Strength of materials and structures

ECTS credits
2 credits

Semester
Fall

In brief

Course langage: French

Presentation

Prerequisites

- MMC, tensor algebra and analysis
- Elastoplastic behavior (see 3rd year Material behavior - Plasticity course)
- Beam model (see 3rd year Thin structures ans instablities course)

Learning objectives

- Discover the classical approaches of linear fracture mechanics
- Discover the main characteristics of the fatigue phenomenon of materials and structures on simple examples
- Know the classical approaches to fatigue called "uniaxial" and discover the current approaches to fatigue (multiaxial)
- Acquire the concepts and calculation methods used in yield design and limit analysis

Description of the programme

- Part 1: Phenomena and Models
  -- Linear fracture mechanics: validity domain and typical problem
  -- Global approach to fracture: energy restitution rate and Griffith criterion
  -- Local approach to fracture: stress intensity factors and K1c criterion
  -- Comparison between the two classical approaches in linear fracture mechanics
  -- Influence of the loading path (monotonic or cyclic) on the fracture behavior of solid of solid structures: phenomenology and classification
  -- Uniaxial" fatigue with a large number of cycles: Wöhler curve and Haigh diagram; Paris law
  -- Uniaxial" fatigue at small number of cycles (oligocyclic): Manson-Coffin law

-- Multiaxial fatigue at large number of cycles: macroscopic criterion of Sines and macro-micro of Dang Van
- Part 2: Yield design and limit analysis
-- Notions of limit loads and plastic failure mechanisms: examples of a lattice of bars and a cylindrical shaft in torsion
-- Theory of yield design: notion of resistance criterion of materials, maximum resisting work and static approach for the calculation of loads potentially bearable by a structure
-- Dual kinematic approach
-- Notion of safety coefficient
-- Application to beam structures, notion of plastic hinge in bending

Generic central skills and knowledge targeted in the discipline

- Know the failure mechanisms
- Know the main criteria of failure
- Know how to determine the mechanisms that can lead to the failure of a given system
- Know how to dimension a structure with respect to yield design

How knowledge is tested

- DS1 : written evaluation of 1 hour on the 1st part (50%)
- DS2 : written evaluation of 1 hour on the 2nd part (50%)

Bibliography

- J. Garrigues, Cinématique des milieux continus (en ligne)
- J. Lemaître et J.-L. Chaboche, Mécanique des matériaux solides, éd. Dunod, 2004
- D. François, A. Pineau et A. Zaoui, Viscoplasticité, endommagement, mécanique de la rupture, mécanique du contact, éd. Lavoisier, 2009
- J. Salençon, Calcul à la rupture et analyse limite, Presses de l'ENPC, 1983

Teaching team

- Thierry Désoyer
- Stéphane Bourgeois

Total des heures		**24h**
CM	Master class	18h
TD	Directed work	6h

Useful info

Name responsible for EU

Lead Instructor

Stéphane Bourgeois

stephane.bourgeois@centrale-marseille.fr