Two phase media and fluid-solid interactions

ECTS credits
2 credits

Semester
Fall

In brief

Course langage: French

Presentation

Prerequisites

Continuum Mechanics, Solid Mechanics and/or Fluid Mechanics (see 1st year Mechanics course)

Learning objectives

• Understand and model solid/fluid interactions in natural or urban environments: porous media (including concrete, soils, rocks and granular media), free surface flows with erosion
• Acquire the basic elements to approach the hydraulic risk, the flood risk, and the risk analysis associated with reservoir dams and river protection dykes
• Concepts related to dams and dikes concerning environmental impacts, renewable energies and climate change impacts

Description of the programme

• Mechanics of porous media (including concrete, soils, rocks and granular media): two-phase conservation equations, behavioral laws (Mohr-Coulomb failure criteria, Cam-Clay behavioral models, Hill instability criterion) and solid/fluid interaction (Darcy's law, heat transport, Terzaghi's effective constraints, internal erosion).
• Two-phase flows, erosion and sediment transport: two-phase conservation equations and jump equations, elements of fluid mechanics (turbulence, roughness), external flow/porous medium interactions (mass exchange, momentum exchange, Brinkman's law, external erosion), free-surface flows
surface flows, Navier-Stokes equations with erosion, shallow water eqs. with erosion
• Application examples: reservoir dams and river dikes for flood protection (utility, design, safety, hydraulic risk analysis, study of some historical failures), impact of reservoir dams on the environment, reservoir dams and renewable energy, flood risk and climate change

- Labs :
  -- Session 1: Poromechanical calculation with Abaqus ;
  -- Session 2 : Simulation of the erosion failure of a river protection dam and flood wave propagation with CastorDigue

Generic central skills and knowledge targeted in the discipline

- Understand and know how to model porous media, free surface flows with erosion
- Know how to propose an operational model adapted to the problem
- Analyze and criticize computational results
- Develop complex models of multiphase media for a new problem

How knowledge is tested

CC: Reports on practical works (100%)

Bibliography

Course handout

Teaching team

Stéphane Bonelli (research director, Inrae, Aix-en-Provence)

Total des heures		**24h**
CM	Master class	12h
TD	Directed work	4h
TP	Practical work	8h

Useful info

Name responsible for EU

Lead Instructor

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