

CIVIL-411

Dam engineering

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Cursus	Sem.	Type
Civil Engineering	MA1, MA3	Opt.
Energy minor	H	Opt.

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	Oral
Workload	90h
Weeks	14
Hours	3 weekly
Lecture	3 weekly
Number of positions	

Summary

Dams are paramount for human development around the world. The course is an introduction to the fascinating domain of dam engineering, from design to construction, for water storage and regulated supply, including for renewable energy generation (hydropower), flood protection and drought prevention.

Content

- Purposes of dams and reservoirs. Potential positive and negative impacts on the environment.
- Types of dams. Selection criteria for the selection of the type of dam.
- Concrete dams: design criteria. Calculations of forces and stresses in gravity dams, buttress dams and arch dams. Behaviour during earthquakes. Constructive details. Particular foundations and uplift pressures. Drainage and foundation treatment. Specification of mass concrete: construction methods and heating effects.
- Construction alternatives: roller compacted concrete, hardfill (embankment), cyclopean concrete
- Dam monitoring. Security concept and risk management. Equipment for auscultation.
- Embankment dams (earth and rock): typical profiles and selection criteria.
- Foundation treatment.
- Stability calculations.
- Earthquake behaviour. Controls during execution and operation. Surface protection.
- Layout of dam and appurtenant structures (flood release system, bottom outlets, water intakes, powerhouse, river diversion system, etc.)
- Emergency Planning
- Innovation in Dam Engineering

Keywords

Layout and design of dams as water retaining structures
 Concrete dams
 Embankment dams
 Mixed dams

Learning Prerequisites**Required courses**

Strength of materials
 Geotechnics (soil mechanics, rock mechanics, slope stability)

Hydraulics (hydraulic works, hydraulic equipment, free surface and pressurized flows)
Concrete structures (stability)

Recommended courses

(in addition to the above required courses)

Earthquake engineering
Hydrology (catchment/flood hydrology)
Geology (fundamentals of geology & hydrogeology)
Construction materials

Important concepts to start the course

Force & displacements, constitutive laws, elasticity etc.
Stability analysis (sliding, overturning, lift and drag)
Virtual works principle
Flow in pervious & fissured media
Uncertainty

Learning Outcomes

By the end of the course, the student must be able to:

- Analyze the elements to be considered to select and design different types of dams
- Compare different solutions from the technical, economic and environmental standpoints
- Sketch the initial layout of a dam
- Propose preliminary design of different types of concrete and embankment dams
- Choose the most adequate dam type for a given location/context

Transversal skills

- Take responsibility for environmental impacts of her/ his actions and decisions.
- Respect relevant legal guidelines and ethical codes for the profession.

Teaching methods

Ex cathedra lectures with in-class exercises during the semester

Expected student activities

Active learning during lectures, exercises.

Assessment methods

Exercises (30%) and Oral exam during exam session (70%)

Supervision

Office hours	No
Assistants	Yes
Forum	Yes
Others	To be presented in first lecture

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

In English : Design, Safety and Operation of Dams, Schleiss, Pougatsch

(<https://press.uchicago.edu/ucp/books/book/distributed/D/bo196817651.html>)

In French: TGC Vol.17, édition 2020, PPUR Les barrages : du projet à la mise en service / Anton J.

Schleiss et Henri Pougatsch,

2020. (http://opac.nebis.ch/F?local_base=nebis&con_lng=FRE&func=find-b&find_code=020&request=978-2-88074-831-9)

Ressources en bibliothèque

- [Design, Safety and Operation of Dams / Schleiss, Pougatsch](#)
- [Les barrages : du projet à la mise en service / Schleiss, Pougatsch](#)

Notes/Handbook

Advances in Dam Engineering: collection of innovative cases, Manso (2023).

Moodle Link

- <https://go.epfl.ch/CIVIL-411>

Prerequisite for

Master diploma

Master thesis in Dam Engineering