MECHANICS I
FUNDAMENTAL BEHAVIOR

Lecture 3

Introduction to Overarching Problems

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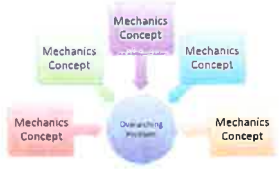
Overarching Problems

- Through the rest of the course, we will deal with three classic civil engineering problems.

- These complex design problems will be referred to as overarching problems because they are broad in nature and bring together many of the fundamental mechanics concepts that we will learn in this class.
- These problems will serve to:
  - provide context of how mechanics concepts are used in civil engineering
  - show how different mechanics concepts relate to each other
  - show how complex problems can be broken up into a series of smaller fundamental steps



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Overarching Problem #1 Steel Truss Bridge

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Overarching Problem #1 Steel Truss Bridge

- Our first overarching problem will involve a steel truss bridge
- The design of this bridge may involve several subdisciplines of civil engineering.

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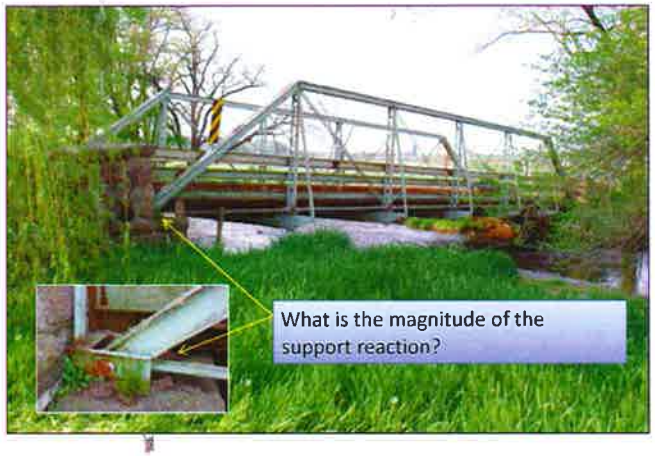
Overarching Problem #1
Steel Truss Bridge



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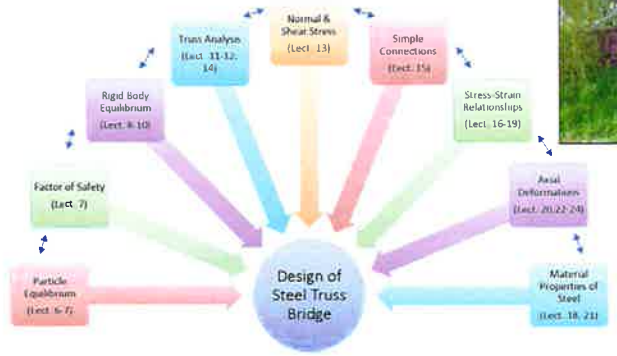
Overarching Problem #1
Steel Truss Bridge

- Several fundamental mechanics concepts that we cover in this class will relate to the design of this bridge.



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Overarching Problem #2
Gravity Dam

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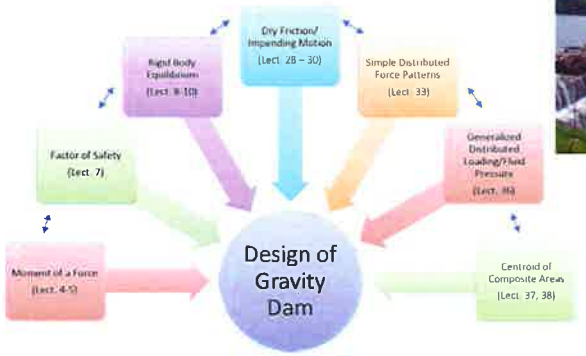
Overarching Problem #2
Gravity Dam

- Several fundamental mechanics concepts that we cover in this class will relate to the design of this dam.



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Overarching Problem #3
Water Tower


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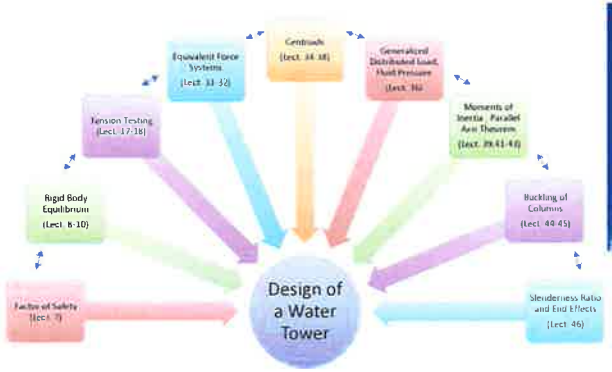
Overarching Problem #3
Water Tower

- Several fundamental mechanics concepts that we cover in this class will relate to the design of a water tower.



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CATME Results

- Announcement of teams
- Sit with your team and introduce yourselves

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Water Towers

- Why do we need them?
- How do they work?
- Deliverable (due in 30 min.):
  - A single slide PowerPoint presentation that your team will deliver in no more than two minutes answering the above questions

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KEEN: The Kern Entrepreneurial Engineering Network

CURIOSITY

In a world of accelerating change, today's solutions are often obsolete tomorrow. Since discoveries are made by the curious, we must empower our students to investigate a rapidly changing world with an insatiable curiosity.

CONNECTIONS

Discoveries, however, are not enough. Information only yields insight when connected with other information. We must teach our students to habitually pursue knowledge and integrate it with their own discoveries to reveal innovative solutions.

KEEN

KERN ENTREPRENEURIAL ENGINEERING NETWORK

CREATING VALUE

Innovative solutions are most meaningful when they create extraordinary value for others. Therefore, students must be champions of value creation. As educators, we must train students to persistently anticipate and meet the needs of a changing world.

MECHANICS I
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The Three C's

KEEN

KERN ENTREPRENEURIAL ENGINEERING NETWORK

CURIOSITY
- **DEMONSTRATE** constant curiosity about our changing world
- **EXPLORE** a contrarian view of accepted solutions

CONNECTIONS
- **INTEGRATE** information from many sources to gain insight
- **ASSESS** and **MANAGE** risk

CREATING VALUE
- **IDENTIFY** unexpected opportunities to create extraordinary value
- **PERSIST** through and learn from failure

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PROBLEM **Problem K3-1** PAGE _____ OF _____

SOLVED BY _____ DATE _____

Civil Engineering Infrastructure Project:

Design and construction of a water tower for a town of 30,000 people in the outer suburbs of Philadelphia.

There are many considerations (technical, economic, and societal) that go into civil engineering infrastructure projects. These considerations vary depending on which subdiscipline of civil engineering you are investigating. Complete the table below with a minimum of one consideration (and maximum of five) per box.

CIVIL ENGINEERING SUBDISCIPLINE	CONSIDERATIONS		
	TECHNICAL	ECONOMIC	SOCIETAL
STRUCTURAL			
MATERIALS			
GEOTECHNICAL			
CONSTRUCTION			
TRANSPORTATION			
WATER RESOURCES			
ENVIRONMENTAL			

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PROBLEM **Problem K3-2** PAGE _____ OF _____

SOLVED BY _____ DATE _____

Civil Engineering Infrastructure Project *in a Developing Country*:

Design and construction of a water tower for a rural village of 500 people in the country of _____.

There are many considerations (technical, economic, and societal) that go into civil engineering infrastructure projects. These considerations vary depending on which subdiscipline of civil engineering you are investigating. Complete the table below with a minimum of one consideration (and maximum of five) per box.

CIVIL ENGINEERING SUBDISCIPLINE	CONSIDERATIONS		
	TECHNICAL	ECONOMIC	SOCIETAL
STRUCTURAL			
MATERIALS			
GEOTECHNICAL			
CONSTRUCTION			
TRANSPORTATION			
WATER RESOURCES			
ENVIRONMENTAL			

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PROBLEM Problem K3-3 PAGE 1 OF 1

SOLVED BY _____ DATE _____

Civil Engineering Infrastructure Project *in a Developing Country*:

Design and construction of a water tower for a rural village of 500 people in the country of _____.

OVERALL OBJECTIVE: Your firm is tasked with developing a summary design, construction, and maintenance plan for a water tower that will store and supply water for a rural village of 500 people in the country you have been assigned.

LONG-TERM DELIVERABLE (END OF SEMESTER): You will pitch your plans to the non-profit Mechanics Foundation in a 12-minute presentation at the end of the semester. Your plans must be developed thoughtfully enough to convince the foundation to provide funding for implementation of your plans in the near future. You will need to clearly identify the water demand for your location and present a detailed design with calculations and computer-generated detail sketches, and include a budget and maintenance plan.

EXPECTATIONS: This should be a fun and thought-provoking exercise weaved throughout the semester that considers (a) technical content, (b) societal and economic benefits and constraints, and (c) an entrepreneurial mindset. Each group is expected to keep track of all time spent on the project, and include this time report in your final submittal. Overall, this project will be worth a minimum of 100 "problem set" points toward your final Problem Set and Other Submissions grade. Bonus points may be awarded for exceptional work.

INTERIM DELIVERABLE #1: Do research on water needs and water use in your assigned country to help establish the volume of water that you intend to store in the water tank you design.

- **Prepare a writeup that is no more than two pages in length (double-spaced, 12 point Times New Roman font, 1" margins) including text, equations, and references. The writeup should clearly indicate the volume of water you intend to store in your tank and explain the rationale behind how you arrived at this value. This writeup is due at the beginning of the class meeting corresponding to Lecture 10, two weeks from today.**
- **Prepare a PowerPoint presentation no more than five minutes long that conveys the same information as your writeup. Groups will present in a randomly selected order during the same class period that your writeup is due. Please bring your presentation to class on a USB drive to upload onto the desktop computer.**
- **Note: Problem K3-2 (orange sheet) must be completed by your group by this date as well. Although you will not formally submit this sheet until the end of the semester, be prepared to show this completed sheet to the instructors on the date you submit your writeup and give your presentation. You may update this sheet throughout the semester as you learn more information.**