CASCE

WORKSHOP ON

ADVANCING THE DISSEMINATION OF THE CREATIVE ART OF STRUCTURAL/CIVIL ENGINEERING

PRINCETON UNIVERSITY – JUNE 3-5 2015

A Modular Approach to Course Development

Cris Moen, Virginia Tech
www.moen.cee.vt.edu

VirginiaTech

CEE 2804
INTRODUCTION to CIVIL ENGINEERING

200 students each fall (whole sophomore CEE class)
15 faculty members
7 TAs

COURSE THEMES

- Civil disciplines and definitions
- Social, scientific, and symbolic perspectives
- Civil engineering history
- Current events
- Engineering critique

COURSE OBJECTIVES

- recognize the breadth and specialty areas within the civil engineering profession;
- identify the components of the civil engineering undergraduate program of study and graduation requirements;
- identify Civil Engineering work in the surrounding community through local field trips;
- recognize the importance of the ASCE Code of Ethics and apply its principles to civil engineering practice;
- recognize contemporary civil engineering issues and the impact of civil engineering solutions on society; and
- conduct written and verbal communications in a professional manner.

Sustainability and resilience too!

COURSE STRUCTURE

- 20 large group lectures
- 11 discussion sessions

Emphasis on linking large group themes to small faculty-led sections

COURSE GOALS

- Excite students about their profession
- Create an atmosphere where students can get to know a CEE faculty member
- Flexible faculty workload

There are plenty of opportunities for faculty to contribute to the themes and content of the course.

LARGE GROUP LECTURES

Lecture Date	Large Group Lectures	Topic
25-Aug	1	Introduction to Civil Engineering
27-Aug	2	Engineering critique with written and oral expression
1-Sep	3	Structural engineering concepts and the Eiffel Tower
3-Sep	4	Maillart and the origins of reinforced concrete
8-Sep	5	CEE Advising
10-Sep	6	Welcome to Civil & Environmental Engineering at Virginia Tech
15-Sep	7	Terzaghi, settlement, and the Washington Monument
17-Sep	8	Sustainability case study
22-Sep	9	Environmental engineering
24-Sep	10	Environmental engineering case study
29-Sep	11	Transportation engineering
1-Oct	12	Transportation engineering case study
6-Oct	13	Engineering ethics and the Johnstown flood
8-Oct	14	Stormwater management case study
13-Oct	15	International programs
15-Oct	16	CEE advising
20-Oct	17	Engineering critique - final project preparation
22-Oct	18	Guest lecture - engineers and society
27-Oct	19	Digital library resources, special collections, and research techniques
29-Oct	20	Land development - guest lecture

The goal is to touch on all of the CEE subdisciplines in interesting ways. Lectures, case studies, guest speakers, live demonstrations…

LARGE GROUP LECTURES

Technical lectures

Lecture Date	Large Group Lectures	Topic
25-Aug	1	Introduction to Civil Engineering
27-Aug	2	Engineering critique with written and oral expression
1-Sep	3	Structural engineering concepts and the Eiffel Tower
3-Sep	4	Maillart and the origins of reinforced concrete
8-Sep	5	CEE Advising
10-Sep	6	Welcome to Civil & Environmental Engineering at Virginia Tech
15-Sep	7	Terzaghi, settlement, and the Washington Monument
17-Sep	8	Sustainability case study
22-Sep	9	Environmental engineering
24-Sep	10	Environmental engineering case study
29-Sep	11	Transportation engineering
1-Oct	12	Transportation engineering case study
6-Oct	13	Engineering ethics and the Johnstown flood
8-Oct	14	Stormwater management case study
13-Oct	15	International programs
15-Oct	16	CEE advising
20-Oct	17	Engineering critique - final project preparation
22-Oct	18	Guest lecture - engineers and society
27-Oct	19	Digital library resources, special collections, and research techniques
29-Oct	20	Land development - guest lecture

LARGE GROUP LECTURES

Advising and CEE pep rally

Lecture Date	Large Group Lectures	Topic
25-Aug	1	Introduction to Civil Engineering
27-Aug	2	Engineering critique with written and oral expression
1-Sep	3	Structural engineering concepts and the Eiffel Tower
3-Sep	4	Maillart and the origins of reinforced concrete
8-Sep	5	CEE Advising
10-Sep	6	Welcome to Civil & Environmental Engineering at Virginia Tech
15-Sep	7	Terzaghi, settlement, and the Washington Monument
17-Sep	8	Sustainability case study
22-Sep	9	Environmental engineering
24-Sep	10	Environmental engineering case study
29-Sep	11	Transportation engineering
1-Oct	12	Transportation engineering case study
6-Oct	13	Engineering ethics and the Johnstown flood
8-Oct	14	Stormwater management case study
13-Oct	15	International programs
15-Oct	16	CEE advising
20-Oct	17	Engineering critique - final project preparation
22-Oct	18	Guest lecture - engineers and society
27-Oct	19	Digital library resources, special collections, and research techniques
29-Oct	20	Land development - guest lecture

LARGE GROUP LECTURES

in class demonstrations, recent alumni, guest speakers

Lecture Date	Large Group Lectures	Topic
25-Aug	1	Introduction to Civil Engineering
27-Aug	2	Engineering critique with written and oral expression
1-Sep	3	Structural engineering concepts and the Eiffel Tower
3-Sep	4	Maillart and the origins of reinforced concrete
8-Sep	5	CEE Advising
10-Sep	6	Welcome to Civil & Environmental Engineering at Virginia Tech
15-Sep	7	Terzaghi, settlement, and the Washington Monument
17-Sep	8	Sustainability case study
22-Sep	9	Environmental engineering
24-Sep	10	Environmental engineering case study
29-Sep	11	Transportation engineering
1-Oct	12	Transportation engineering case study
6-Oct	13	Engineering ethics and the Johnstown flood
8-Oct	14	Stormwater management case study
13-Oct	15	International programs
15-Oct	16	CEE advising
20-Oct	17	Engineering critique - final project preparation
22-Oct	18	Guest lecture - engineers and society
27-Oct	19	Digital library resources, special collections, and research techniques
29-Oct	20	Land development - guest lecture

Need to work more on emphasizing interdisciplinary links and collaboration.

LARGE GROUP LECTURE EXAMPLE

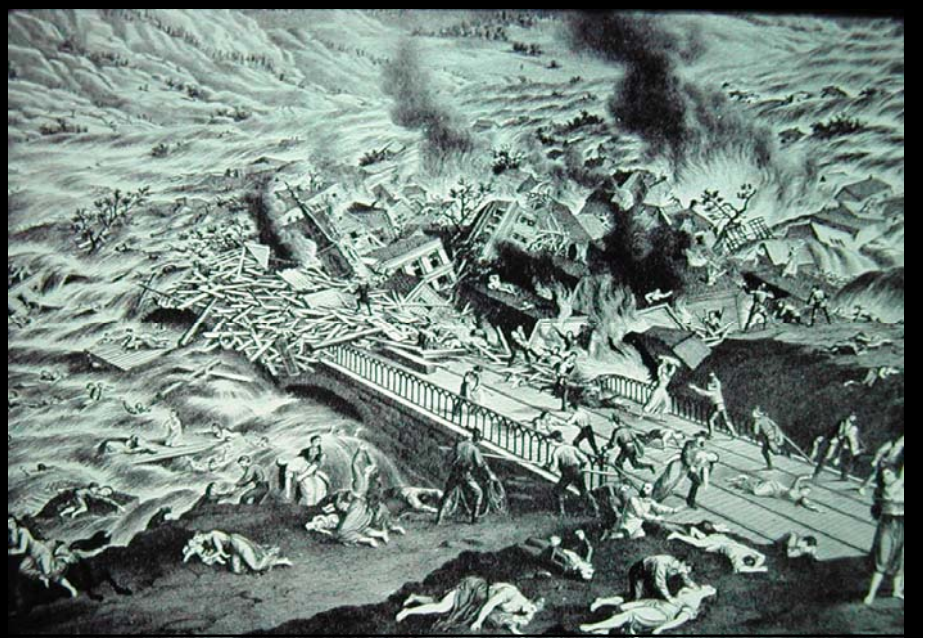
CEE 2804
INTRODUCTION to CIVIL ENGINEERING

Stormwater management and water resources engineering

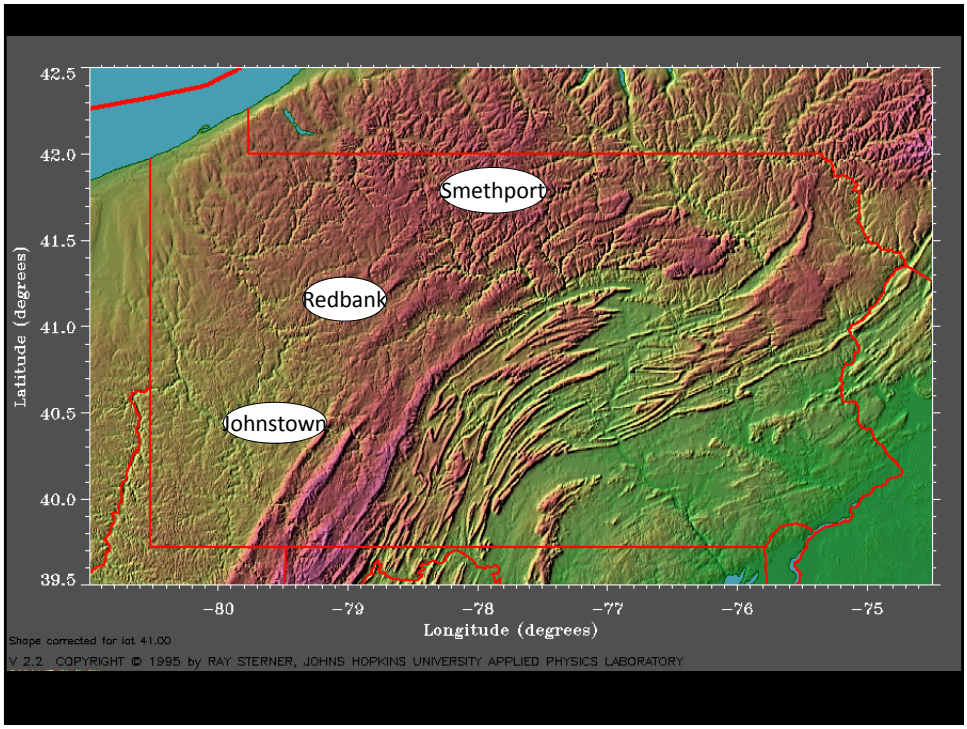
Why do floods occur?

What is this?

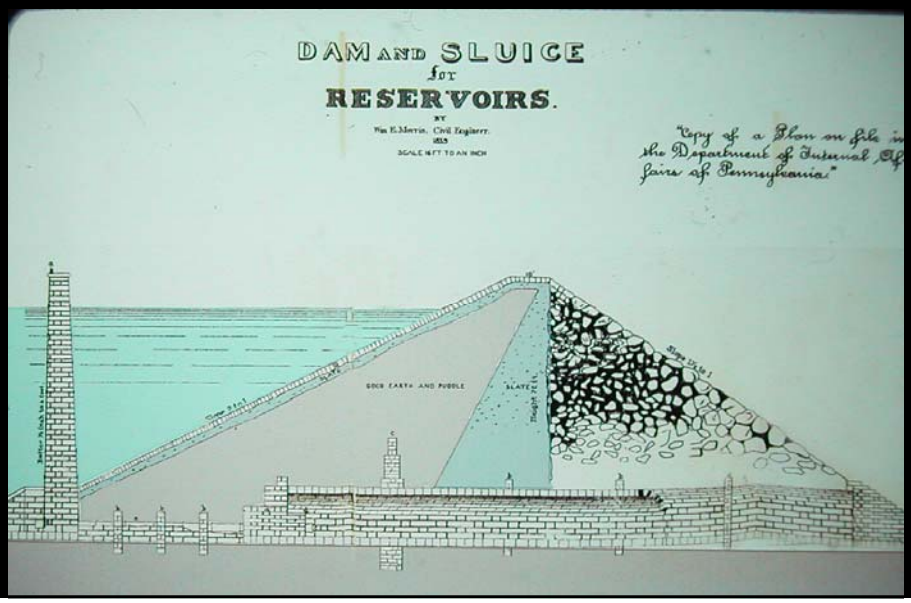
Johnstown Flood



"When the storm struck western Pennsylvania it was the worst downpour that had ever been recorded for that section of the country. The Signal Service called it the most excessive rainfall of the century for so large an area and estimated that from 6 to 8 inches of rain fell in 24 hours over nearly the entire central section."



South Fork Dam Cross-Section



http://www.youtube.com/watch?v=Q62vlcFLLIM

$$Q = A * V$$

Q = Discharge (cubic feet per second)

A = Cross-sectional flow area (square feet)

V = Mean flow velocity (feet per second)

$$A = W * D$$

W = Width (feet)

D = Average depth (A/W)

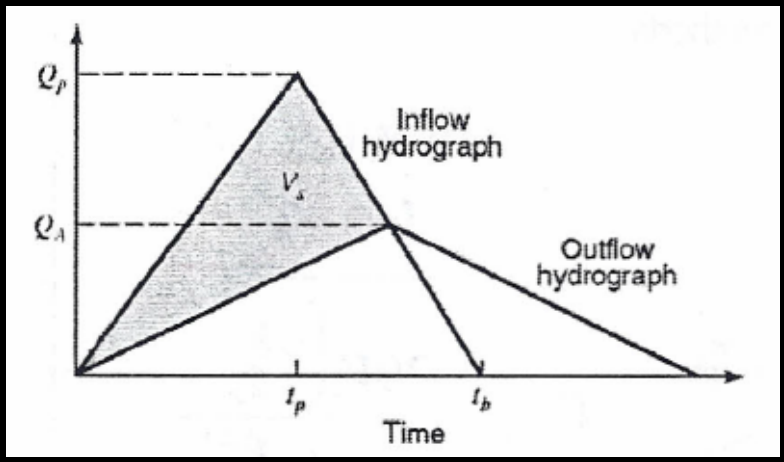
South Fork Creek

Drainage Area: 48.6 square miles

May 31, 1889:

W = 120 ft, D = 10 ft, V = 8 ft/s

Q = 9,600 cfs (198 cfs / square mile)



$$V_s = 0.5 t_b (Q_p - Q_a)$$

DISCUSSION SESSIONS

- faculty intro
- 2 field trips
- 2 presentations (over 4 class periods)
- 2 peer reviews & discussion
- 1 open session
- final project workshop (help students with thesis statements)

FIELD TRIPS

Smart Road
Drinking Water Treatment Plant
Bridges on Rt 114 over the New River
Campus buildings under construction
CAVE
Blacksburg Town Engineer's Office
CEE Research Labs (Structures & Materials; Geotech; Water Res)
Anderson & Associates Office
Draper Aden's Office
VT Airport & Tower Simulator
ICTAS II – Green Building
College Avenue Promenade
Covered Bridges – Mountain Lake

ASSIGNMENT EXAMPLE – Structural…

Eiffel Tower Structural Study

Historical Significance

At the 1889 International Exhibition of Paris, France planned to showcase its strong engineering and technological heritage. It commissioned a design competition for a "grand masterpiece" that would serve as the central landmark of the exhibition. Several hundred entries were submitted, and Gustav Eiffel, a successful engineer and metalworks company owner, emerged as the winner. Constructed in less than two years, The Eiffel Tower clearly demonstrates Gustav Eiffel's expertise in the design and construction of wrought iron structures.

Visual and Structural Influences

The Eiffel Tower stretches approximately 1000 feet from foundation to antenna, with four curved tower legs serving as the backbone of a wrought iron lattice structural network (figure 1). Wind is the dominant natural force on the Tower. The curved geometry of the main supporting legs is mathematically defined to efficiently carry the wind pressures. The use of wrought iron members minimizes the Tower's self weight and allows the wind to blow through the structure instead of bearing against it.

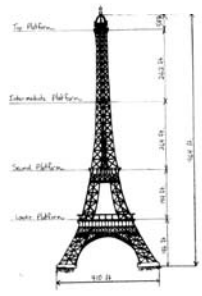


FIGURE 1.

Simplifying the Structure

Homework 1
CEE 2804 - Introduction to Civil Engineering
Fall 2013

The Eiffel Tower structural study assignment

In this assignment, you have the following tasks:
1. Calculate the force in the legs of the Eiffel tower due to wind
(a) at the intermediate platform,
(b) the second platform,
(c) the first platform, and
(d) at the base.

2. Calculate the force in the legs of the Eiffel tower due to gravity (dead load)
(a) at the intermediate platform,
(b) the second platform,
(c) the first platform (NOTE: To get the dead load at the first platform you must interpolate from the diagram in Figure 3)
(d) at the base.

3. Eiffel Alternate Design
Calculate what the force would be in the legs due to wind at the base if the tower legs did not spread out, but, instead, remained a constant 123 feet apart.

Finally, you should provide commentary on your results. Specifically,

4. Comment 1
Comment on the relative magnitude of the force in the legs at the base due to the wind and gravity loads, and

5. Comment 2
comment on the comparison of the forces in the legs at the base due to wind when the tower legs either spread or do not.

In order to accomplish the tasks set out in this assignment, you should read carefully the attached description of the analysis of the Eiffel Tower. At the end of this description are the general equations for calculating the bending moment and the forces in the legs of the tower. Also shown, as an example, is the calculation at the level of the second platform. You should follow this example closely to calculate the tower leg forces at the intermediate platform, the first platform, and the base of the tower.

Optional supplementary information:
A much more detailed version of the Eiffel tower structural study is available on Scholar. Read this if you would like a deeper understanding of the scientific function of the tower.

Notes and help: Assume no wind pressure above top platform, use 906ft as the height; assume 2D, therefore only two legs, interpolate from Fig 3 to get dead load at first platform.

ASSIGNMENT EXAMPLE – VT CEE Infrastructure

Homework 3
CEE 2804 - Introduction to Civil Engineering
Fall 2013

Due date: upload to Scholar in pdf format by Wednesday, September 18 at noon.

VT CEE infrastructure

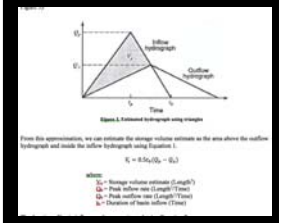
Select a civil engineering infrastructure site on campus that you have personally visited for this assignment. Collect basic facts and formulate some thoughts about the site you select. Provide the following in a nicely typed up document not more than 2 pages long:

- picture of the infrastructure you have selected (pond, park, road, stream, sidewalk,, building,…)
- name, location and all other basic facts you can find
- reasons why you selected it/like it
- describe how its design was influenced by at least two civil engineering subdisciplines (pick those that you are really interested in! Geotechnical, environmental and water resources, transportation, land development, construction engineering and management, structures and materials)
- analysis/criticism related to the 3 S's
- make sure to include other infrastructure examples you would compare yours against
- an informal reference list (e.g. web addresses, personal communication, magazine articles for your facts)

It is required that you use Pearson Writer to review your writing. Attach a summary to your HW that describes changes you made to your writing based on Pearson Writer's suggestions.

The homework will be graded on the clarity of presentation, the depth of your thoughts, the extent to which you provide some meaningful details and supporting facts about your selected infrastructure.

ASSIGNMENT EXAMPLE – Water resources

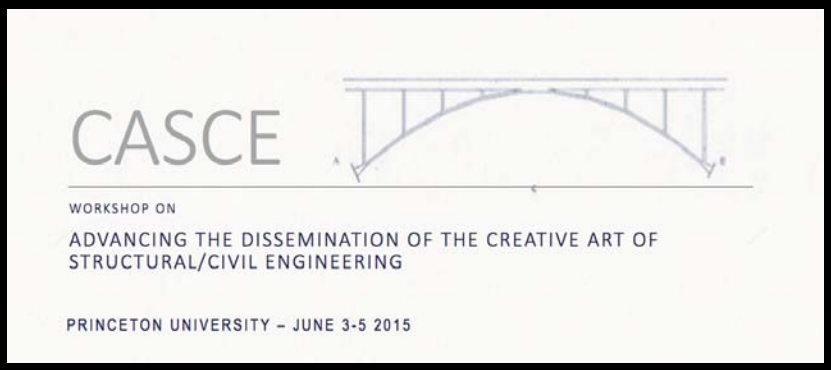


On July 19, 1996, western Pennsylvania was hit with widespread flash flooding. The flooding, which was seen across six different counties, was a result of a large number of thunderstorms moving through the area. The Excel spreadsheet found on Scholar titled StormData.xlsx contains rainfall and discharge observations from Redbank Creek for that day. The Discharge sheet has seven columns – year, month, day, hour, minute, hour counter (starting at 0.25 hours at 12:15 am, July 19th), and discharge of Redbank Creek (in cubic feet per second). The Rainfall Rate sheet has five columns – year, month, day, minute, and rainfall rate (in millimeters per hour) averaged over the 1560 square kilometer drainage basin. Using the given information, calculate the following:

2. Create a plot of discharge versus time. Label x and y axes.
3. Create a plot of rainfall versus time. Label x and y axes.
4. What is the peak discharge rate? At what time did this occur?
5. What is the peak rainfall rate? At what time did this occur?
6. Why is there a difference between the time of peak discharge and the time of peak rainfall rate?
7. To reduce the risk of future flooding, western Pennsylvania has decided to create a detention basin to try to control the rate of flow during large storm events. Read the following notes about detention basins and use the given equations to estimate the volume of water that the basin will need to hold. Assume the maximum detention outflow is 156 cubic feet per second (cfs).

- Princeton (PI), UMass, VT
- Improving Undergraduate STEM Education (IUSE) program
- Start date Sept. 1, 2014 (4 year project)

http://www.nsf.gov/awardsearch/showAward?AWD_ID=1431609&



Overcoming Potential Challenges to Course Development

Cris Moen, Virginia Tech
www.moen.cee.vt.edu

Course development and adoption will be successful if it is tailored to work within the existing curricular structure with the support of your colleagues inside and outside your department and by priming the students early in course.

Working with the curriculum, not against it

It was easier to update an existing course than start a new course at Virginia Tech.

Approval was direct with the Dept. curriculum committee.

Support of Dept. chair (s) is essential.

Faculty support

If you make the course easy to interact with, then your colleagues will be happy to participate.

This means small bites - invite them to give an class demonstration, ask them to provide a grad student to develop a HW assignment, …

Take some time to educate faculty about the overall ideas of the course - social, scientific, symbolic, critique, …

Student priming

Engineering students are trained to plug and chug and so thinking critically is very, very uncomfortable for them.

Provide them with lots of examples and definitions right away, at the beginning of the course. What are scientific, social, and symbolic perspectives to civil engineering infrastructure? What does critique mean? How do you critique something? You mean I can take any position I want? Are you crazy professor?!