ME-104 Teaching staff:

Lectures & Lead instructors of the course:


Prof. Pedro Reis

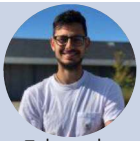

Prof. Sangwoo Kim

Instructors: (Logistics and Demos)


Dr. Fani Derveni


Dr. Uba K. Ubamanyu

Ph.D. Teaching Assistants:

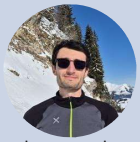

Eduardo Gutierrez


Gilad Yakir


Javier Sabater


Danick Lamoureux


Roxane Ollivier


Alessandro Rizzi


Florian Hartmann


Federico Peretti


Nan Xu

Undergraduate Teaching Assistants:


Adam Francés


Barnabás Györke


Inès Degas


Hippolyte Debarre


Alejandro Guirao Iglesias


Maxime Tourne


Carolina Rossi


Rami Ben Amor


Léo Durand


Lucie Tournier


Barbara Zilm


Milena Markovic


Raphaël Javary

Logistics:

	Monday	Tuesday	Wednesday	Thursday	Friday
10h15					
11h15					
13h15					
14h15	Lecture		Studio	Lecture	
15h00	Lecture		Studio	Lecture	
	Office hours			Office hours	

Lectures

Mondays: STCC Cloud C (14/4 & 26/5 in CE1-6)
Thursdays: SG1

* Presentation of fundamental content
* Sample example problems
* Practical demonstrations & experiments
* Engineering applications & context
* Hybrid offering in Zoom (but priority for in-class)
  Zoom link on Moodle.

Studios (Exercise classes)

Wednesdays: CM11/CM13/CM14

* Reviews and trailers of lecture content
* Pencil/paper exercises

- **'Office' hours:** Right after lecturers or by appointment.
- **Practice Quizzes (not for grade):** 1st Quiz — Wed., 12/03/2025: 13h15-14h15; 2nd Quiz — Wed., 30/04/2025: 13h15-14h15. During regular studios but in mock exam conditions.
- **Assessment method:** Final exam (100%) — Final exams period
- **Language of instruction:** English
  - BUT, many of the teaching assistants also speak French.
  - Feel free to ask questions in either English of French. (answers in French during Quizzes/Exam are fine)
  - Whenever possible, I'll try to provide English/French word for main concepts, e.g. *Buckling* (fr.: *flambage*)

Introduction to Structural Mechanics - Topics

Part I

Statics: System of Forces

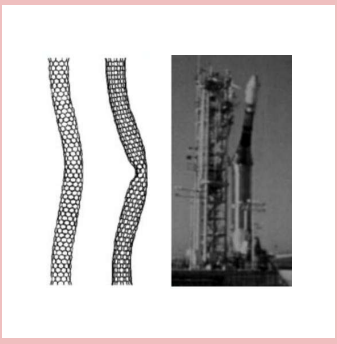
Part II

Static Structures

Part III

Deformation of Elastic Structures

Part IV



Structural Failure

ME-104 Introduction to Structural Mechanics

Part I : System of forces

- L2: Truss & Beam Structures
- L3: System of forces
- L4/5: Equilibrium in 2D
- L6: Constraints/Determinacy
- L7: Equilibrium in 3D
- Practice Quiz 1 (during studio) 12/03/2024

Part II : Rigid Structures

- L8: Structures, Mechanisms
- L9/10: Trusses, Frames & Machines
- L11: Distributed Forces
- L12/13: Beams
- L14: Non-straight beams
- L15/16: Virtual work
- L17: Stability of Equilibrium states

Part III: Elastic Deformation

- L18: Axial loading (1D)
- L19: Deformable Structures I
- Practice Quiz 2 (during studio) 30/04/2024
- L20: Deformable Structures II
- L21: Stress, Strain (>1D)
- L22: Elasticity
- L23/24: Beam Bending

Part IV: Structural Failure

- L25/26: Elastic failure (Buckling)

Disclaimer: This plan is indicative (minor changes may be implemented during the semester).

Introduction to Structural Mechanics - Studios

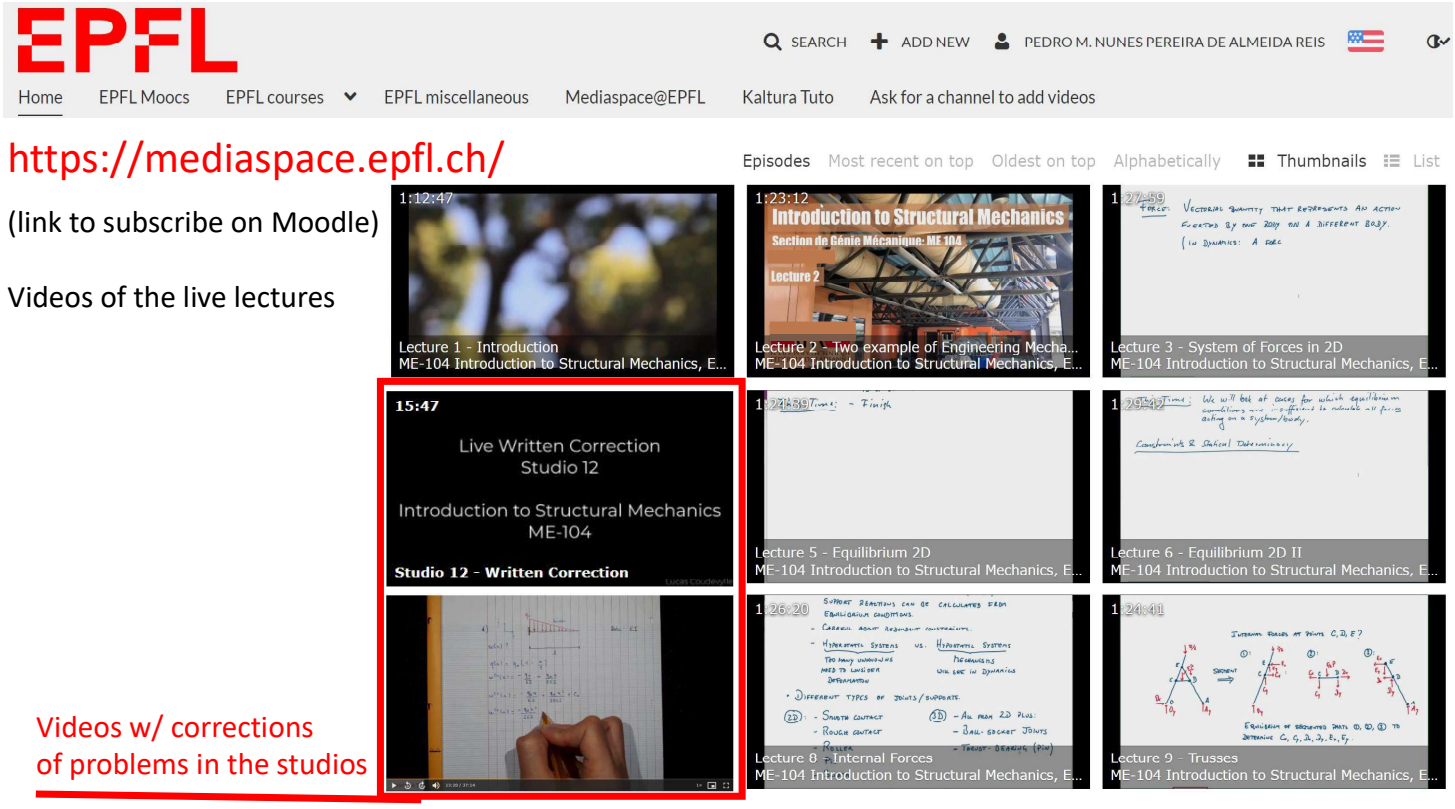
Studios = Exercise Classes

Studio 1:	Math revision - vectors
Studio 2:	Systems of forces in 2D
Studio 3:	Equilibrium exercises in 2D
Quiz 1:	Practice Quiz 1 (March 12th)
Studio 4:	Statical determinacy and Equilibrium in 3D, Truss calculations
Studio 5:	Centroids and distributed forces
Studio 6:	Beams
Studio 7:	Frames and Arches
Studio 8:	Virtual work
Quiz 2:	Practice Quiz 2 (April 30st)
Studio 9:	Deformable bodies
Studio 10:	Stresses and recap
Studio 11:	Beams bending, Superposition, Buckling
Studio 12:	Review session: Past exams

Disclaimer: This plan is indicative (minor changes may be implemented during the semester).

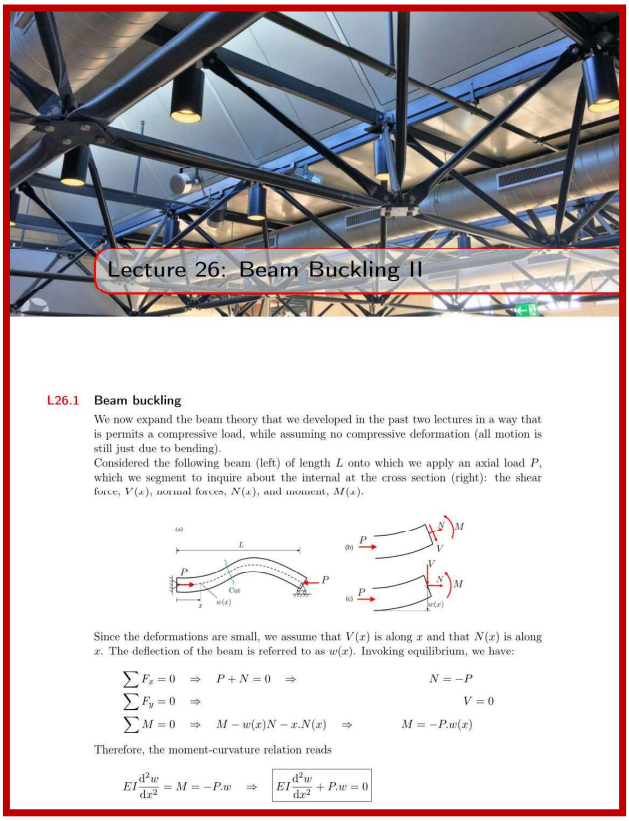
ME-104 Main Learning objectives:

1. Understand the nature of static forces and moments, as well as their balance on loaded structures.
2. Recognize and analyze structural elements that compose simple structures (bars, cables, trusses, beams) toward predicting their mechanical performance.
3. Understand how the combination of force/moment balance, constitutive relation, and compatibility conditions can be used to determine the deformation and internal loads of a structure.
4. Gain introductory knowledge on the concepts of stress, strain and how they are connected through a constitutive law (with a focus on 2D linear elasticity).
5. Recognize the limits of elastic deformation and understand the basis of the onset of inelastic deformation, with a focus on elastic buckling.
6. Recognize how introductory structural mechanics concepts fit in the broader context of more advanced topics in the mechanics of solids and structures.



Lecture notes:

(Posted on Moodle, the day of the lecture)



L26.1 Beam buckling

We now expand the beam theory that we developed in the past two lectures in a way that is permits a compressive load, while assuming no compressive deformation (all motion is still just due to bending).

Considered the following beam (left) of length L onto which we apply an axial load P, which we segment to inquire about the internal at the cross section (right): the shear force, $V(x)$, normal forces, $N(x)$, and moment, $M(x)$.

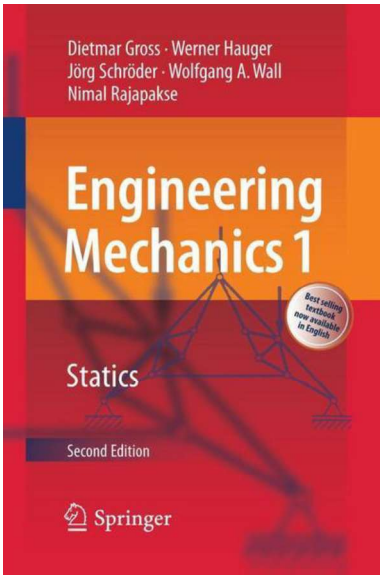
Since the deformations are small, we assume that $V(x)$ is along x and that $N(x)$ is along x. The deflection of the beam is referred to as $w(x)$. Invoking equilibrium, we have:

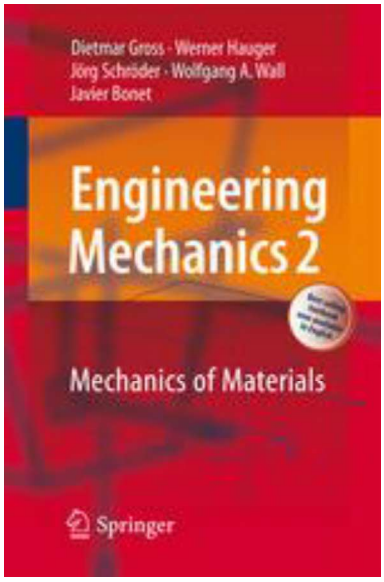
$$\sum F_x = 0 \quad \Rightarrow \quad P + N = 0 \quad \Rightarrow \qquad N = -P$$
$$\sum F_y = 0 \quad \Rightarrow \qquad V = 0$$
$$\sum M = 0 \quad \Rightarrow \quad M - w(x)N - x.N(x) \quad \Rightarrow \qquad M = -P.w(x)$$

Therefore, the moment-curvature relation reads

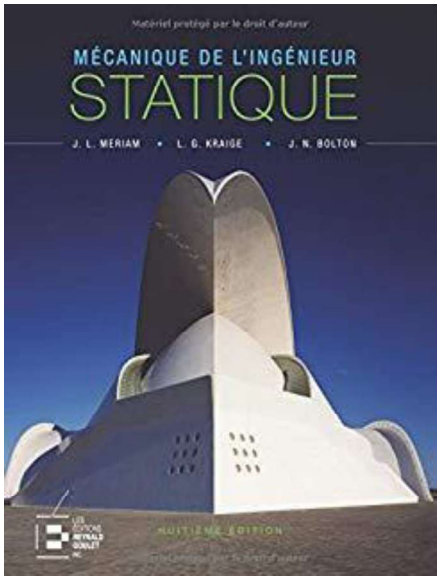
$$EI\frac{\mathrm{d}^2 w}{\mathrm{d}x^2} = M = -P.w \quad \Rightarrow \quad \boxed{EI\frac{\mathrm{d}^2 w}{\mathrm{d}x^2} + P.w = 0}$$

Official Course books



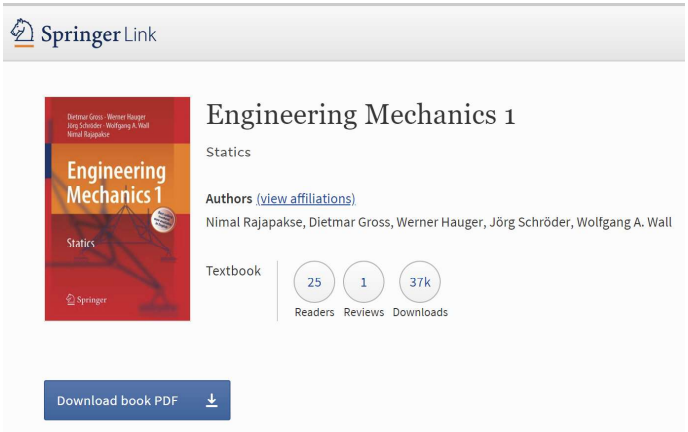


(in french)



Free .pdf of books from EPFL network for EPFL use

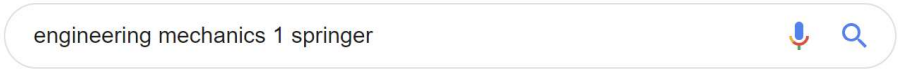
https://link.springer.com/book/10.1007/978-3-540-89937-2



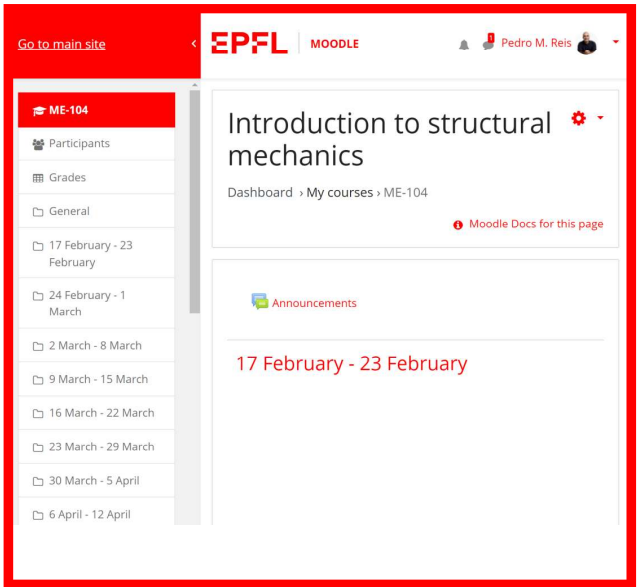
https://link.springer.com/book/10.1007%2F978-3-662-56272-7

Link to these books given on Moodle

Or search for:

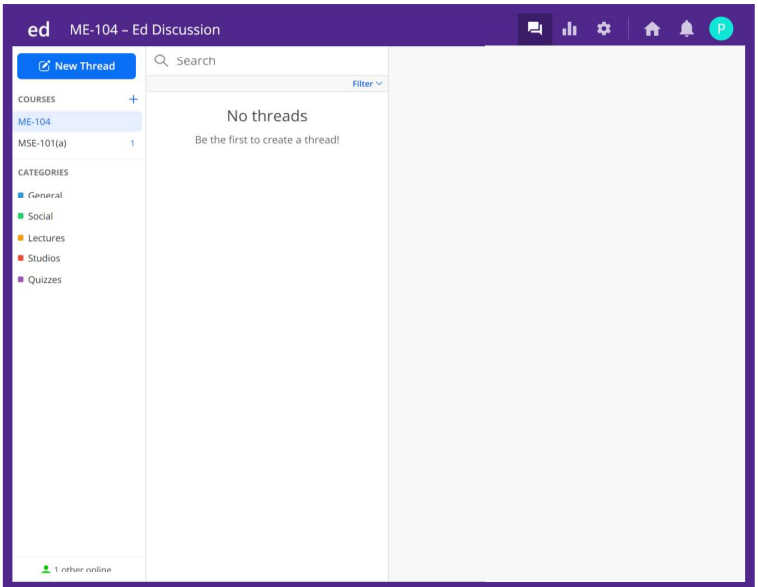


https://moodle.epfl.ch/



Official portal to make announcements and post materials such as lecture notes, exercises, practice problems, etc.

https://edstem.org/eu/courses/2047



General student forum for ME-104. The questions you post will be answered both by lecturers/instructors as well as by other students.