

CIVIL-710

**Fatigue and fracture of structures**

Brühwiler Eugen, Invited lecturers (see below), Nussbaumer Alain

<b>Cursus</b>	<b>Sem.</b>	<b>Type</b>
Civil & Environmental Engineering		Opt.

Language of teaching	English
Credits	3
Session	
Exam	Oral
Workload	90h
<b>Hours</b>	<b>42</b>
Courses	30
Project	12
<b>Number of positions</b>	<b>20</b>

**Frequency**

Only this year

**Remark**

February 14th - April 14th 2022

**Summary**

All the necessary bases for the determination of stress intensity factors and application of fracture mechanics to structures. Use of fracture mechanics for fatigue and fatigue life curves to design safely structural elements against fatigue. Application to different construction materials.

**Content**

The course will treat the following topics:

- Fracture micromechanisms in steels, Griffith and Irwin theories, concept of stress intensity factor (SIF), fracture toughness
- SIF determination: FEM and derivation of geometric functions, Green's functions and weight functions
- Fatigue under constant and variable loadings, fatigue thresholds, modeling of fatigue (endurance) limit
- Plated steel structures : Fatigue strength of welded steel elements, size effect, residual stresses influence, application of fracture mechanics to fatigue, sources of scatter & probabilistic description
- Tubular steel structures : Hot spot stress method for fatigue design
- Structural glass: Subcritical crack growth, predicting time to failure
- Reinforced concrete structures : Fracture mechanics, fracture of concrete, size effect, brittle failure, fatigue of reinforced concrete elements, evaluation of fatigue safety of bridge decks, fracture due to dynamic effects.
- R-UHPFRC structures: fracture and fatigue properties of Ultra-High Performance Fiber Reinforced Composites, structural implications, design provisions

**Note**

Invited Professor Davide Leonetti coming from Eindhoven University of Technology.

**Keywords**

Fracture mechanics, fatigue, steel structures, concrete structures, probabilistic modelling, structural safety

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

Mechanics of structures and materials, Finite element method

**Learning Outcomes**

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

- Ability to deal with different materials, to compute stress intensity factors, predict brittle fracture, analyse fatigue data, compute fatigue damage, design safely structural elements against fatigue

## Resources

### Bibliography

Anderson TL. Fracture mechanics. Fundamentals and Applications. 3rd edition. Boca Raton, FL: CRC Press, Taylor & Francis Group; 2005.  
Lecture notes from E. Brühwiler and D. Leonetti.