

CIVIL-323

**Reinforced concrete structures**

Ruggiero David Michael Volpe

<b>Cursus</b>	<b>Sem.</b>	<b>Type</b>
Civil Engineering	BA5	Obl.

Language of teaching	English
Credits	5
Session	Winter
Semester	Fall
Exam	Written
Workload	150h
Weeks	14
<b>Hours</b>	<b>5 weekly</b>
Lecture	3 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**Summary**

This course introduces the student to the behaviour and design of reinforced concrete structures. The student will learn the principles of analysis of reinforced concrete and how to design common concrete elements including columns, beams, and slabs.

**Content**

Introduction: General background; History of reinforced concrete; Sustainability  
 Material behaviour of concrete; Shrinkage, creep, temperature effects; Material behaviour of reinforcing steel  
 Equilibrium, compatibility, constitutive laws; Linear elements in compression; Linear elements in tension; Bond and development  
 Basic principles of flexure; Uncracked, cracked elastic, plastic behaviour; Design of singly and doubly reinforced beams  
 Combined flexure and axial load; M-N interaction diagrams; Biaxial bending  
 Beam shear; Truss model; Longitudinal demand due to shear  
 Serviceability; Long-term deflection; Crack opening  
 Column design; Second-order effects  
 Elastic vs. plastic design; Upper bound, lower bound  
 Background of slabs; Strip method for slabs  
 Yield line method for slabs  
 Punching in slabs  
 Strut-and-tie analysis  
 Detailing; Frame corners; Changing sections

**Keywords**

Structures, Concrete, Stress fields, Design

**Learning Prerequisites****Required courses**

Structural mechanics (for GC), Continuum mechanics (for GC)

**Important concepts to start the course**

Statics, mechanics of materials

**Learning Outcomes**

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

- Apply the principles of equilibrium, compatibility, and constitutive behaviour to reinforced concrete

- Identify the appropriate design method for a given element
- Design reinforced concrete beams, slabs, and columns
- Analyze the effects of long-term loading
- Compare different methods for shear design

### Transversal skills

- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Respect relevant legal guidelines and ethical codes for the profession.
- Manage priorities.
- Set objectives and design an action plan to reach those objectives.
- Assess one's own level of skill acquisition, and plan their on-going learning goals.
- Access and evaluate appropriate sources of information.

### Teaching methods

- Ex cathedra
- Powerpoint
- Discussion
- Computational tools
- In-class exercises
- Problem sets

### Expected student activities

- Attend lectures
- Participate in exercises
- Home study
- Problem sets

### Assessment methods

- Continuous assessment (40% of total grade)
- Final written exam (60% of total grade)

### Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

### Resources

#### Moodle Link

- <https://go.epfl.ch/CIVIL-323>

### Prerequisite for

Reinforced concrete structures - Advanced topics, Ponts en béton