Structural Analysis II

(ECIV 3315)

Course Outline

Second Semester

2018-2019

Structural Analysis II

- Course Details
  - Course title: Structure Analysis II
  - Course code: ECIV 3315
  - Prerequisites: Structure Analysis I (ECIV 3314)
- Instructor
  - Dr. Mohammed Arafa
- Teaching Assistant
  - Eng. Mahmoud Nasman
  - Eng. Reham El-Hattab

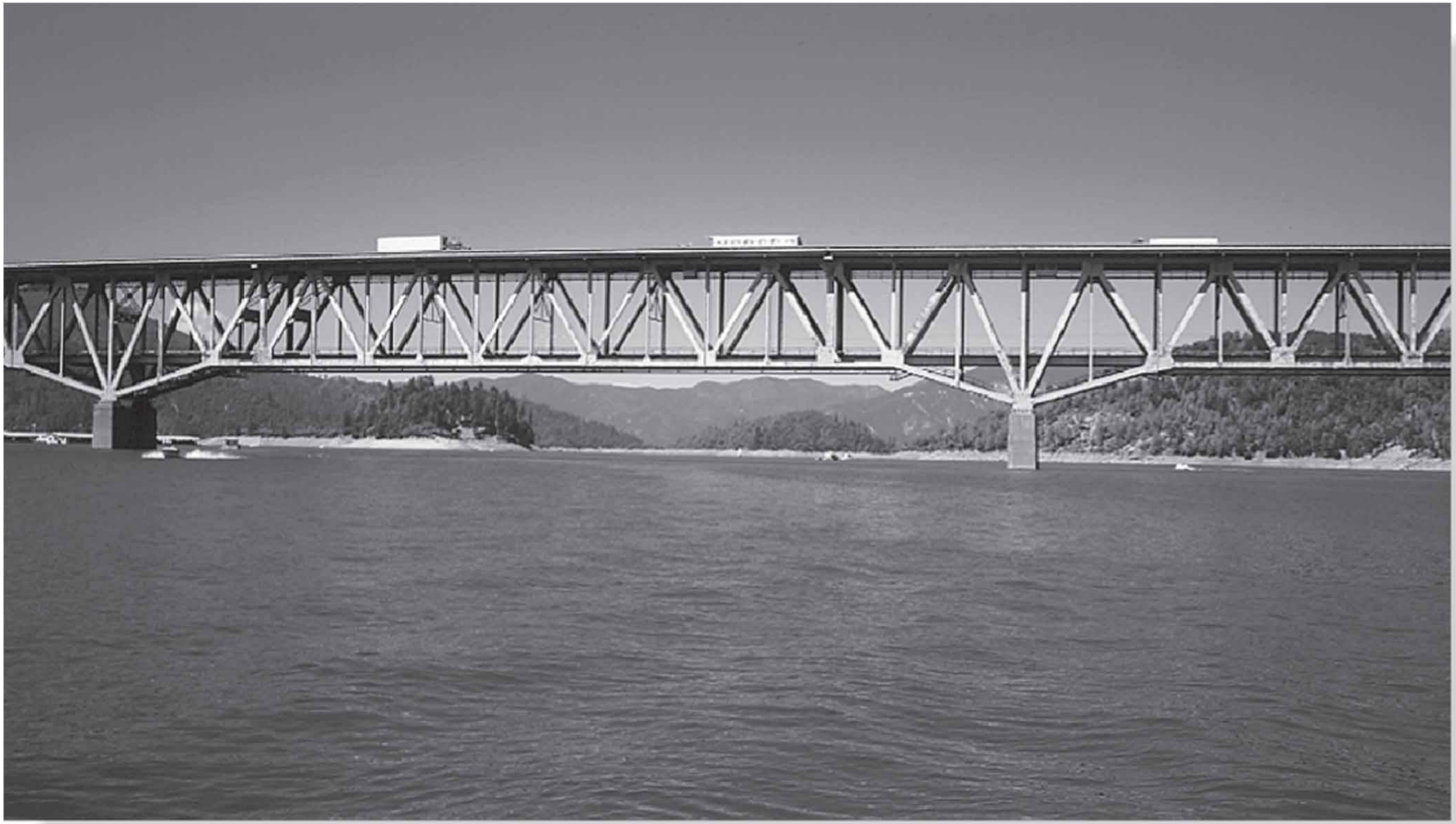
Objectives

- This course aims at teaching the students the concept of analyzing indeterminate structures using classical and up to date methods.
- Provide the students with an understanding of the methods of analyzing indeterminate structures.
- Using Commercial Computer Software in Structural Analysis.
- Developing a FE computer program for analysis Trusses and Beams.

Methods of Analysis

- **Approximate method**
- **The Force method**
- **The Displacement method**
  - **Slope deflection**
  - **Moment distribution**
  - **Stiffness Method (Introduction to The Finite Element Method)**

	Unknowns	Equations Used for Solution	Coefficients of the Unknowns
Force Method	Forces	Compatibility and Force Displacement	Flexibility Coefficients
Displacement Method	Displacements	Equilibrium and Force Displacement	Stiffness Coefficients



Syllabus

- Approximate Method
  - Trusses
  - Frames and Beams
- Force Method of Analysis
  - Beams
  - Frames
  - Trusses
- Slope-Deflection Equations
  - Beams
  - Frames
    - No Sidesway
    - Sidesway

Syllabus

- Moment Distribution
  - Beams
  - Frames
    - No Sidesway
    - Sidesway
- Stiffness Methods **(An Introduction to FEM)**
  - Trusses
  - Beams
  - Frames

Course Materials

- Lecture Notes
  - Power points slides
  - Handout sheets
- Text Book
  - STRUCTURAL ANALYSIS, 9th Edition, 2015 by R. C. Hibbeler

TEXTBOOK'S INTERNET SITE:
http://www.pearsonhighered.com/bookseller/product/Structural-Analysis/9780136020608.page

Reference

- Any Structural Analysis Book
- Fundamentals of Structural Analysis, by K. Leet, C. Uang and A. Gilbert, McGraw-Hill, 2010
- Matrix Analysis of Structure, by Aslam Kassimali Second Edition, 2012, Cengage Learning, 2012
- Fundamental of Structural Analysis, by H. West and L. Geschwindner, John Wihley & Sons, Inc., 1993.

Grading Policy

- Midterm Exam 30%
- Homework, Quizzes and Small project 20%
- Final Exam 50%

Exams Dates:

Midterm Exam : Wednesday, 10.04.2019, Time 10:00-11:00

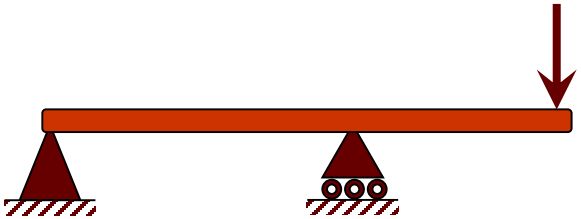
Final Exam: Wednesday, 12.06.2019, Time 11:00-13:00

Introduction

Why we study indeterminate structure ?

Introduction

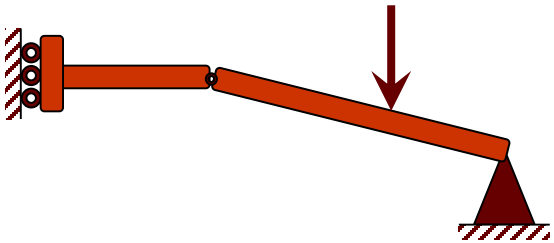
- What is statically ***DETERMINATE*** structure?
  - When all the forces (reactions) in a structure can be determined from the equilibrium equations its called statically determinate structure
  - Structure having unknown forces equal to the available equilibrium equations



No. of unknown = 3

No. of equilibrium equations = 3

3 = 3 thus statically determinate



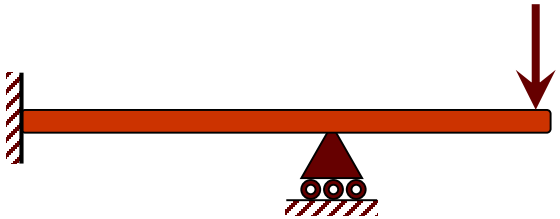
No. of unknown = 6

No. of equilibrium equations = 6

6 = 6 thus statically determinate

Introduction

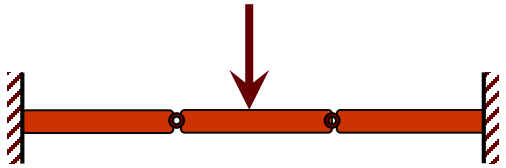
- What is statically ***INETERMINATED*** structure
  - Structure having more unknown forces than available equilibrium equations
  - Additional equations needed to solve for the unknown reactions



No. of unknown = 4

No. of equilibrium equations = 3

4 > 3 thus statically Indeterminate



No. of unknown = 10

No. of equilibrium equations = 9

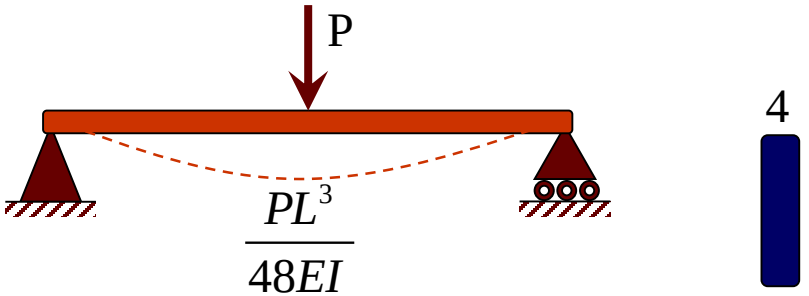
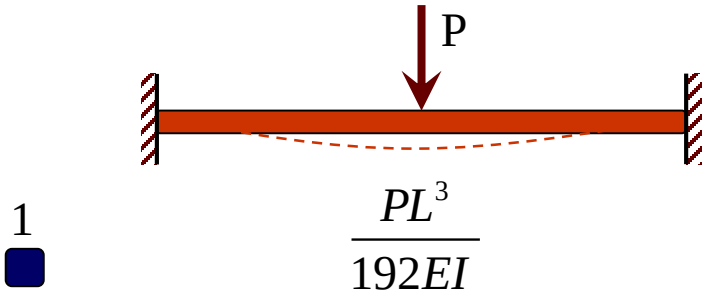
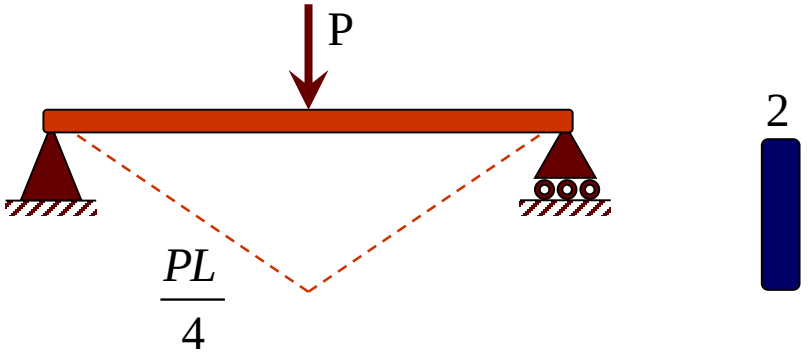
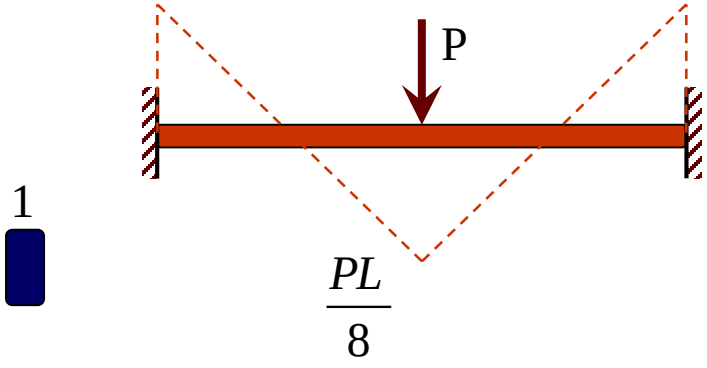
10 > 9 thus statically Indeterminate

Indeterminate Structure

Why we study indeterminate structure

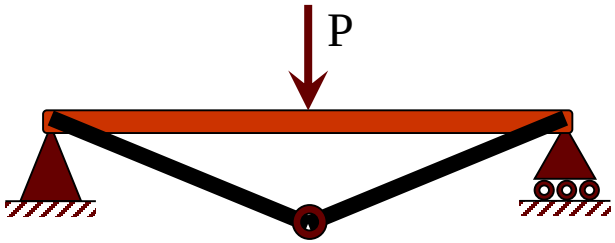
- Most of the structures designed today are statically indeterminate
- Reinforced concrete buildings are considered in most cases as a statically indeterminate structures since the columns & beams are considered as continuous member through the joints & over the supports
- More stable compare to determinate structures or in another word **safer**.
- In many cases more economical than determinate.
- The comparison in the next page will enlighten more

Contrast

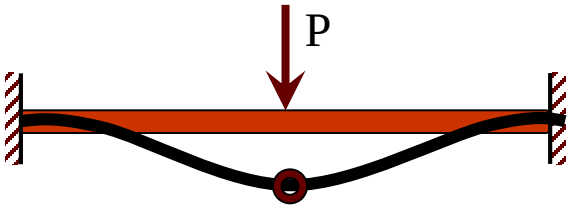
	Determinate Structure	Indeterminate Structure
Deflection	Considerable compared to indeterminate structure 	Generally smaller than determinate structure 
Stress	High moment caused thicker member & more material needed 	Less moment, smaller cross section & less material needed 

Contrast

	Determinate Structure	Indeterminate Structure
Stability in case of over load	✶Support will not develop the horizontal force & moments that necessary to prevent total collapse ✶No load redistribution ✶When the plastic hinge formed certain collapse for the system	✶Will develop horizontal force & moment reactions that will hold the beam ✶Has the tendency to redistribute its load to its redundant supports ✶When the plastic hinge formed the system would be a determinate structure

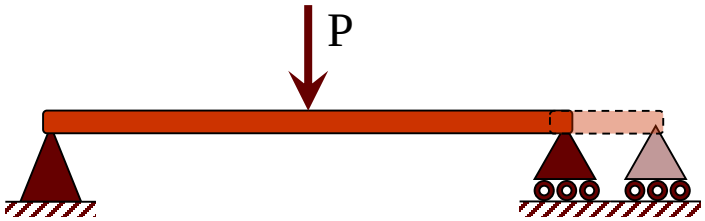
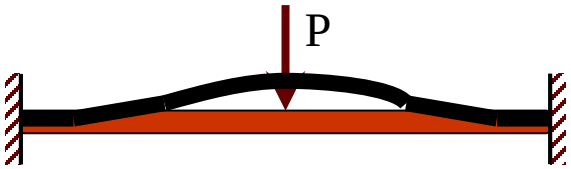
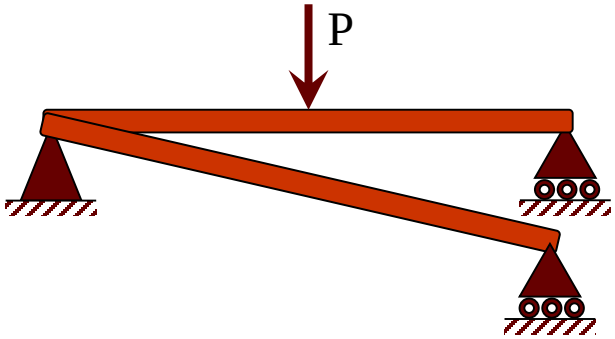


Plastic Hinge



Plastic Hinge

Contrast

	Determinate Structure	Indeterminate Structure
Temperature	No effect & no stress would be developed in the beam 	Serious effect and stress would be developed in the beam 
Differential Displacement	No effect & no stress would be developed 	Serious effect and stress would be developed