CIVIL-409

Stability of structures

Cursus	Sem.	Type
Civil & Environmental Engineering		Opt.
Civil Engineering	MA2, MA4	Opt.
Civil engineering minor	E	Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	3 weekly
Exercises	1 weekly
Number of positions	

Remark

Pas donné en 2026-27 - Biennal course taught in odd years.

Summary

Advanced topics in structural stability; elastic & inelastic column buckling; lateral-torsional buckling of bridge/plate girders; nonlinear geometric effects; frame stability; computational formulation of stability theory; Geometric stiffness method; Plate buckling; Plastic collapse analysis

Content

- Week 1: Introduction & easy statics
- Week 2: Plastic analysis and collapse loads
- Week 3: Stability of axially loaded members
- Week 4: Interaction curves - bending and axial load
- Week 5: Lateral torsional buckling of members - P1
- Week 6: Lateral torsional buckling of members - P2
- Week 7: Frame stability
- Week 8: Geometric stiffness method for buckling analysis
- Week 9: Euler method and equlibrium paths
- Week 10: Potential energy method for assessing stability
- Week 11: Dynamic method for assessing stability
- Week 12: Plate buckling
- Week 13: Applications of plate buckling in structural mechanics
- Week 14: Case studies on structural stability

Keywords

structural stability, static & dynamic loading, nonlinear geometric instabilities, nonlinear behaviour, frame stability, plastic analysis, plate buckling, plate girders

Learning Prerequisites

Required courses

- Statics
- structural analysis
- mechanics of materials and/or structural mechanics

Recommended courses

- Design of steel structures
- Design of concrete structures
- Statics
- Structural mechanics

Learning Outcomes

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

- Assess / Evaluate
- Critique
- Design
- Estimate
- Analyze
- Check
- Dimension
- Define

Transversal skills

- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Set objectives and design an action plan to reach those objectives.
- Use a work methodology appropriate to the task.
- Communicate effectively with professionals from other disciplines.
- Access and evaluate appropriate sources of information.
- Use both general and domain specific IT resources and tools
- Communicate effectively, being understood, including across different languages and cultures.
- Identify the different roles that are involved in well-functioning teams and assume different roles, including leadership roles.

Teaching methods

3-hour lectures, 1-hour exercises
Use of:

- Power point
- Online reading
- Python-based tools to facilitate learning and computational thinking
- In-class exercises
- Problem sets

Expected student activities

- Class participation
- Weekly In-class exercises

Assessment methods

- Graded assignments (30% of the total grade)
- Final written exam (70% of hte total grade)

Supervision

Others The course lectures will be provided online 3-hours after the end of each class.

Resources

Bibliography

- Ziemian, RD. Guide to stability design criteria for metal structures
- Bazant, Z., and Cedolin, L. Stability of structures
- Chen, WF., Him, EM. Structural stability: Theory and Implementation
- SIA-263 / Eurocodes

- SIA standard 263 [printed version]
- Guide to stability design criteria for metal structures / Ziemian
- Structural stability: Theory and Implementation / Chen and Lui
- SIA standard 263 [available online for EPFL community]
- Stability of structures / Bazant and Cedolin

Ressources en bibliothèque

- SIA standards [available online for EPFL community]
- Find the references at the Library
- Structural stability: Theory and Implementation / Chen

Notes/Handbook

- The course lectures, list of in-class exercise problems, problem sets and exams are based on lecture notes that are provided weekly through Moodle.
- The course does not follow a specific textbook.

Moodle Link

- https://go.epfl.ch/CIVIL-409

Prerequisite for

- Master projects in structural analysis and advanced design of structures
- Nonlinear static and dynamic analysis of structures
- Performance assessment of new and existing structures
- Performance-Based Earthquake Engineering (PBEE)