approach: respect for local communities, management of environmental impacts, and financial transparency.
- Acquiring communication skills: fundraising, partnerships, and promoting the project.
- Analysing and learning from successes and challenges encountered to improve future editions, **whilst systematically incorporating feedback from local beneficiaries**.

Key Figures

- 20 projects completed since 2005.
- Annual budget: 170 to 200 k €(self-funding + donations).
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  - *Building for Solidarity*, compiled by NGOs and associations.
- Online resources:
  - Websites of partner NGOs (e.g. OVC Rwanda, Électricité Sans Frontières).
  - Feedback from previous Human'ISA cohorts.

Keywords: Solidarity-based development, humanitarian aid, design, adaptation, local resources, project

SAÉ 9-5 – Work placement – *Professional contracts*

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face teaching

Assessment

Duration	10 weeks

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

This course description is currently being drafted.

A dedicated working group has been set up to define and formalise the details relating to this learning and assessment scenario.

The final version of the description is scheduled to be completed by 15 July 2026 at the latest.

SAÉ 9-6 – Programme proposal – *Professional contracts*

Timetable
Semester.....9
Term .....Sept. – Jan
Face-to-face teaching

Assessment
Defences and Portfolio

Duration	1 week
Supervised hours	33 hours
Self-study	h

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- All resources for the relevant course
- Experience gained in the workplace and during previous SAÉ placements
- Project management tools and methods

Objectives

- To apply all the skills acquired during the course
- To lead a project by drawing on design and implementation skills
- Develop a comprehensive understanding of the technical, organisational, economic and human aspects of a project
- To enhance autonomy and the ability to work in a professional environment

Programme

- Identifying a problem or need arising from the professional context
- Analysis of the technical, regulatory and organisational context
- Development of a suitable design solution
- Implementation, where possible, of an execution or pilot phase
- Presentation of results and feedback

Key Learning Points

- Integrating the resources and skills acquired throughout the programme
- Analysing a complex issue and proposing appropriate solutions
- Managing a project from the design phase through to its implementation or trialling
- Evaluate the results achieved and critically assess the choices made
- Communicate effectively with the various project stakeholders

Bibliography

- Technical, standard and regulatory documents used depending on the subject covered

Keywords

Project – Design – Implementation – Testing – Autonomy – Project management – Professional skills

SAÉ 9-3 – Collective solidarity development project: design/preparation phase

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face in person

Assessment
Defences and Portfolio

Duration	2 weeks
Supervised hours	66 hours
Self-study	h

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- Basic knowledge of project management (scheduling, budgeting, logistics).
- Understanding of sustainable construction and building techniques adapted to local contexts.
- Awareness of the social, cultural and environmental challenges facing developing countries.
- Ability to work in a multidisciplinary team and in an intercultural setting.

Objectives

- To design and carry out a community-based construction project (school building, healthcare centre, etc.) in response to the identified needs of a local community, **whilst strictly adhering to local building standards and on-site safety regulations**.
- To organise and plan all stages of the project – preparation, funding, travel, construction and evaluation – **whilst minimising risk-taking and prioritising architecture suited to local resources and needs**.
- Collaborate with local partners (NGOs, associations, local authorities) to ensure the project's sustainability and its alignment with real needs.
- Develop cross-disciplinary skills: budget management, fundraising, communication, adaptability and professional ethics.
- Commit to a socially responsible approach: social responsibility, respect for local cultures, and sustainable development, **by adopting a collaborative and participatory approach with the beneficiaries**.

Programme

- Preparation (18 months):
  - Identification of the project and local partners.
  - Technical and financial study (plans, cost estimates, securing funding), **taking into account local standards and safety requirements**.
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  - Communication and fundraising activities (events, partnerships, grants).
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  - Ongoing assessment of the work and adjustments where necessary.
- Closure and post-project analysis:
  - Official handover of the project to the community.
  - Technical, financial and human resources review (report, presentation, lessons learnt).
  - Capitalising on lessons learnt for future cohorts.

Key learnings

- The ability to manage a complex project in an international and intercultural context, **whilst ensuring the safety of participants and compliance with local standards**.
- Mastering construction techniques suited to local resources and sustainability standards, **prioritising inclusive architecture that respects identified needs**.
- Developing an ethical and responsible approach: respect for local communities, management of environmental impacts, and financial transparency.
- Acquiring communication skills: fundraising, partnerships, and promoting the project.
- Analysing and learning from successes and challenges encountered to improve future editions, **whilst systematically incorporating feedback from local beneficiaries**.

Key Figures

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- Online resources:
  - Websites of partner NGOs (e.g. OVC Rwanda, Électricité Sans Frontières).
  - Feedback from previous Human'ISA cohorts.

Keywords: Solidarity-based development, humanitarian aid, design, adaptation, local resources, project

SAÉ 9-5 – Work placement

Timetable
Semester.....9
Period .....Sept. – Jan
Face-to-face teaching

Assessment

Duration	10 weeks

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

This course description is currently being drafted.

A dedicated working group has been set up to define and formalise the details relating to this learning and assessment scenario.

The final version of the description is scheduled to be completed by 15 July 2026 at the latest.

Semester 10 – BCR pathway

Competency C1 – Analysing a construction project within its environment

Learning Outcomes for Competency C1		%
SAÉ 10-1	Group project on solidarity-based development: implementation phase	6.99 %
SAÉ 10-2	End-of-studies placement related to the course of study	93.01

Competency C2 – Prescribing technical solutions for sustainable and more durable construction

SAÉ for Competency C2		%
SAÉ 10-1	Collective solidarity development project: implementation phase	6.99 %
SAÉ 10-2	End-of-course work placement related to the course	93.01%

Competence C3 – Designing structures and systems

SAÉ for Competence C3		%
SAÉ 10-1	Group project on solidarity-based development: implementation phase	6.99 %
SAÉ 10-2	End-of-studies placement related to the course of study	93.01

Competency C4 – Managing a construction organisation

SAÉ for Competency C4		%
SAÉ 10-1	Collective social development project: implementation phase	6.99 %
SAÉ 10-2	End-of-studies placement related to the course of study	93.01%

Semester 10 – GCM programme

Competency C1 – Analysing a construction project within its context

Assessment of Competency C1		%
SAÉ 10-1	Collective solidarity-based development project: implementation phase	6.99%
SAÉ 10-2	End-of-studies placement related to the course of study	93.01%

Competency C2 – Prescribing technical solutions for sustainable and more durable construction

SAÉ for Competency C2		%
SAÉ 10-1	Collective solidarity development project: implementation phase	6.99 %
SAÉ 10-2	End-of-studies placement related to the course of study	93.01

Competence C3 – Dimensioning structures and systems

SAÉ for Competence C3		%
SAÉ 10-1	Group project on solidarity-based development: implementation phase	6.99 %
SAÉ 10-2	End-of-studies placement related to the course of study	93.01

Competency C4 – Managing a construction organisation

SAÉ for Competency C4		%
SAÉ 10-1	Community-based development project: implementation phase	6.99%
SAÉ 10-2	End-of-studies placement related to the course of study	93.01%

Semester 10 – H&E programme

Competency C1 – Analysing a construction project within its context

Assessment for Competency C1		%
SAÉ 10-1	Group project on solidarity-based development: implementation phase	6.99 %
SAÉ 10-2	End-of-studies placement related to the course of study	93.01

Competency C2 – Prescribing technical solutions for sustainable and more durable construction

SAÉ for Competency C2		%
SAÉ 10-1	Collective solidarity development project: implementation phase	6.99 %
SAÉ 10-2	End-of-studies placement related to the course of study	93.01%

Competence C3 – Designing structures and systems

SAÉ for Competency C3		%
SAÉ 10-1	Group project on solidarity-based development: implementation phase	6.99 %
SAÉ 10-2	End-of-studies placement related to the course of study	93.01

Competency C4 – Managing a construction organisation

SAÉ for Competency C4		%
SAÉ 10-1	Collective social development project: implementation phase	6.99 %
SAÉ 10-2	End-of-studies placement related to the course of study	93.01%

Semester 10 – RIS programme

Competency C1 – Analysing a construction project within its environment

Assessment of Competency C1		%
SAÉ 10-1	Group project on solidarity-based development: implementation phase	10.14 %
SAÉ 10-3	Work placement period	89.86

Competence C2 – Proposing technical solutions for sustainable and more durable construction

C2 Competence Assessment		%
SAÉ 10-1	Collective solidarity development project: implementation phase	10.14 %
SAÉ 10-3	Work placement period	89.86%

Competency C3 – Dimensioning structures and systems

SAÉ for Competency C3		%
SAÉ 10-1	Group project on solidarity-based development: implementation phase	10.14 %
SAÉ 10-3	Work placement period	89.86

Competency C4 – Managing a construction organisation

SAÉ for Competency C4		%
SAÉ 10-1	Collective social development project: implementation phase	10.14 %
SAÉ 10-3	Work placement period	89.86%

Semester 10 – MHS pathway

Competency C1 – Analysing a construction project within its context

SAÉ for Competency C1		%
SAÉ 10-1	Group project on solidarity-based development: implementation phase	10.14 %
SAÉ 10-3	Work placement	89.86%

Competency C2 – Prescribing technical solutions for sustainable and more durable construction

SAÉ for Competency C2		%
SAÉ 10-1	Collective solidarity development project: implementation phase	10.14 %
SAÉ 10-3	Work placement period	89.86%

Competency C3 – Dimensioning structures and systems

SAÉ for Competency C3		%
SAÉ 10-1	Group project on solidarity-based development: implementation phase	10.14 %
SAÉ 10-3	Work placement period	89.86

Competency C4 – Managing a construction organisation

SAÉ for Competency C4		%
SAÉ 10-1	Collective social development project: implementation phase	10.14 %
SAÉ 10-3	Work placement period	89.86%

SAÉ 10-1 – Collective solidarity development project: implementation phase

Timetable
Semester 10
Period .....Jan–Feb
Face-to-face in person

Assessment
Defences and Portfolio

Duration	5 weeks
Supervised hours	20 hours
Self-study	120 hours

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Design structures and systems
C4 - Manage a construction organisation

Prerequisites

- Basic knowledge of project management (scheduling, budgeting, logistics).
- Understanding of sustainable construction and building techniques suited to local contexts.
- Awareness of the social, cultural and environmental issues facing developing countries.
- Ability to work in a multidisciplinary team and in an intercultural setting.

Objectives

- To design and carry out a community-based construction project (school building, healthcare centre, etc.) in response to the identified needs of a local community, **whilst strictly adhering to local building standards and on-site safety regulations**.
- To organise and plan all stages of the project – preparation, funding, travel, construction and evaluation – **whilst minimising risk and prioritising architectural solutions suited to local resources and needs**.
- Collaborate with local partners (NGOs, associations, local authorities) to ensure the project's sustainability and its alignment with real needs.
- Develop cross-disciplinary skills: budget management, fundraising, communication, adaptability and professional ethics.
- Commit to a socially responsible approach: social responsibility, respect for local cultures, and sustainable development, **by adopting a collaborative and participatory approach with beneficiaries**.

Programme

- Preparation (18 months):
  - Identification of the project and local partners.
  - Technical and financial study (plans, cost estimates, fundraising), **taking into account local standards and safety requirements**.
  - Logistical organisation (travel, accommodation, equipment, safety).
  - Communication and fundraising activities (events, partnerships, grants).
- On-site implementation (5 to 6 weeks):
  - Construction work carried out in collaboration with local professionals and supervised by our trainers, **with strict adherence to safety regulations and risk minimisation**.
  - Training beneficiaries in the maintenance and use of the facilities.
  - Ongoing assessment of the work and adjustments where necessary.
- Closure and post-project analysis:
  - Official handover of the project to the community.
  - Technical, financial and human resources review (report, presentation, lessons learnt).
  - Capitalising on lessons learnt for future cohorts.

Key learnings

- The ability to manage a complex project in an international and intercultural context, **whilst ensuring the safety of participants and compliance with local standards**.
- Mastering construction techniques suited to local resources and sustainability standards, **prioritising inclusive architecture that respects identified needs**.
- Developing an ethical and responsible approach: respect for local communities, management of environmental impacts, and financial transparency.
- Acquiring communication skills: fundraising, partnerships, and promoting the project.
- Analysing and learning from successes and challenges encountered to improve future editions, **whilst systematically incorporating feedback from local beneficiaries**.

Key Figures

- 20 projects completed since 2005.
- Annual budget: 170 to 200 k €(self-funding + donations).
- Average built area: 500 m² per project.
- Examples of projects:
  - 2019: Extension of a secondary school in Benin.
  - 2020: School and canteen in Tanzania.
  - 2023: Healthcare centre in Paraguay.
  - 2025: Secondary school in Senegal.

Bibliography

- Technical guides: SETRA, ICTAAL, and local building standards.
- Books:
  - *Sustainable Development in Practice*, by J. Theys, published by La Découverte.
  - *Building for Solidarity*, compiled by NGOs and associations.
- Online resources:
  - Websites of partner NGOs (e.g. OVC Rwanda, Électricité Sans Frontières).
  - Feedback from previous Human'ISA cohorts.

Keywords: Solidarity-based development, humanitarian aid, design, adaptation, local resources, project

SAÉ 10-2 – End-of-course work placement related to the study programme

Timetable
Semester 10
Period .....Jan–Feb
Face-to-face in person

Assessment
Report and oral defence

Duration	19 weeks

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 - Manage a construction organisation

Prerequisites

No specific prerequisites other than having completed the full ISA BTP engineering programme.

Objectives

- To guide the future engineer's career path and better identify their aptitude for a particular branch of the profession or for a specific company.
- To facilitate entry into the workforce.
- To participate in the preparation and/or management of construction sites (all types and/or TCE), or in the design of a project, the development of construction methods, operating procedures and the technical and human resources to be deployed by the company awarded the contract.

Programme

- Complete a 20-week work placement as an engineer's assistant (Level 2) in a construction company (or two consecutive placements totalling 20 weeks).
- The intern will work as an assistant to a construction engineer on all types of building sites or in various trades, or in engineering offices, to assist with the design, supervision, preparation and/or management of building sites.
- Develop a project accounting for at least 25% of the placement, the subject of which will be approved before the placement begins or as early as possible.
- Assessment based on:
  - The intern's conduct and the achievement of the set objectives (assessed by the company supervisor and the lecturer).
  - The placement report.
  - The oral presentation on the project.

Key learning outcomes

- Integrating into the workplace and actively contributing to technical projects.
- Structuring and writing a high-quality professional report, in French or a foreign language (bonus marks may be awarded).
- To present a technical project orally to a panel.
- Self-assess one's skills and career path.

Bibliography

- *Methodological Guide to the Work Placement Report*, ISA BTP.
- *The Civil Engineering Profession*, A. Mercier, Eyrolles.
- *Succeeding in Your Work Placement*, C. Dupont, Dunod.

Assignment

- **Internship report** (approximately 25 pages + appendices) including:
  - A cover page (student's name, company, sector of activity, keywords).
  - An introduction: background, objectives of the work placement, brief overview of the company and department, outline of the report.
  - Project description (minimum 25% of the placement): background, problem statement, development, conclusion.
  - An assessment and conclusion (1 page).
  - A bilingual glossary (if the placement was abroad) and six keywords (1 page).
- **Oral defence** (15 minutes):
  - Introduction.
  - Presentation of the project: background, research question, development, conclusion.
  - Conclusion on the placement and the course of study.
- **Self-assessment**: use of the dedicated tool (instructions provided during the academic year).

Keywords: Work placement, civil engineering, placement report, presentation, self-assessment, career entry, technical project. "'—

This format adheres to the structure and requirements you have shared. If you wish to add or amend anything, please do let me know!

SAÉ 10-3 – Work placement

Timetable
Semester 10
Term .....Jan–Feb
Face-to-face in person

Assessment
Report and oral defence

Duration	19 weeks

Targeted skill(s)
C1 – Analysing a construction project within its context
C2 - Specify technical solutions for sustainable and more durable construction
C3 - Dimensioning structures and systems
C4 – Managing a construction organisation

Prerequisites

Have successfully completed the previous work-study periods and be in the final year of the engineering apprenticeship programme.

Objectives

- To complete the apprentice engineer's professional development by consolidating their skills within a company.
- To facilitate entry into the workforce and prepare the student for autonomy as an engineer.
- To play an active role in the preparation, management or design of complex technical projects within the company.

Programme

- A 19-week work placement in the role of assistant engineer or junior engineer.
- Integration into a project or operational team to contribute to technical, managerial or design tasks, in line with the training programme.
- Completion of a significant project, accounting for at least 25 per cent of the placement period, the topic of which is agreed in advance with the company mentor and the academic supervisor.
- Assessment based on:
  - Achievement of set objectives and commitment within the company (assessed by the company mentor and the academic supervisor).
  - The activity report.
  - The oral presentation of the project.

Key learning outcomes

- Carrying out engineering tasks independently within a company.
- Structuring and drafting a concise, technical professional report.
- To present and defend a project before a panel.
- Self-assess one's skills and career plans.

Bibliography

- *Methodological guide to the activity report*, ISA BTP.
- *The Engineering Profession through Apprenticeship*, P. Martin, Dunod.
- *Making a Success of Your Work-Study Programme*, L. Bernard, Eyrolles.

Assignment

- **Activity report** (approximately 25 pages + appendices) including:
  - A cover page (apprentice's name, company, sector of activity, keywords).
  - An introduction: background, objectives for the period, brief overview of the company and department, outline of the report.
  - Project details (covering at least 25% of the placement period): background, problem statement, development, conclusion.
  - An assessment and conclusion (1 page).
  - A bilingual glossary (if the experience is international) and six keywords (1 page).
- **Oral defence** (15 minutes):
  - Introduction.
  - Presentation of the project: background, problem statement, development, conclusion.
  - Conclusion on the work placement and academic journey.
- **Self-assessment**: use of the dedicated tool (instructions provided during the academic year).

Keywords: Work placement, apprenticeship, engineer, activity report, presentation, career entry, technical project.