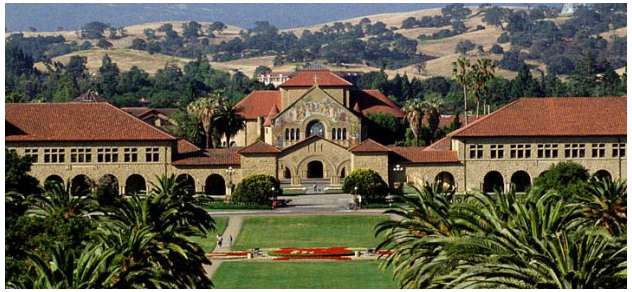
ME323 LECTURE 1

Alex Chortos

PURDUE
UNIVERSITY

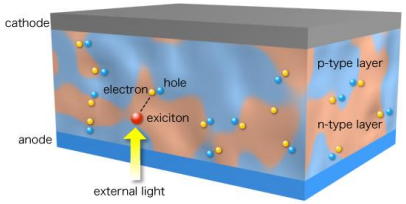
About Me

B.A.Sc. Nano Engineering

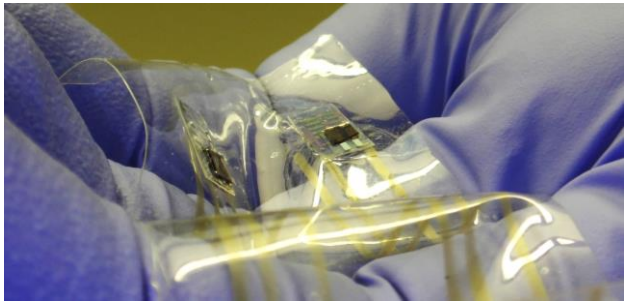


PhD Materials Science

Materials Science



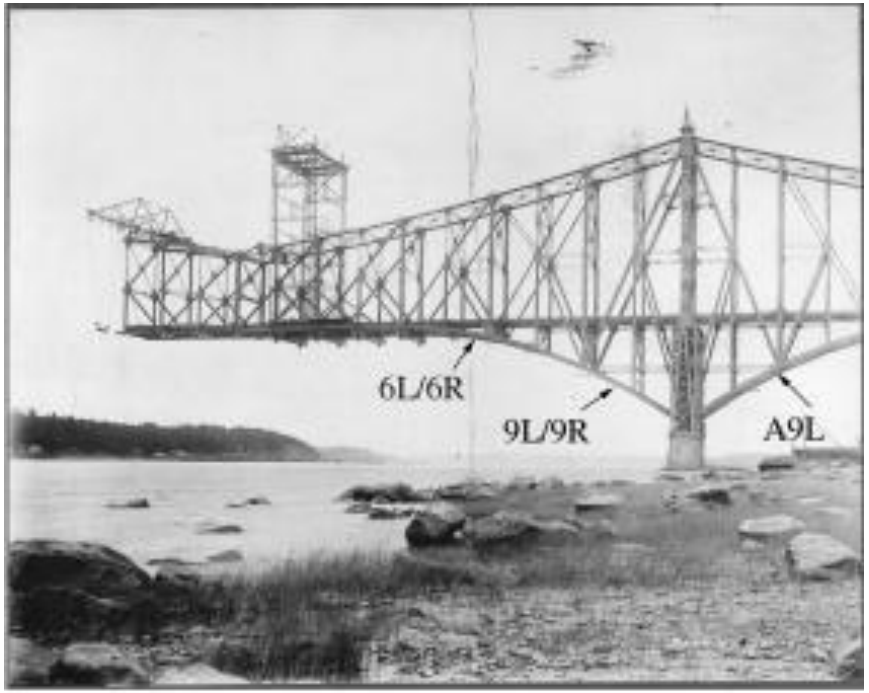
Solar cells for sustainability



Sensory prosthetic skin

Soft robots

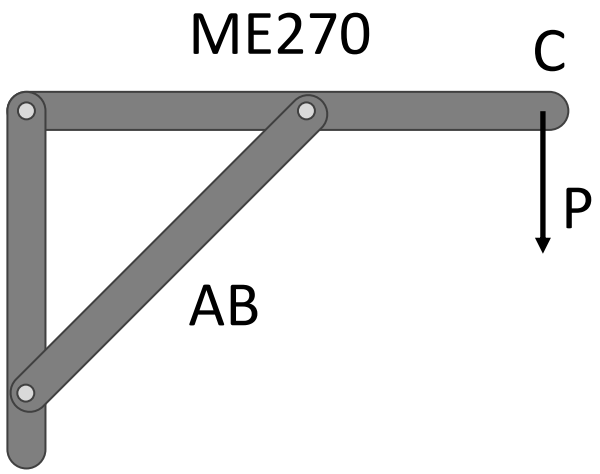
Quebec Bridge



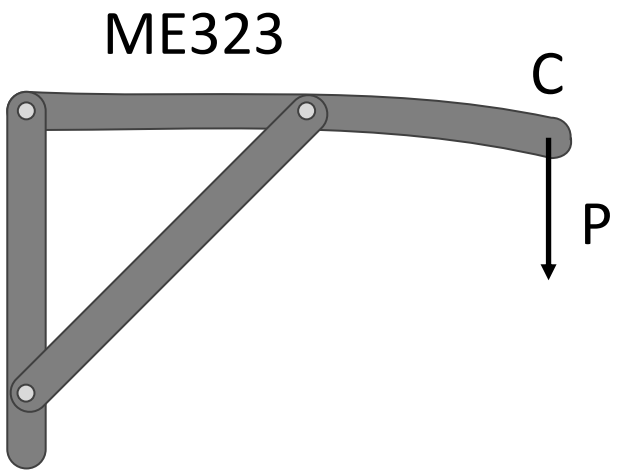
- Collapsed and killed 86 workers
- Collapsed again and killed 15 workers

Modern Example

ME323: Statics with Deformable Structures



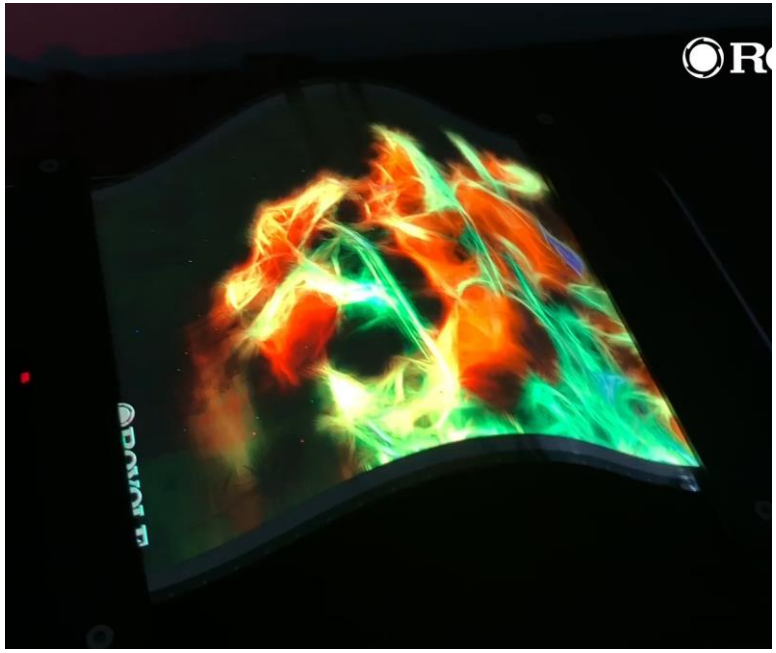
When you put a force at C, how much force does AB experience?



When you put a force at C, how much will point C deflect? At what value of the force will the system fail?

Applications of ME323

Emerging Applications of ME323



Flexible Electronics

Unconventional Robotics

CAGR ~15-20%

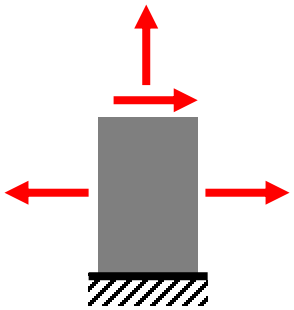
Overview of ME323

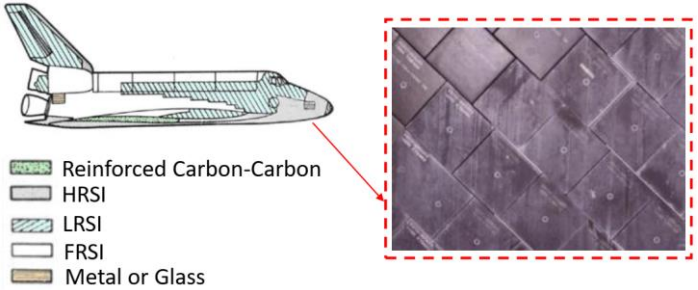
Lecture 2: Uniaxial stress

Lecture 3: Shear stress

Lecture 4: Design

Lecture 5: General stress





Lecture 6: Axial determinate

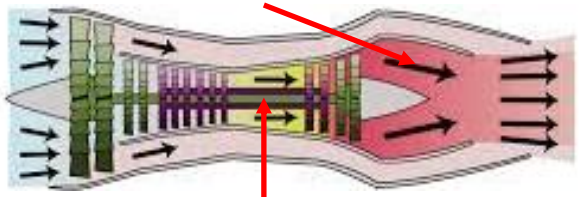
Lecture 7: Axial indeterminate

Lecture 8: Planar trusses

Lecture 9: Thermal effects

How can we use knowledge of materials properties to solve stress distributions in complex assemblies

9: Thermal Effects

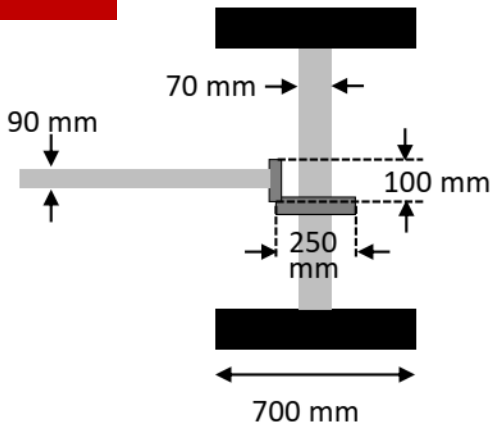


10: Torsion

Lecture 10: Torsion

Lecture 11: Torsion determinate

Lecture 12: Torsion indeterminate

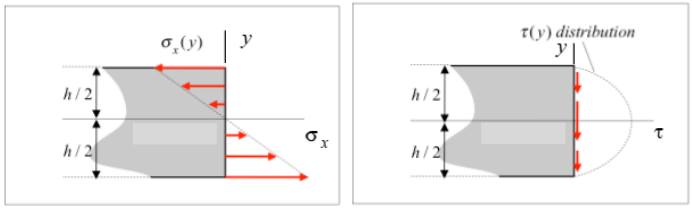


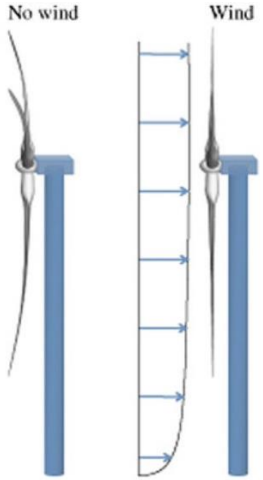
Overview of ME323

Lecture 13-14: Beams: Flexural stress

Lecture 15: Beams: Shear stress

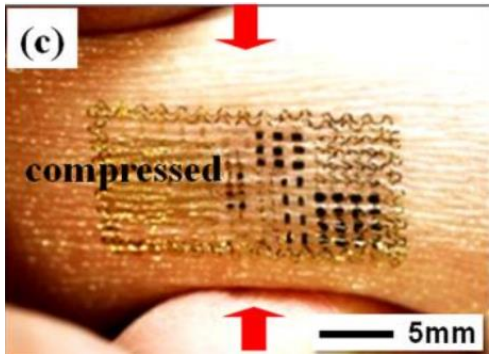
Lecture 16-20: Beam deflections

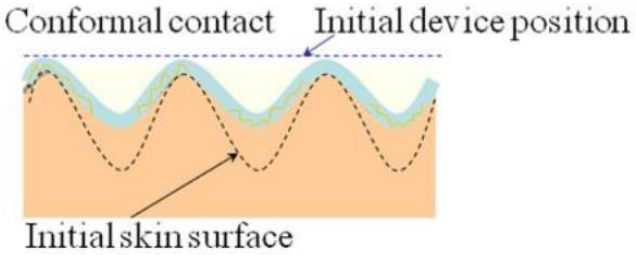


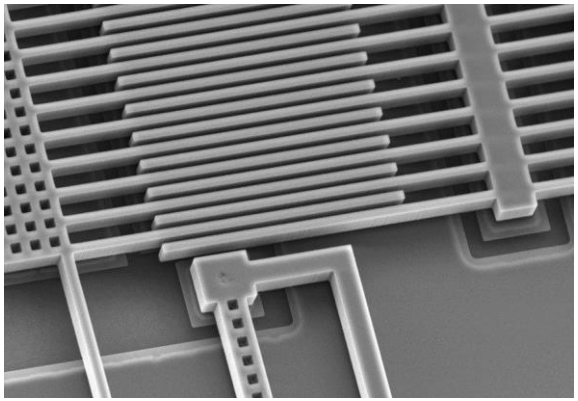


Lecture 21-24: Castigliano's theorems

$$U = \frac{1}{2}Pe$$

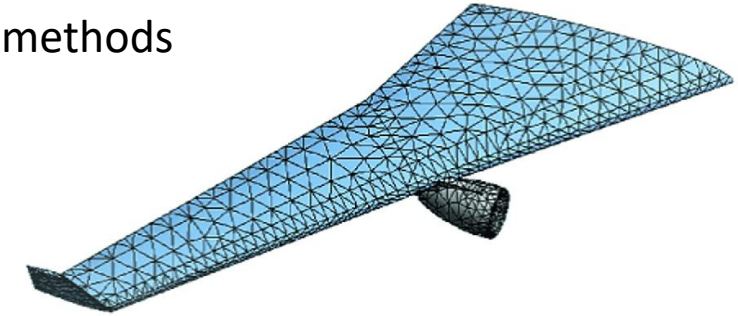




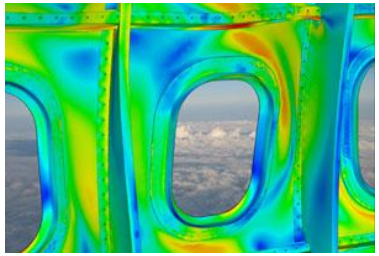


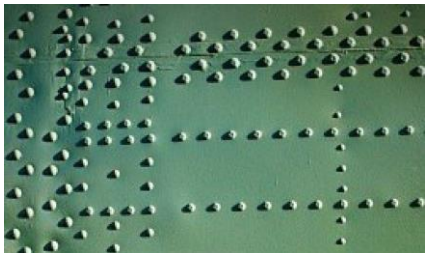
Overview of ME323

Lecture 27-28: Finite element methods



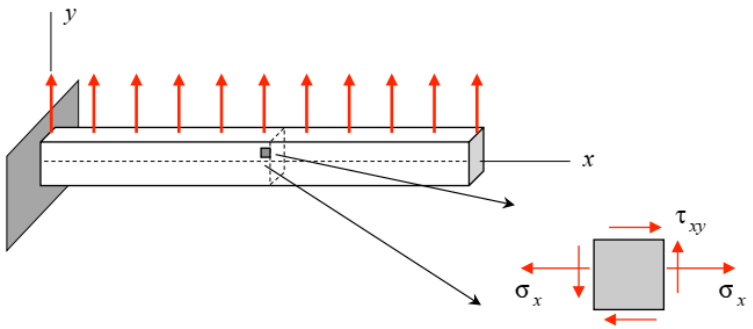
Lecture 30: Pressure vessels





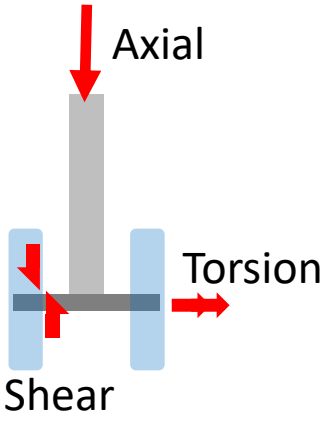
Why is the rivet pattern on an airplane like this?

Lecture 31-33: Stress transformations



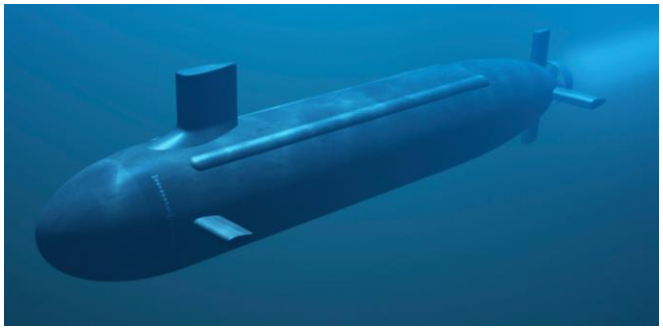
Overview of ME323

Lecture 34-36: Combined loading



Why does a windmill have 3 blades?

Lecture 37-39: Failure theories



How deep can a submarine dive?

General Information

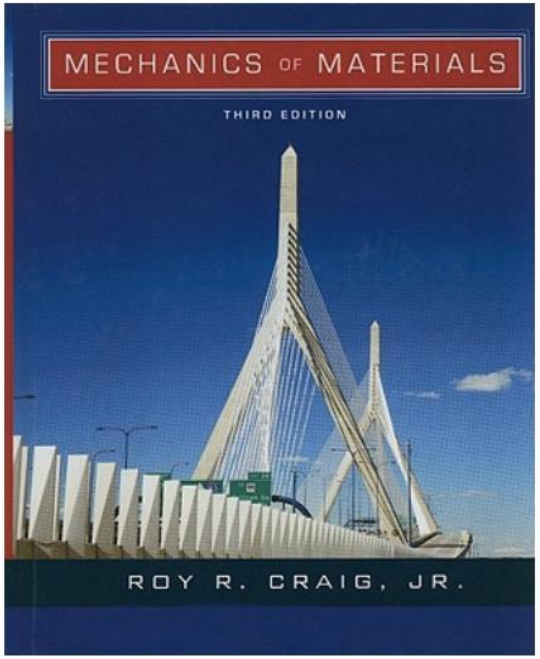
- Instructor: Alex Chortos (achortos@purdue.edu)
- Lectures: MWF 8:30-9:20 am (PHYS 223)
- TA office hours

	Tues	Weds	Thurs	Fri
8	Michael	Michael	Michael	Michael
9				
10	Kashayar		Khashayar	
11				Ben
12		Mohit		
1			Khashayar	Ayishe
2	Mohit		Mohit	
3		Ben		Mohit
4	Ben		Ben	
5				
6		Ayishe		Khashayar
7				
8				

- Professor office hours?

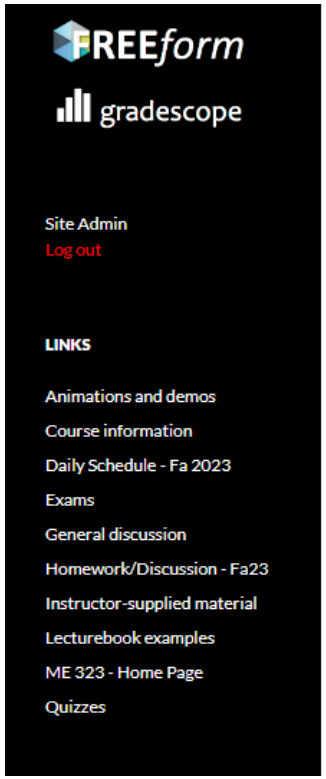
ME323 Content

- Textbooks:
  - Mechanics of Materials
    Roy R. Craig Jr.
    John Wiley & Sons, 3rd Edition
    Encouraged
  - Course Lecture Book
    Required: at University Bookstore



- Course website:
  - www.purdue.edu/freeform/me323
  - Solutions to examples in pdf or youtube videos
  - Discussion forum for students

ME323 website



ME 323 - HOME PAGE

WELCOME!

Welcome to the ME 323 course website for the Fall 2023 term. The material on this site is a complement to the lecture book for the course. And, all material here is accessible without the need to log in. Please review the resources that are available to you in the links on the left sidebar of the page. *Logging in is required only for adding comments to the blog posts.* ***Read me*** for instructions in logging in to the website.

Have a good semester!

DAILY SCHEDULE

The *Daily Schedule* page provides you with a guide on what you will be covering each day of class.

HOMEWORK/DISCUSSION

The *Homework/Discussion* page provides you with the following: i) *download links for homework problems*; ii) *discussion threads on homework sets*; and iii) *links to*

Course Procedure

- Conceptual content will be covered directly from the lecture book; you are encouraged to write notes in the book.
- Most in-class examples will be taken from the lecture book.
- Some additional examples will be introduced that are focused on real applications.
- Hotseat

- “Quizzes” will be in-class activities that are designed to be done in groups of 3-4 people. They are intended to test concepts while also challenging to think beyond course material. These activities will be announced in advance.

Grading

- Quizzes and homework – 30%
  - 26% homework; 4% “quizzes”

- Midterms – 25 or 45%
  - Closed book and closed notes
  - Wed, Sept 27th, 8-10 pm
  - Wed, Nov 1st, 8-10 pm
- Final Exam – 25 or 45%
  - Closed book and closed notes
  - If the average for the midterms is higher, the midterms will be worth 45%; if the average for the final is higher, the final will be worth 45%.

Homeworks

- Weekly homework (due Friday)
- Posted online on Friday by 7 pm and due the next Friday at 11:59 pm
- Submitted online through Gradescope
- Assignments submitted after the deadline but within 24 hours will be penalized by 20% reduction in score. Assignments submitted more than 24 hours after the deadline will not be accepted except with a university-approved justification (e.g. Grief Absence Notification).

ME Free Tutoring

Sign Up for FREE Tutoring

Tutoring sessions are handled through BoilerConnect & are held in-person.

Make an appointment today*:
https://www.purdue.edu/boilerconnect/

***Be sure to select Polytech, ECE & ME Tutoring. Then select ME Tutoring.**

Getting to know you

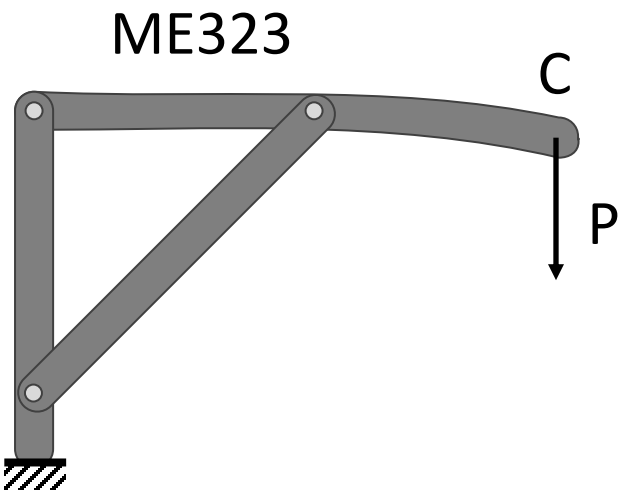
First hotseat question:
What topic are you most interested in after graduation from ME? E.g. consumer electronics, automotive, aerospace, etc.

Statics Review – Boundary Conditions

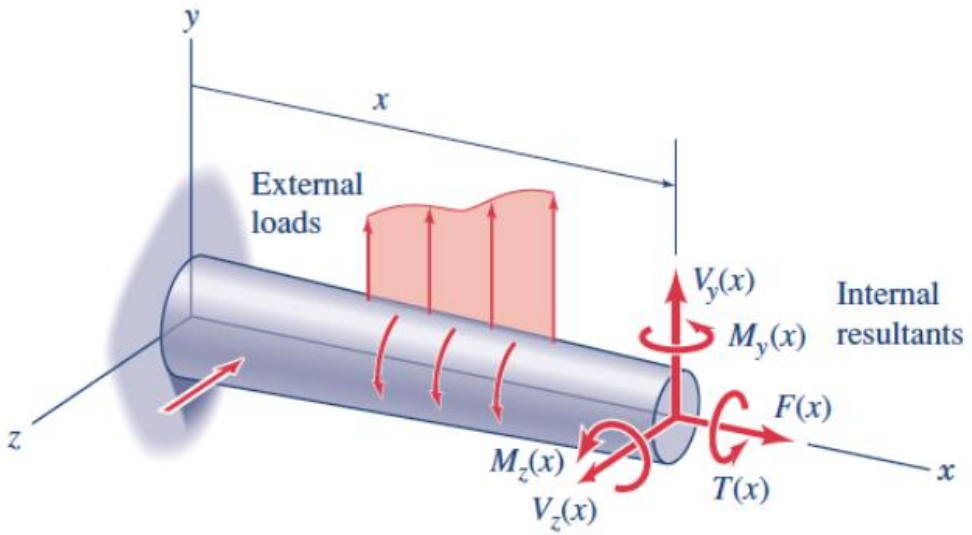
REACTIONS – 2D	
1. Roller support	
2. Cable or rod	
3. Pin support	
4. Cantilever support (fixed end)	

$$\sum \boldsymbol{F} = \mathbf{0} \quad \left(\sum \boldsymbol{M}\right)_O = \mathbf{0}$$

Statics Review - Resultants



External loads - Internal resultant



$$\sum \boldsymbol{F} = \mathbf{0} \quad \left(\sum \boldsymbol{M}\right)_O = \mathbf{0}$$

$$\begin{cases} \sum F_x = 0 \\ \sum F_y = 0 \\ \sum F_z = 0 \end{cases} \quad \begin{cases} \left(\sum M_x\right)_O = 0 \\ \left(\sum M_y\right)_O = 0 \\ \left(\sum M_z\right)_O = 0 \end{cases}$$

Review Example – Static Equilibrium

- Determine the internal resultants at B