



Aalto University

MEC-E8007

Fracture Mechanics

Luc St-Pierre

Schedule

Lectures:

- Tuesdays and Wednesdays, 14.15-16.00, Otakaari 4, room 216.
- Hybrid lectures, recordings will be available via mycourses.
- Attendance is not mandatory.

Calculation hours:

- Thursdays, 14.15-16.00, Otakaari 4, room 216.
- If you cannot attend, send your questions by email.

Evaluation

- **5 Assignments (40%)**

- Your mark will be based on your 4 best assignments.
- 4 sets of problems and 1 computer exercise.
 - *Upload your assignment via MyCourses.*
 - *Contact me by email if you need an extension.*

- **Exam (60%)**

- Wednesday June 1, from 9.00-12.00.
- Online exam, open books.

Grade	Final mark %
5	≥86
4	76-85
3	66-75
2	56-65
1	50-55
0 – Fail	≤49

Contact persons

Teacher in charge:

Luc St-Pierre luc.st-pierre@aalto.fi

Teaching assistant:

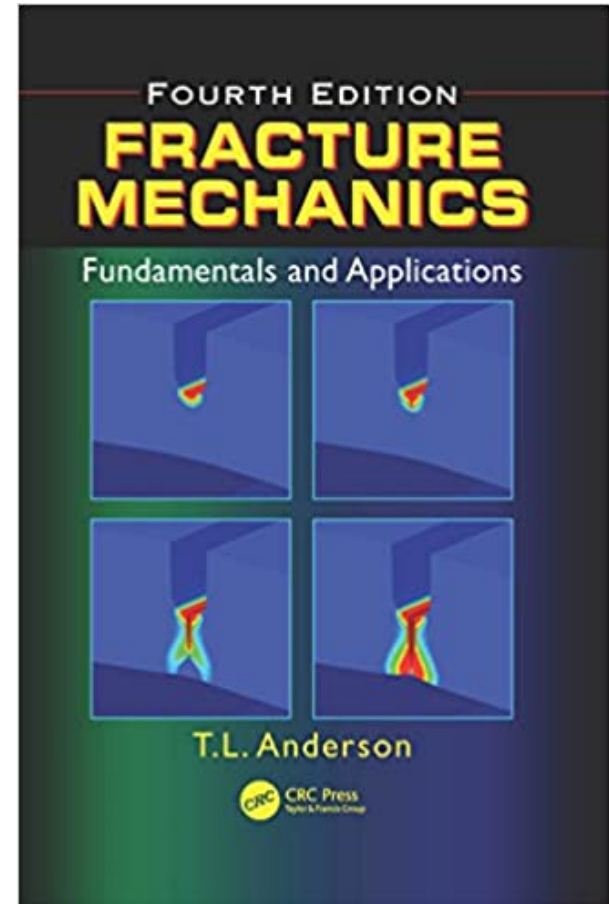
Iman El Gharamti iman.elgharamti@aalto.fi

Material

Lecture notes will be available on MyCourses.

Consult the textbook if you need additional information:

- T.L. Anderson, Fracture Mechanics: fundamentals and applications, 4th edition, 2017.



E-books available

- M. Janssen; J. Zuidema; R.J.H. Wanhill; *Fracture mechanics*, Spon press, 2004.
- C.T. Sun; Z.-H. Jin; *Fracture mechanics*, Butterworth-Heinemann/Elsevier, 2012.
- A.T. Zehnder; *Fracture mechanics*, Springer, 2012.
- N. Perez; *Fracture mechanics*, Springer, 2017.
- E.E. Gdoutos; *Fracture mechanics: an introduction*, Springer, 2020.

Why study fracture mechanics?

- **To understand how materials break and prevent structures from failing.**
- **Most structures fail because of:**
 1. Negligence during design, fabrication or operation.
 2. The use of new materials or processes leads to unexpected outcomes.
- **Several type-2 failures have led to the development of fracture mechanics, which is a relatively new field (1900-).**

Historical perspective

- Old structures (castles, cathedrals & bridges) were made of bricks and mortar, and designed to be loaded in **compression**.
- The industrial revolution brought the mass production of iron and steel.
- This changed the design approach: now structures were able to carry **tensile** stresses.
- This change in design lead to problems. Occasionally, a steel structure would fail at stresses well below the tensile strength.
- Why? That is what we will learn in Fracture Mechanics.

Content

- **Linear Elastic Fracture Mechanics (LEFM)**
 - Week 1: Stress intensity factor.
 - Week 2: Energy release rate.
 - Week 3: Mixed-mode fracture.
- **Elastic Plastic Fracture Mechanics**
 - Week 4: Plastic zone size and J-integral.
 - Week 5-6: Numerical approaches, Fracture tests and mechanisms.

Connections with other courses

