

Advancing the Practice of Teaching Civil Engineering

**ABC-UTC
PROFESSORS'
WORKSHOP SERIES**

AUGUST 20, 2021

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aka “Dr. Batts”



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Who am I?



Teacher Training

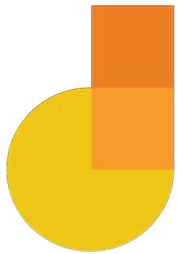
- ▶ Tutoring
- ▶ Lehigh University (BS 2007)
- ▶ The University of Texas at Austin (MS 2009, PhD 2014)
- ▶ ASCE ExCEED Graduate (2016), Assistant Mentor
- ▶ ESCALA Facilitator
 - ▶ Certificate in College Teaching and Learning in HSIs
 - ▶ STEM Mini-Course Workshop
- ▶ Assistant Professor
 - ▶ Washington State University
 - ▶ George Mason University
 - ▶ Angelo State University
- ▶ LifeTeen Core Member

Learning Objectives

- ▶ **Compare** the elements of effective ABC bridge projects to elements of effective teaching
- ▶ **Describe** four subjective task values as motivators of action
- ▶ **Identify** one specific way to increase value in an assignment in your course

The ABCs of Staging

- ▶ What elements are needed to effectively use ABC for a bridge project?
 - Planning?
 - Timing?



Jamboard Activity



Illinois DOT: <https://abc-utc.fiu.edu/wp-content/uploads/sites/52/2020/01/lateral-slide-illinois-3.jpg>

Elements for Effective ABC/Teaching

Good
connections

Timing

Standards

Keep it simple
but it must
meet the
demands

PLANNING!

Preparation

Limited Time
to Implement

All the World's a Stage...

- ▶ Audience (students)
- ▶ Focal Point at Front (you)
- ▶ Great Expectations (aspirations)
- ▶ Story Unfolding (teaching content)
- ▶ Pay to Be There (tuition)

**WHETHER YOU LIKE IT OR NOT, AS A
TEACHER YOU ARE ON STAGE!**



Prior Preparation Prevents Poor Performance

- ▶ Script
- ▶ Timing
- ▶ Costume/Makeup
- ▶ Rehearsal
- ▶ Show Time
- ▶ Critical Acclaim



ADVANCING THE PRACTICE OF TEACHING CIVIL ENGINEERING

Workshop Timings

- [0:55-0:00] Music- Mechanics of Materials Compilation
 - <https://www.youtube.com/watch?v=Ilk6W8u0RXo>
- [0:00-0:03] Introduction
 - Discuss “staging”
- [0:03-0:13] Jamboard activity to list elements of effective ABC
 - Intro how to use Jamboard
 - <https://jamboard.google.com/d/1JnOlgZpgprPGWZDiThoMBCA7sV8M1aqLN0-qo5Gvk04/edit?usp=sharing>
 - Debrief
- [0:13-0:18] Staging, Preparation
- [0:18-0:23] 4 types of subjective task values and descriptions
- [0:23-0:34] Silent Reflection and Breakout Groups
 - Rank the values in order of easiest (1) to hardest (4) for your courses
 - Discuss how and why you ranked them accordingly
 - Discuss how the civil engineering professors could improve value
- [0:34-0:37] Debrief
- [0:37-0:40] Ideas from Dr. Batts's Classes
 - Real World Problems
 - Themes
 - AMechanics Race
 - World Structures Report and Presentation
- [0:40-0:55] Breakout Groups
 - Discuss with same groups the assignment you chose
 - Identify ways you could improve it and the correlating value
 - Brainstorm ideas with your peers
- [0:55-0:58] Debrief
- [0:58-1:00] Wrap Up!

Are You Worth It?

- ▶ Angelo State University
 - ▶ In-State: **\$20 per class**
 - ▶ Out-of-State: **\$64 per class**
- ▶ Public University
 - ▶ Average: **\$35 per class**
- ▶ Private University
 - ▶ Average: **\$111 per class**

* based on average data from studentloanhero.com

3 Credits

2 x / Week

28 classes / semester

What other 1:15 activities would you pay this amount?

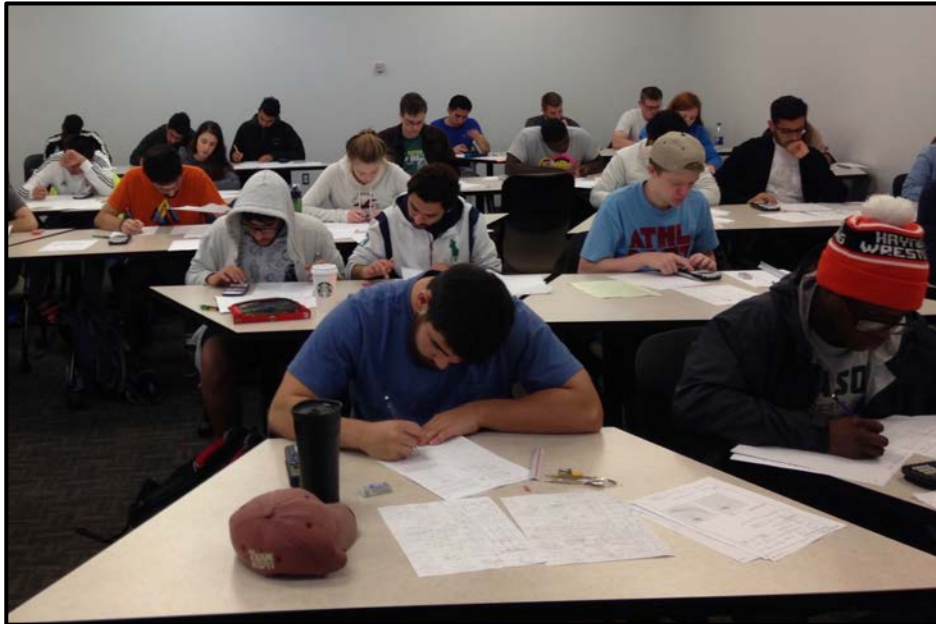
- Do we not then have a responsibility to deliver?
- Are we meeting the needs of the paying client?

Subjective Task Values as Motivators of Activity Choices

- ▶ Interest Value
- ▶ Utility Value
- ▶ Attainment Value
- ▶ Perceived Cost

Interest/Intrinsic Value

- ▶ Intrinsic interest or enjoyment of a task while performed



VS



Utility Value

- Congruence of a task with achievement of long-range goals or external rewards

STRUCTURAL ANALYSIS TOOLS

I. Equilibrium

- relate forces and stresses in the structural system
- ΣF_x ; ΣF_y ; ΣM_z (for 2D structures)

II. Kinematics (Compatibility)

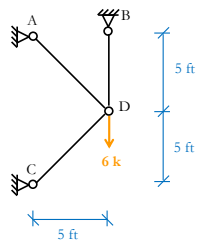
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III. Material Law (Constitutive Law)

-

Any structural analysis problem can be solved using these three tools

Example 1: Find the forces in each member and calculate the deflection at D in the vertical direction



Member Properties

$A = 2 \text{ in}^2$
 $E = 29,000 \text{ ksi}$

$L_{BD} = 5 \text{ ft}$
 $L_{AD} = L_{CD} = 5\sqrt{2} \text{ ft}$

Structural Determinacy

Solution:

I. Equilibrium

CEIE 311: Structural Analysis

INDETERMINATE TRUSSES

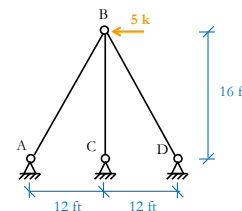
Learning Objectives:

- Setup the force method to solve internal forces in indeterminate trusses
- Use the force method to solve reactions in indeterminate frames
- Use the force method to solve reactions in indeterminate structures with multiple degrees of indeterminacy



Public Domain

Example 2: Setup a compatibility equation that could be used to solve the indeterminate truss below.



Primary Structure

Compatibility Equation

CENG 3361: Structural Analysis I

Puente Mezcala Solidaridad- Guerrero, Mexico



<https://www.gob.mx/mt/articulos/monitorean-puentes-y-estructuras-de-mexico?idiom=es>

Member Properties

$A = 3 \text{ in}^2$
 $E = 29,000 \text{ ksi}$

$L_{BD} = 16 \text{ ft}$
 $L_{AD} = L_{CD} = 20 \text{ ft}$

Structural Determinacy

Redundant Structure

Puente Mezcala Solidaridad- Guerrero, Mexico



<https://www.gob.mx/mt/articulos/monitorean-puentes-y-estructuras-de-mexico?idiom=es>

Comple

Attainment Value

- ▶ Congruence of a task with one's self-image and personal or collective/social identities

Themed Notes

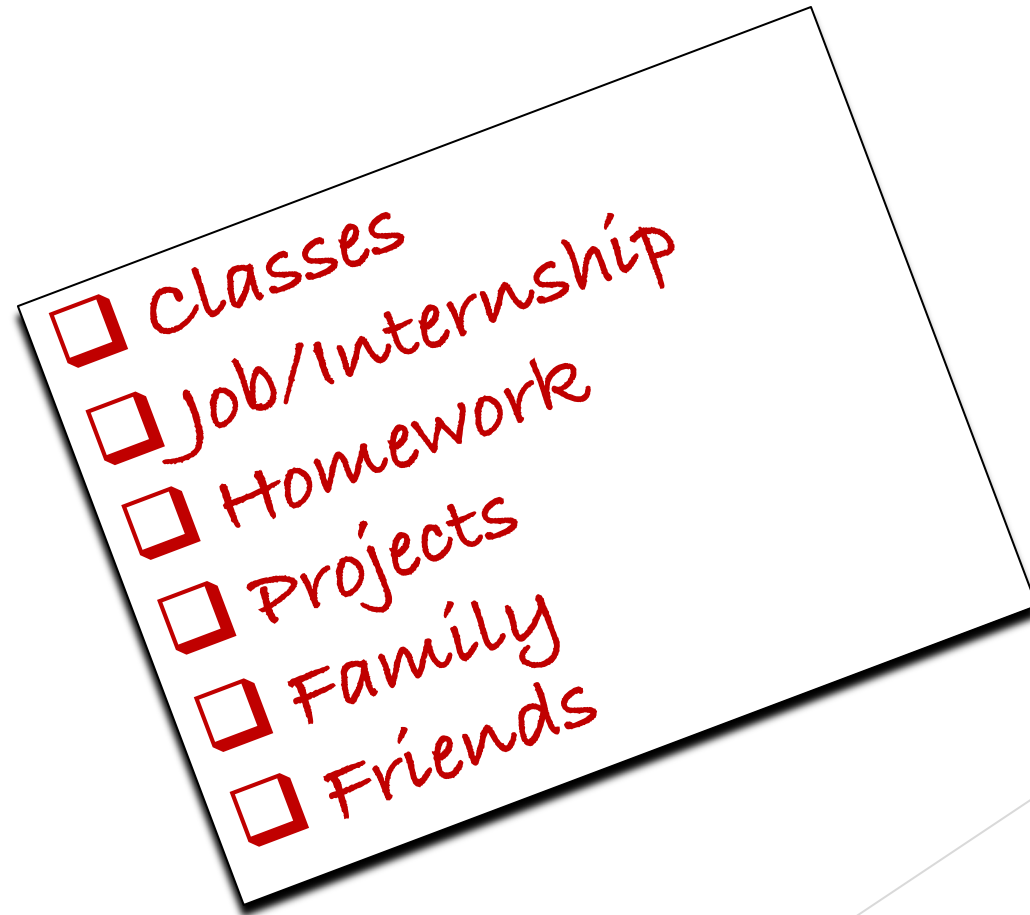
World Structures
Reports and
Presentations

Culturally Aware
Engineers



Perceived Cost

- ▶ Perceived cost of participating in a task
 - ▶ Financial
 - ▶ Emotional
 - ▶ Time
 - ▶ Energy



The 4 Values Applied to a Task

- ▶ Interest Value
- ▶ Utility Value
- ▶ Attainment Value
- ▶ Perceived Cost



Creative Commons License: https://cdn.pixabay.com/photo/2016/08/14/20/06/lawn-mower-1593898_960_720.jpg

Silent Reflection and Breakout Groups

- ▶ Rank the 4 Values
 - ▶ (1) easiest to implement
 - ▶ (4) hardest to implement
- ▶ Why?
- ▶ Taking turns, share your thoughts with your breakout group (2 min/person; use timer)
- ▶ Use remaining time to freely discuss how to positively affect these values in CE courses

Marvel at Mechanics (Interest)

- ▶ Selby [2014] uses MCU in Environmental Engineering course
- ▶ Lowman [1995] “must genuinely like college-age students and identify with their interests, both serious and foolish”

ENGR 2332 - EXAM II

AVENGERS:

CULMINATING COMPETITION

Mohr's Circle- Will his suit fail?

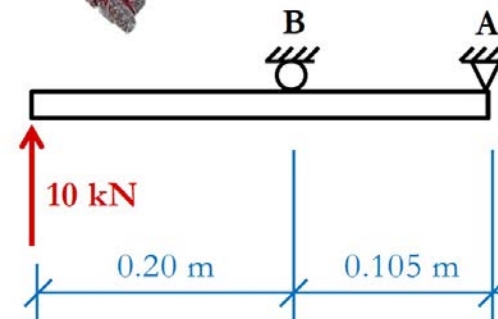
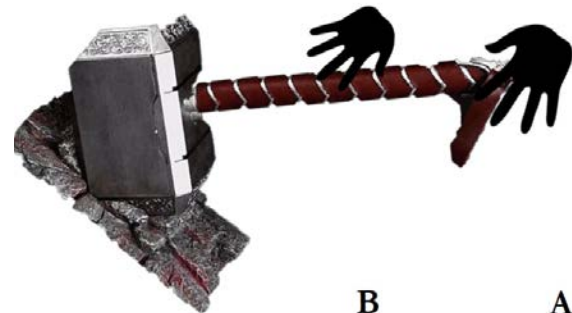


<https://www.cbr.com/best-worst-iron-man-actions/>

Identify the emoji that best represents Dr. Batts's reaction to this new movie plot [1 pt]:



Mjolnir: Em-Jole-Near



Themed Classes (Interest)

- ▶ Estes [2005]: At best, enhance concept and retention... at worst, students are more attentive

*Actual
Class
Notes and
Material*

Identify
Theme

Create
Costume

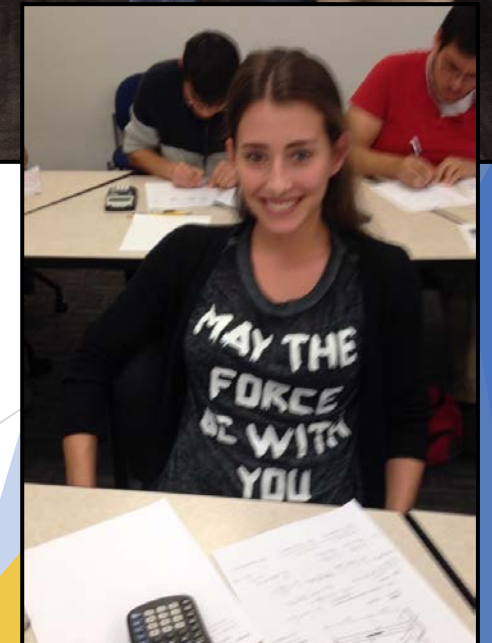
Script,
Puns,
Parodies

Physical
Model

Props,
References



Star Wars Episode 8: Attack of the Statically Indeterminate Systems

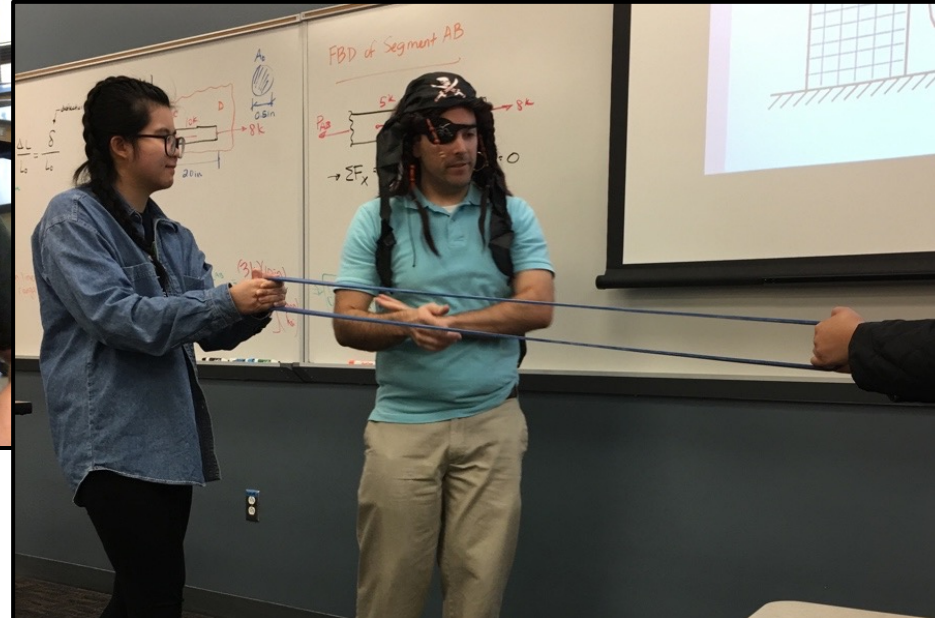
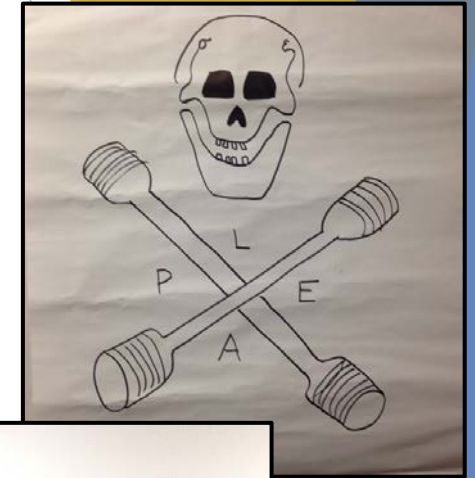
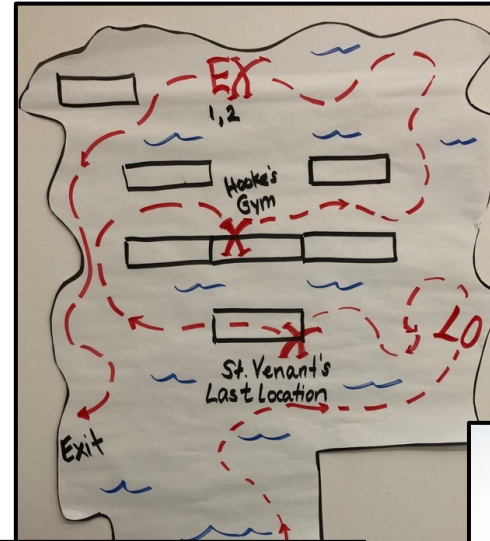


Don't want to perform your own themes? Subscribe to me on YouTube!

<https://www.youtube.com/channel/UCBYPHtcwvtCB8oNMHbdxd1g>

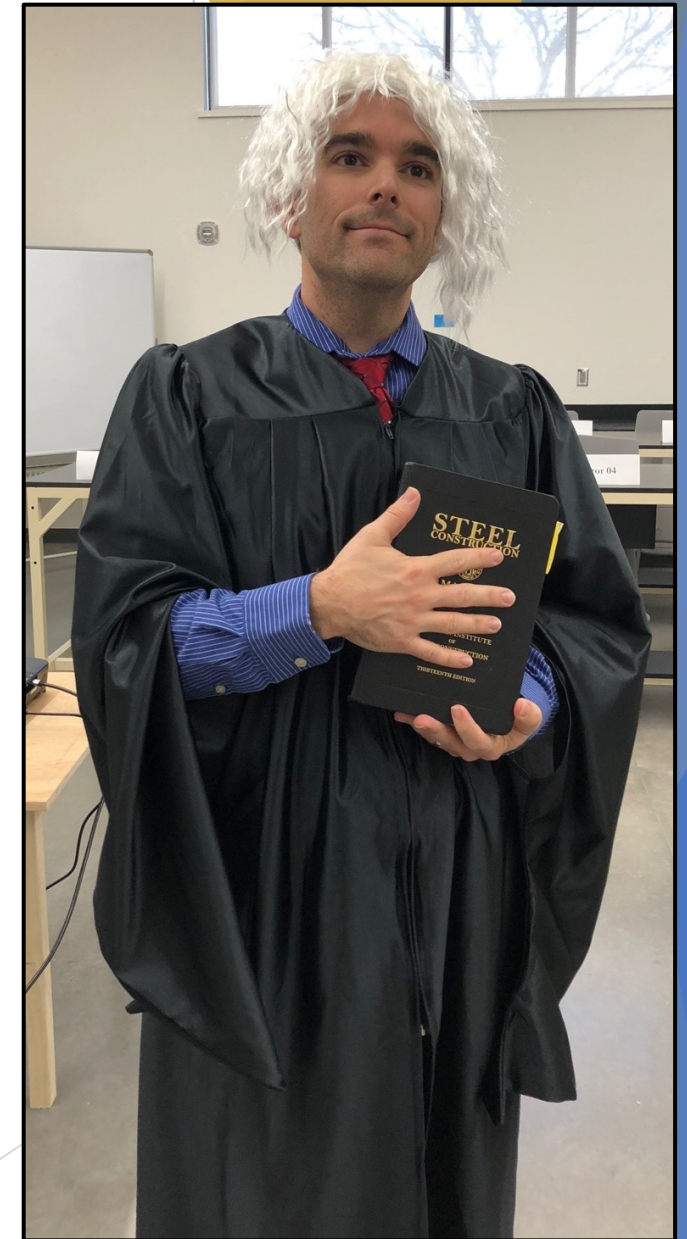
Quest for Hooke's Law

- ▶ Treasure map leads to letters from St. Venant and Hooke
- ▶ Find elastic workout bands to explain internal axial forces
- ▶ Calculate deflections!



Tresca v. von Mises

- ▶ Compare two different theories or approaches
- ▶ Use physical models and YouTube videos to submit evidence
- ▶ Jury chooses the winning case



Student Comments with Themes

I LOVE the new teaching style. It made the material so much more interesting. Also the songs and different demonstrations helped me remember the concepts. THANK YOU FOR PUTTING IN SO MUCH EFFORT!

I found the different themes and costumes something to look forward to when coming to class.

makes remembering the material easier.

My teaching reviews are in.
"You should prepare notes like Dr Batts!"

The "new" style made it a lot more interactive and easier to pay attention.

It was always entertaining and you never knew what was going to happen when you walked through that door to the class room.

Everything! This was the best class I have ever taken. You truly inspired me to learn and be interested in the material.

- Really enjoy the enthusiasm Dr. Batts brings to the classroom everyday. It is contagious and inspires learning.

Quantitative Result Summary

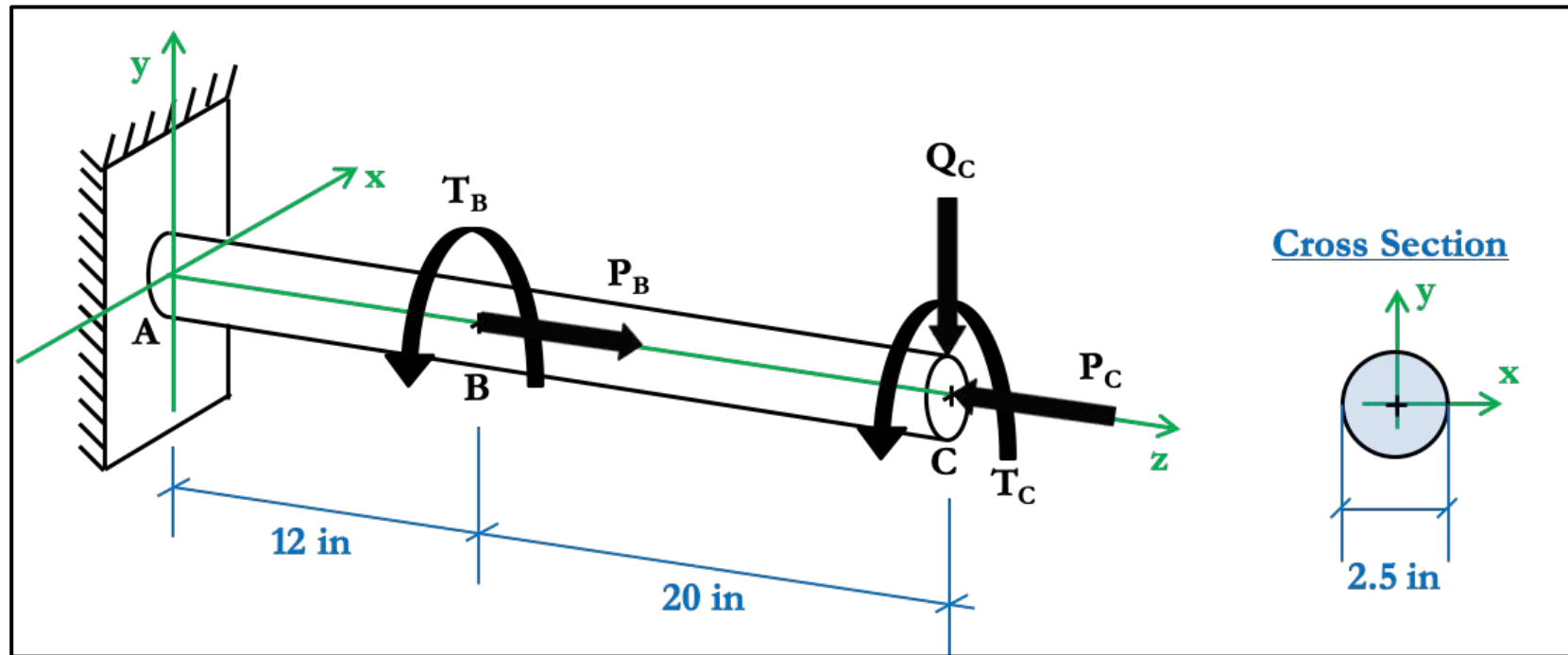
Attribute	SP 16	F 16	SP 17	SP 18	SU 18	SP 19
Overall Rating of Teaching	4.58	4.90	4.91	4.84	5.00	4.92
Overall Rating of Course	4.32	4.76	4.72	4.79	4.71	4.83
Intellectually Stimulating	4.54	4.95	4.97	4.68	4.43	4.83
Actively Involved in Class	4.51	5.00	4.94			



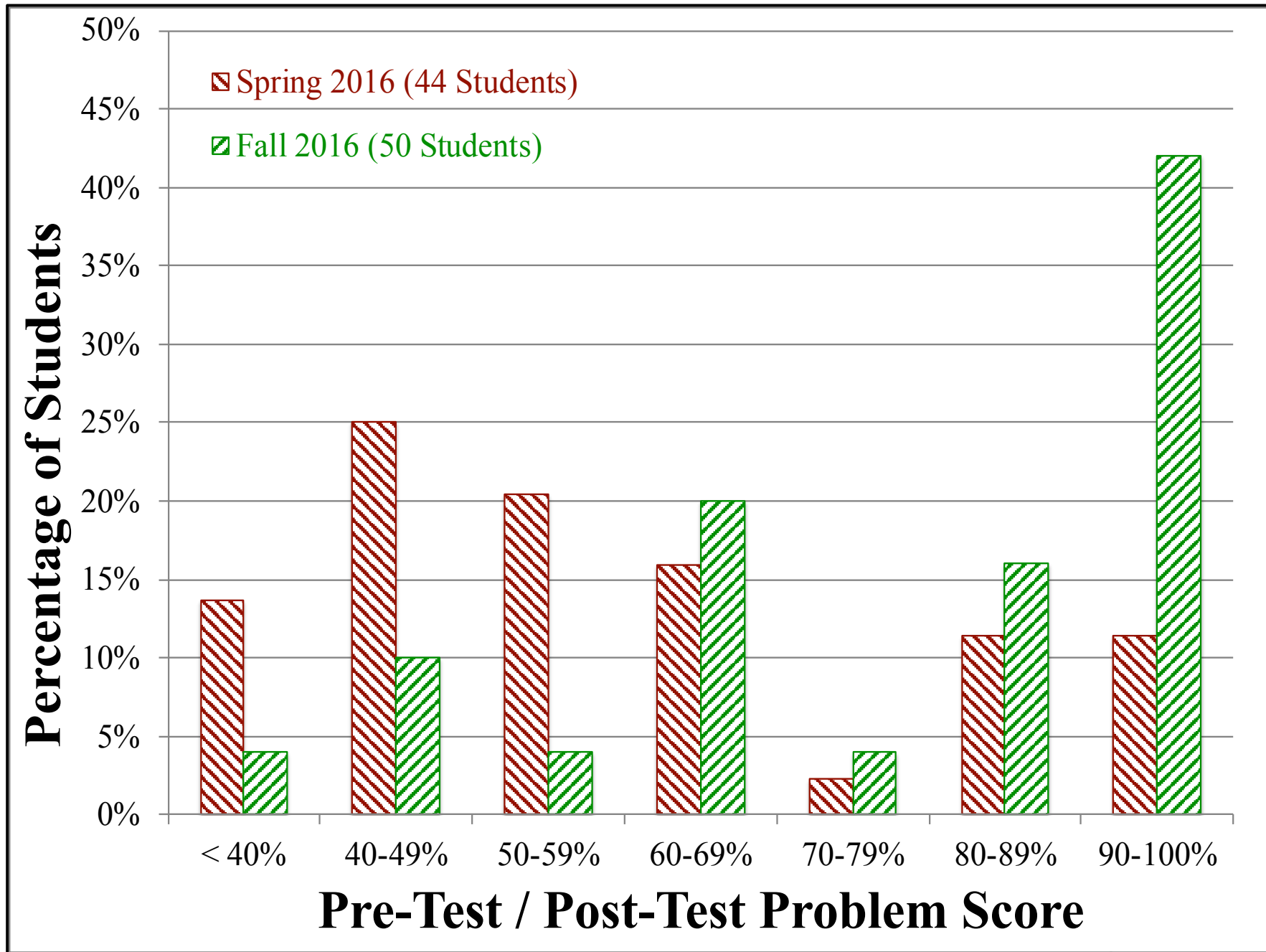
Case Study

Student Learning Outcome

Calculate forces and deformations in one-dimensional systems due to axial loads and torsional loads



- ▶ Spring 2016 Final Exam Question
- ▶ Fall 2016 Exam I Question

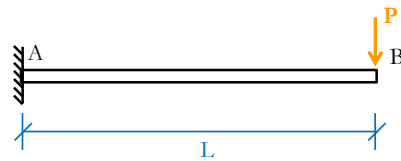


Real World Problems (Utility)

► Structural Analysis Course Notes

CEIE 311: Structural Analysis

Example 3: Find the deflection at B in the vertical direction

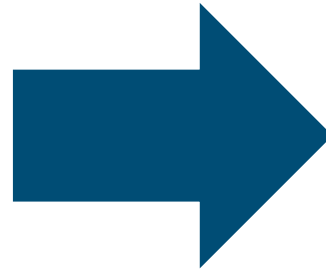
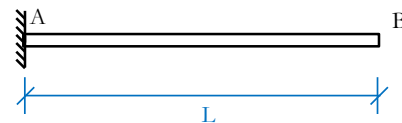
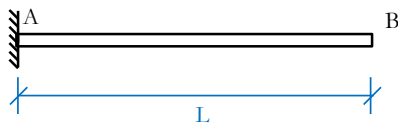


Member Properties
 $EI = \text{constant}$

Solution:

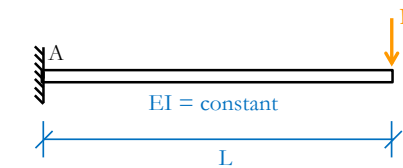
Real System

Virtual System



CENG 3361: Structural Analysis I

Example 3: Find the deflection at B in the vertical direction



Solution:

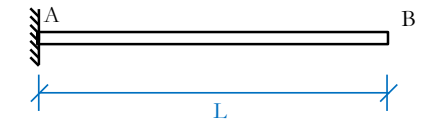
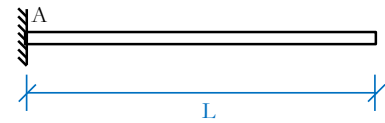
Real System

Puente Pumarejo, Colombia



<https://www.berd.eu/en/news/m1-70-s-da-berd-a-fazer-historia-na-colombia/>

Virtual System



- Real world examples
- Themes highlight cultures, icons, failures, natural disasters

World Structures Reports/Presentations (Utility/Attainment)



- Students could see themselves as structural engineers
- Excitement to share culture
- Aspirations for graduate school



Post-test Survey

- Fall 2018
 - 22 of 23 students responded

Learning Objective

Identify the contributions of culture to structural engineering projects

Having the opportunity in this course to explore different cultures, circle your level of agreement with the following statements.
(1) Strongly Disagree (2) Disagree (3) Neutral (4) Agree. (5) Strongly Agree

A. Prior to taking the CENG 3361 course, I did not consider how engineers could improve society.

B. Structures are not just a functional use of space, but also represent the culture of the people who use it.

C. The selection of building materials relies on the availability of materials locally.

D. Structural aesthetics should be chosen to relate to local culture.

E. The World Structures Report/Presentation helped me to see the role culture has on structural projects being built across the world.

F. The inclusion of pictures/references/examples to specific countries in the provided class handouts enhanced the educational experience versus if the handouts did not reference these countries.

G. Throughout the course, I can recall instances in which the instructor showed respect for other cultures, including my own.

H. This course has made me more culturally aware as an engineer.

Question:	A	B	C	D	E	F	G	H
% Answering (4) or (5):	4.55%	95.45%	72.73%	63.64%	100.00%	77.27%	100.00%	100.00%

Grade Analysis

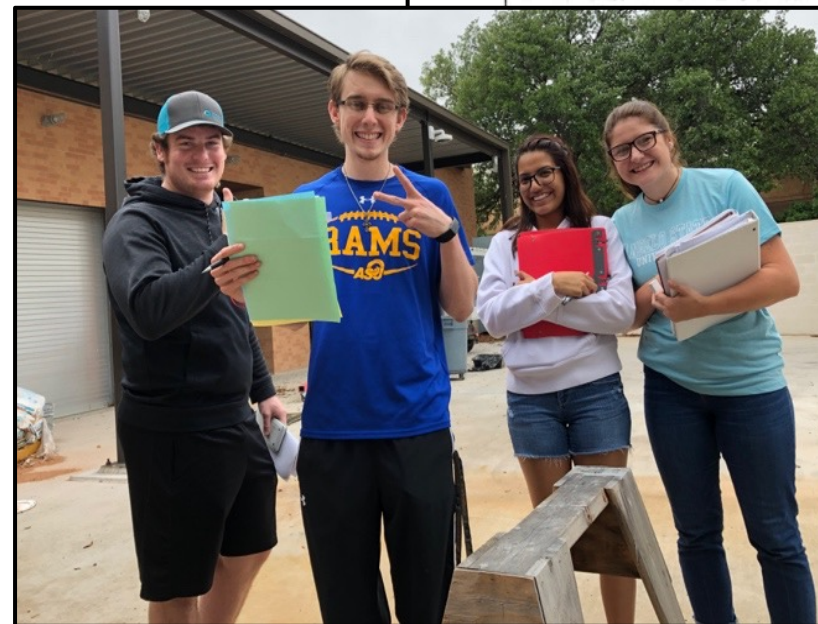
► They are not worse!

<i>Structural Analysis I Taught by Author</i>							
Semester	Enrollment	A	B	C	D	F	QW
Fall 2013*	60	40.0%	35.0%	16.7%	5.0%	1.7%	1.7%
Spring 2013*	59	25.4%	61.0%	13.6%	0%	0%	-
Fall 2015	38	28.9%	36.8%	31.6%	0%	2.6%	0%
Total Pre-Change	157	31.8%	45.2%	19.1%	1.9%	1.3%	0.6%
Fall 2018	23	52.2%	34.8%	8.7%	0%	4.3%	0%
Fall 2019	18	22.2%	55.6%	16.7%	5.6%	0%	0%
Total Post-Change	41	39.0%	43.9%	12.2%	2.4%	2.4%	0%

* available course data did not specifically include total number of withdrawals; author recalls one specific case

Other Ideas by Dr. Batts

- ▶ AMechanics Race
- ▶ Escape Rooms
- ▶ AISC Days of Steel Video Series



CLUE #3	ENGR 2332	AMECHANICS RACE
<p>GIVEN: The beam with loading and cross section shown.</p>		
<p>FIND: (a) Draw the V, M diagrams for the beam (b) Calculate Q and I for the section at the neutral axis (c) Using V_{max}, calculate the maximum transverse shear stress $\tau_{max} = \frac{V_{max} Q}{I t}$ (d) Using M_{max}, calculate the maximum bending stress $\sigma_{max} = \frac{M_{max} y_{max}}{I}$</p>		
<p>SOLUTION:</p>		
$Q = \frac{1}{4} \text{ in}^3$ $I = \frac{1}{4} \text{ in}^4$ $\tau_{max} = \frac{V_{max}}{c} \text{ Ksi}$ $\sigma_{max} = \frac{M_{max}}{c} \text{ Ksi}$		

Utility Value Research

- ▶ Often simple interventions
 - ▶ Example: Ask students to write about the relevance of course topics to own life/family/community
- ▶ Research shows small increase in utility value can increase performance of students
 - especially underrepresented minorities and first generation students
- ▶ HW problem discussion in upper level courses

Breakout Groups

- ▶ Timed Turns (3 min/person)
 - ▶ Discuss the assignment you selected with your breakout group
 - ▶ Identify how you would like to improve one of the values or decrease the perceived cost of that assignment
- ▶ Brainstorm additional ideas

Thanks!

- ▶ Please feel free to contact me with any questions
 - ▶ anthony.battistini@angelo.edu
- ▶ YouTube Channel
 - ▶ Anthony Battistini
- ▶ Upcoming Opportunities
 - ▶ AISC Days of Steel Videos
 - ▶ ESCALA Stem Mini-Course
 - ▶ ASEE Conference Papers

