



COURSE DESCRIPTION CARD - SYLLABUS

Course name

Flexibility in engineering design [S2Bud1E-ZBZ>EwPI]

Course

Field of study

Civil Engineering

Year/Semester

1/1

Area of study (specialization)

Sustainable construction and management

Profile of study

general academic

Level of study

second-cycle

Course offered in

English

Form of study

full-time

Requirements

compulsory

Number of hours

Lecture

15

Laboratory classes

0

Other

0

Tutorials

30

Projects/seminars

0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

The student has basic knowledge of civil engineering. The student is able to acquire information from indicated sources and analyse engineering activities. The student is aware of the need for continuous learning and professional responsibility. The student understands issues related to construction project management throughout the life cycle, including sustainable construction criteria.

Course objective

To acquire and expand knowledge of flexible design approaches in the planning, execution, and operation of construction projects. To develop awareness of designing buildings not only with respect to initial construction costs but also considering life-cycle costs, adaptability, future expansion, and change of use.

Course-related learning outcomes

Knowledge:

- Has advanced knowledge of strength of materials, modelling of materials and structures, including fundamentals of the Finite Element Method and nonlinear structural analysis.
- Has in-depth knowledge of algorithms used in selected software supporting analysis and design of building structures and tools useful for planning and managing construction projects, including BIM

technology.

- Has in-depth knowledge of geodetic surveys and measurement methods used in construction processes, including inventory, diagnostic and control procedures.
- Has structured and theoretically grounded knowledge of processes occurring throughout the life cycle of construction objects and understands the need for their systematic assessment and maintenance.

Skills:

- Is able to perform preliminary economic analysis of engineering solutions, prepare cost estimates, schedules, contracts, and business plans, and manage construction processes, including defining responsibilities of construction and investor supervision.
- Is able to assess risks related to construction projects and building operation, implement safety principles, and develop work standards and quality management procedures.

Social competences:

- Is ready to independently develop and expand knowledge in the field of modern construction processes and technologies.
- Is ready to think and act in an entrepreneurial way.
- Is aware of the need for continuous professional and personal development and is ready to critically evaluate acquired knowledge.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: the final grade results from the evaluation of the presentation of the case study and the credit colloquium (in the last class)

Exercises: the final grade based on the partial grades from the final project (analysis of a given case) and a final colloquium covering the topics raised during the classes

Grading scale:

- <90-100%> - 5.0 (A)
- <80-90%> - 4.5 (B)
- <70-80%> - 4.0 (C)
- <60-70%> - 3.5 (D)
- <50-60%> - 3.0 (E)
- <50% - 2.0 (F)

Programme content

Lecture 1 - Introduction to flexibility in engineering design

Lecture 2 - Uncertainty and risk in planning, execution and operation of construction projects

Lecture 3 - Analytical methods in traditional and flexible approaches

Lecture 4 - Flexibility in practical design and implementation of construction projects

Lecture 5 - Case studies of flexibility in building design

Lecture 6 - Discussion and presentation of case studies

Lecture 7 - Summary and assessment

Class 1 - Introduction

Class 2 - Flexible approach to construction processes

Class 3 - Case studies of flexibility applications

Class 4 - Net Present Value (NPV) analysis

Class 5 - Monte Carlo Analysis

Class 6 - Decision trees

Class 7 - Informed decision-making

Class 8 - Final test

Course topics

Issues related to flexibility in engineering design in construction. Analysis of flexible design concepts under changing conditions of project implementation and operation. Decision-support methods under uncertainty, including economic analysis, Net Present Value (NPV), decision trees, and group decision-making. Practical applications of flexible design approaches in construction projects in national and international contexts. The role of flexibility in optimising costs, enabling adaptability of buildings, and

managing the building life cycle.

Teaching methods

Lectures:

- problem-based lecture
- discussion - case study analysis
- inverted class method

Exercises:

- project method
- working in groups
- analysis of a given case

Bibliography

Basic:

1. Richard De Neufville, Stefan Scholtes, Flexibility in Engineering Design, MIT 2011
2. Richard De Neufville, Applied Systems Analysis: Engineering Planning and Technology Management, McGraw-Hill College 1990

Additional:

1. Richard De Neufville, Systems Analysis for Engineers and Managers, McGraw-Hill 1971
2. Gerhard Pahl, W. Beitz, Jörg Feldhusen, Karl-Heinrich Grote, Engineering Design: A Systematic Approach, Springer Nature 2007
3. Project Management Institute, A Guide to the Project Management Body of Knowledge (PMBOK Guide), Fifth Edition or subsequent editions, e.g., Eighth Edition (2026)
4. Richard De Neufville, Amedeo Odoni, Airport Systems: Planning, Design, and Management, McGraw Hill Professional 2002

Breakdown of average student's workload

	Hours	ECTS
Total workload	90	3,00
Classes requiring direct contact with the teacher	45	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	45	1,50