Statics - TAM 211

Lecture 35 – Final Class

December 21, 2018

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Announcements

- Check ALL of your grades on Blackboard. Report issues
- Last Office Hours: TA Zhaoyu will hold office hours today (Friday Dec 21) in his office B307 in the ZJUI building

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- Upcoming deadlines:
  - Tuesday (12/25)
    - HW 14
  - Friday (12/28)
    - Written Assignment 14
- Final Exam – computer based
  - Wednesday January 9, 9:00-12:00
  - Instructional Lab Building: D211 (ME students), D331 (CEE students)
  - Covers Lectures 1-34 (Chapters 1-11 of sections identified in lecture)

Grade distribution for TAM 211

In class i-Clickers: 3%

Discussion group activity: 12%

Online Homework (PrairieLearn): 10%

Written Assignments: 15%

Quizzes: 40%

Final Exam: 20%

Grade distribution

Final grades: The total score s corresponds to final grades as follows.

$97\% \le s \le 100\%$	A+	$92\% \le s < 97\%$	A	$89\% \le s < 92\%$	A-
$86\% \le s < 89\%$	B+	$82\% \le s < 86\%$	B	$79\% \le s < 82\%$	B-
$76\% \le s < 79\%$	C+	$72\% \le s < 76\%$	C	$69\% \le s < 72\%$	C-
$66\% \le s < 69\%$	D+	$59\% \le s < 66\%$	D	$55\% \le s < 59\%$	D-
$s < 55\%$	F				

Grades: on Blackboard

- Any errors in grade reporting on Blackboard must be reported within 2 weeks of the due date or by the last day of class, whichever is earlier.
- Missing grade for discussion section, written assignment, online homework, or quiz contact TA

Course Overview

Description: In this course, we will cover fundamental concepts that are used in every engineering discipline. We will begin with forces, moments and move towards structural analyses of frames, devices, and machines. By the end, you will be able to solve rigid body mechanics problems that will inform the design of everything from bridges to biomedical devices.

Big Idea: Clear knowledge of external forces (boundary conditions) is required to determine what constraints are necessary for the safe (static equilibrium) development and design of any widget. Free body diagrams are an essential tool for understanding the forces and moments on a body.

General procedure for analysis

1. Read the problem carefully; write it down carefully.
2. MODEL THE PROBLEM: Draw given diagrams neatly and construct additional figures as necessary.
3. Apply principles needed.
4. Solve problem symbolically. Make sure equations are dimensionally homogeneous
5. Substitute numbers. Provide proper units *throughout*. Check significant figures. Box the final answer(s).
6. See if answer is reasonable.

Most effective way to learn engineering mechanics is to ***solve problems!***

Chapter 1: General Principles
Main goals and learning objectives

- Introduce the basic ideas of *Mechanics*
- Give a concise statement of Newton's laws of motion and gravitation
- Review the principles for applying the SI system of units
- Examine standard procedures for performing numerical calculations
- Outline a general guide for solving problems

Chapter 2: Force vectors
Main goals and learning objectives

Define scalars, vectors and vector operations and use them to analyze forces acting on objects

- Add forces and resolve them into components
- Express force and position in Cartesian vector form
- Determine a vector's magnitude and direction
- Introduce the unit vector and position vector
- Introduce the dot product and use it to find the angle between two vectors or the projection of one vector onto another

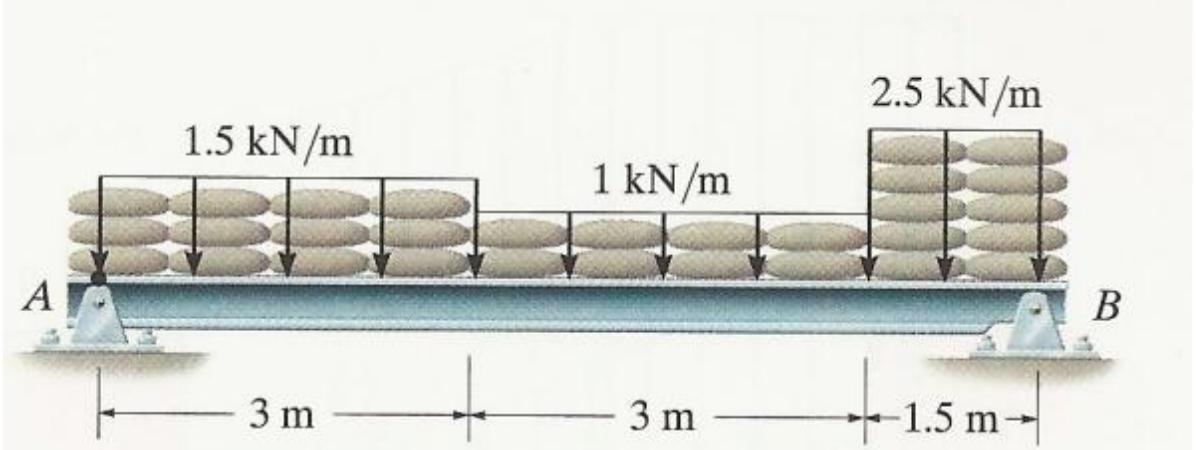
Chapter 3: Equilibrium of a particle
Goals and Objectives

- Practice following general procedure for analysis.
- Introduce the concept of a free-body diagram for an object modeled as a particle.
- Solve equilibrium problems using the equations of equilibrium.
  - 3D, 2D planar, idealizations (smooth surfaces, pulleys, springs)

Chapter 4: Force System Resultants
Goals and Objectives

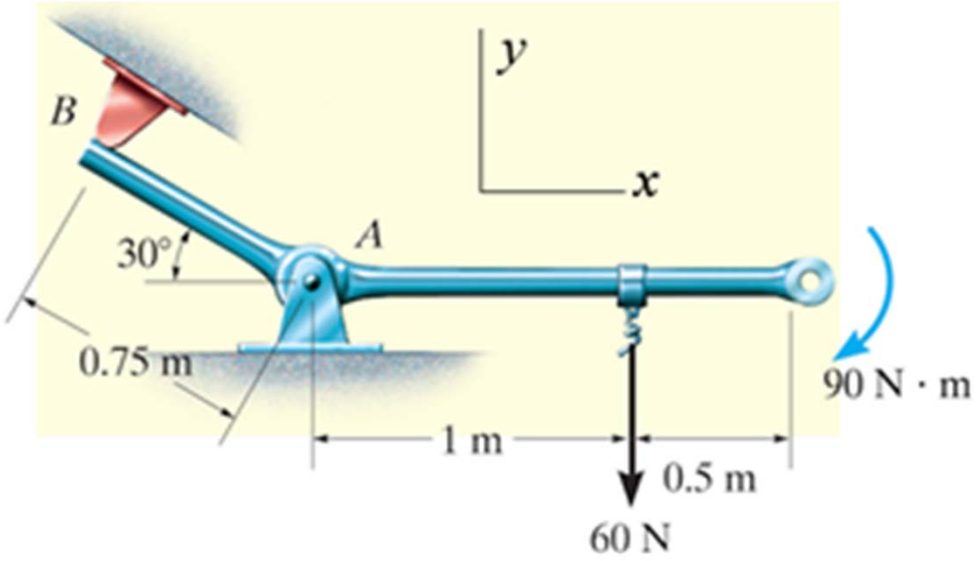
- Discuss the concept of the moment of a force and show how to calculate it in two and three dimensions
- How to find the moment about a specified axis (Scalar Triple Product)
- Define the moment of a couple
- Finding equivalence force and moment systems
- Reduction of distributed loading

The beam supports the distributed load caused by the sandbags. Determine the vertical reaction at point A.



Chapter 5: Equilibrium of Rigid Bodies
Goals and Objectives

- Introduce the free-body diagram for a rigid body
- Develop the equations of equilibrium for a 2D and 3D rigid body
- Solve rigid body equilibrium problems using the equations of equilibrium in 2D and 3D
- Introduce concepts of
  - Support reactions for 2D and 3D bodies
  - Two- and three-force members



Chapter 6: Structural Analysis
Goals and Objectives

- Determine the forces in members of a truss using the method of joints
- Determine zero-force members
- Determine the forces in members of a truss using the method of sections
- Determine the forces and moments in members of a frame or machine

Chapter 7: Internal Forces

- Determine internal loadings in members using method of sections
- Generalize this procedure and formulate equations that describe the internal shear force and bending moment throughout a member
- Be able to construct or identify shear a force nd bending moment diagrams for beams when distributed loads, concentrated forces, and/or concentrated couple moments are applied

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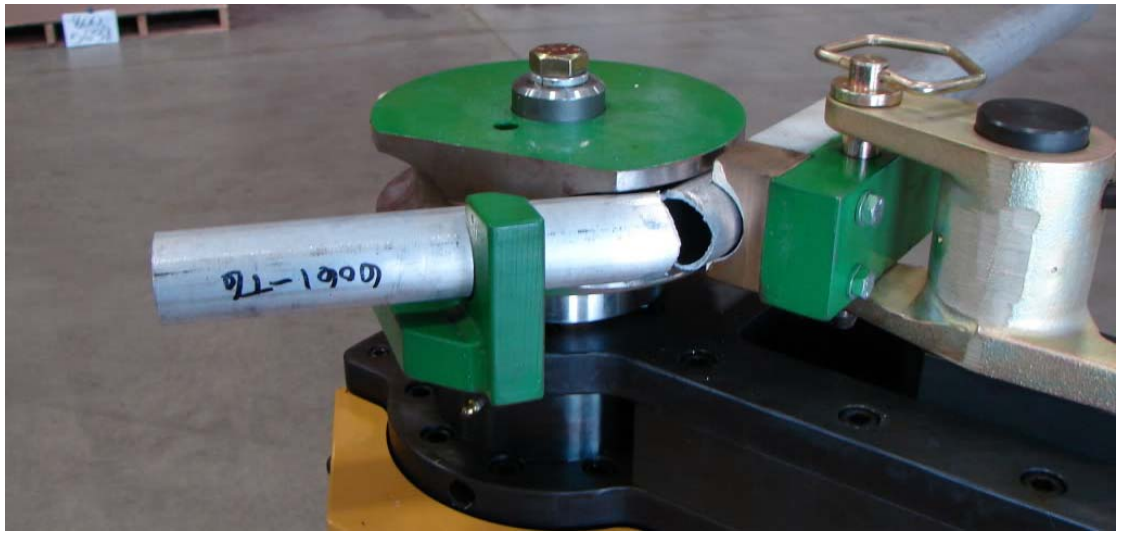


http://aluminumtubingshiyodoka.blogspot.com/2016/06/aluminum-tubing-mcmaster-carr.html

Chapter 8: Friction
Goals and Objectives

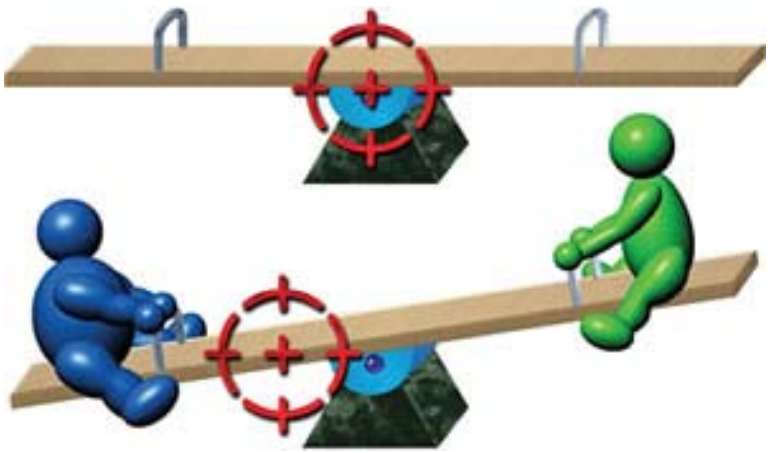
- Sections 8.1-8.2
- Introduce the concept of dry friction
- Analyze the equilibrium of rigid bodies subjected to this force
  - Tipping
  - Slipping

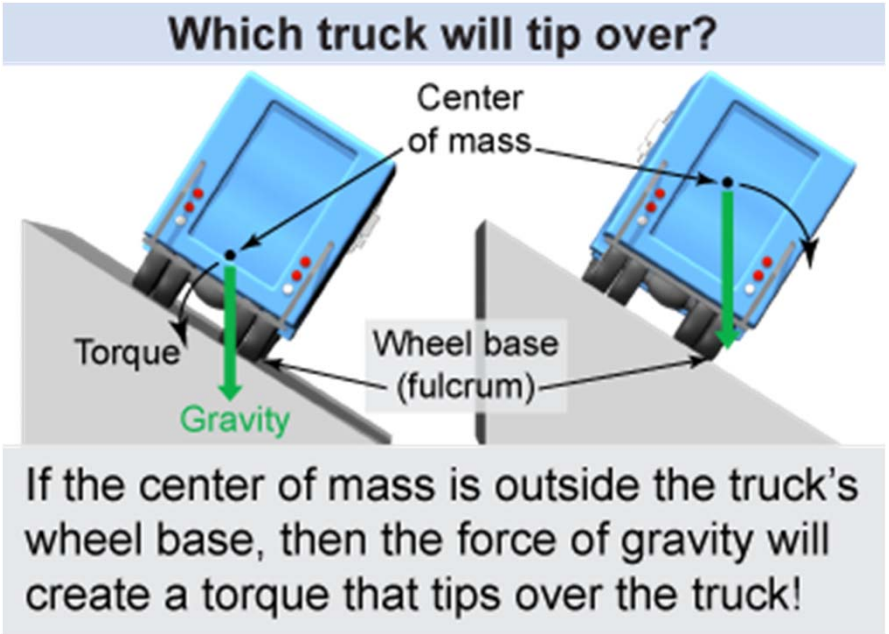
Tip Over House Korea

Tianmei Marvel Comics Car Non-Slip Mat

Chapter 9: Part I
Center of Gravity and Centroid

- **Sections 9.1-9.2**
- Understand the concepts of center of gravity, center of mass, and centroid.
- Determine the location of the center of gravity and centroid for a system of discrete particles and a body of arbitrary shape.





Chapter 10: Moments of Inertia
Goals and Objectives

- Understand the term "moment" as used in this chapter

- Determine and know the differences between
  - First/second moment of area
  - Moment of inertia for an area
  - Polar moment of inertia
  - Mass moment of inertia

- Introduce the parallel-axis theorem.

- Be able to compute the moments of inertia of composite areas.

Chapter 9: Part II
Fluid Pressure

- **Chap 9.5**
- Present a method for finding the resultant force of a pressure loading caused by a fluid

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http://www.deepseanews.com

Chapter 11: Virtual Work
Goals and Objectives

- Introduce the principle of virtual work
  - Compare deriving equations of equilibrium using the Force-Balance Method and Virtual Work (or Energy-Balance Method)

- Show how virtual work applies to determining the equilibrium configuration of a single body or a series of pin-connected members

See you at UIUC next year!

Feel free to contact me

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