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Fracture Mechanics of Materials

Aims

This course aims at providing basic knowledge and understanding of how materials may fail in service. The specific objectives include (i) explanation of the physical processes underlying fracture from a single crack and from distributed cracks, (ii) main concepts of fracture mechanics in terms of stress analysis and failure mechanisms, (iii) introduction of linear elastic fracture mechanics (LEFM) and ductile fracture, (iv) examples of Fracture Mechanics methods at work for selected engineering applications.

Targeted audience

Students of Mechanics, Materials Science and Engineering, other subjects of Engineering Science.

Content

The course will cover the following topics:

- Spectacular engineering failures and their impact of fracture mechanics development
- Microscopic and macroscopic characteristics of brittle and ductile fracture
- Linear Elastic Fracture Mechanics: crack tip fields, fracture modes
- Stress intensity factor concept, *K* factors
- Practical *K*-determination, superposition principle, interaction of cracks
- Experimental measurements of fracture toughness
- Energy approach to fracture, Griffith theory of fracture, energy release rate *G*
- Influence of the T-stress and higher order terms, equivalence between SIF and G
- Extension of Griffith theory by Irwin and Orowan, R-curves
- *J*-integral
- Small scale yielding
- Elastic plastic fracture mechanics: Dugdale model, HRR field, fracture criterion, determination of *J*-integral and J_c
- Fatigue crack growth, Paris law, S-N curves
- Stress corrosion cracking, creep crack growth
- Introduction to Damage Mechanics

References

D. Broek, Elementary Engineering Fracture Mechanics, Kluwer Academic Publishers, Dordrecht, 1986.
T.L. Anderson, Fracture Mechanics: Fundamentals and Applications, 3rd Edition, Taylor & Francis, 2005.