

CIVIL-369

Structural stability

Sousa Albano António, Heredia Rosa Diego Isidoro, Lignos Dimitrios

| 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 | |

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 equilibrium 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 the 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

Ressources en bibliothèque

- [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](#)

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-369>

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)