MÉCANIQUE DES STRUCTURES MINCES : PLAQUES ET COQUES

MECHANICS OF THIN STRUCTURES : PLATES AND SHELLS

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| Lecturers : 14.0 | TC : 10 | PW : 4.0 | Autonomy : 4 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

Thin structures, light and allowing optimization of the weight / performance ratio, feature prominently in many industries (aeronautics, civil engineering, chemical engineering, etc.). The main objective of this course is to provide the future engineers with elements required for modeling and design of buildings based on thin structural elements by analyzing the behavior of 2D thin structures, flat or curved.
In consideration of the material gain conferred by the thinness, the risk of instability is amplified: phenomena such as buckling of plates and shells have to be accounted for. The second objective of this course is to provide the future engineers with the bases to study instabilities of elastic thin structures.

Keywords : Solid mechanics, Thin plates and shells, Love-Kirchhoff model, Love model, Dimensioning, Elastic instability, Extensometry, Comparison theory/experiments

Programme

Part 1 - Elastic behavior of plates: 4 Lectures, 2 Tutorials, 1 Practical work; Definition, schematization, hypotheses, and mechanical forces ; internal forces; local balance ; LoveKirchhoff thin plates model ; boundary conditions.
Practical work: experimental validation of the Love-Kirchhoff model and study of an approximate solution.
Part 2 - Elastic behavior of shells of revolution: 2 Lectures, 2 Tutorials; Geometry of surfaces, definition, schematization, mechanical forces ; internal membrane forces ; local balance for shells of revolution ; usual loadings ; Elastic stress, strain, and displacements.
Part 3 - Elastic stability of thin structures: 2 Lectures/Tutorials; Buckling of thin plates and

Learning outcomes

- Being able to design plates and shells (stress, displacements, and elastic instabilities)
- Being able to determine predominant elastic effects in thin structures (stress, strain, displacements)
- Being able to build a model for 2D thin structures, following the way of modeling used for 1D structures during the previous semesters
- Being able to compare theory and experiment: engage a critical analysis to validate a model or an approximation (by an energy approach)

Independent study

Objectifs : Theoretical and experimental applications of the course to circular and rectangular plates. Writing of a synthesis document summarizing the experiments and critical anlyses.

Méhodes : Coordinated / Standard autonomies, group work near the practical works rooms (open access to test devices), ownership of the handout, validation of the theoretical/numerical works, group reflection: processing of measurements and critical analysis.

Core texts

S. P. Timoshenko, S. Wionowski-Krieger, *THEORY OF PLATES AND SHELLS*, Mc Graw Hill, 1970
F. Frey *TRAITÉ DE GÉNIE CIVIL DE L'ECOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE, VOL. 1 À 6*, Presses Polytechniques et Universitaires Romandes, 2003
S. P. Timoshenko, J. M. Gere*THEORY OF ELASTIC STABILITY*, Dover Publications, 2009

Assessment

Final mark = 50% Knowledge + 50% Know-how
Knowledge mark = 100% final exam
Know-how mark = 100% continuous assessment